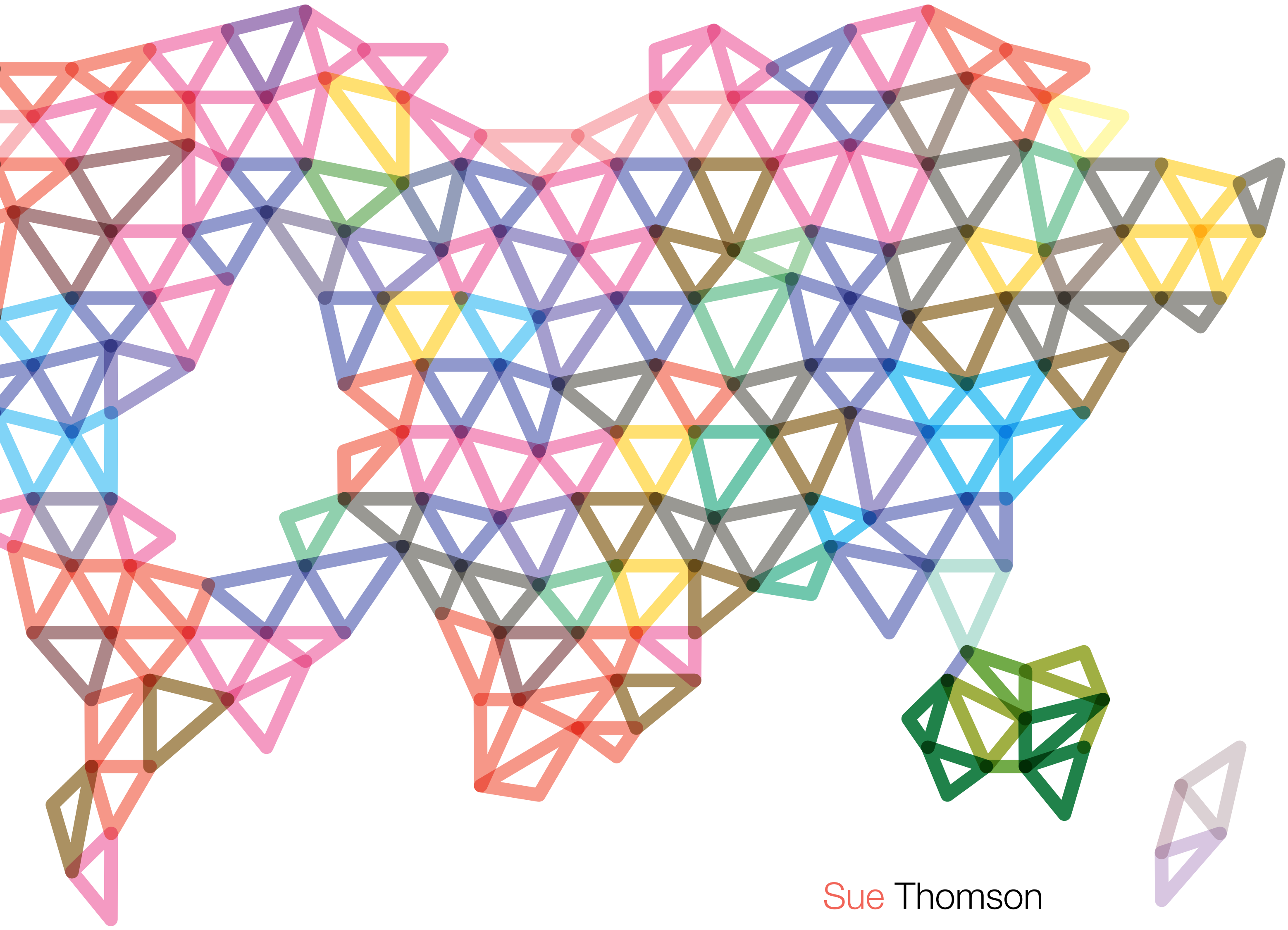
TIMSS 2015

Reporting Australia's results



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First published 2017
by Australian Council *for* Educational Research Ltd
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www.acer.edu.au
www.acer.edu.au/timss

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Cover design, text design and typesetting by ACER Creative Services
Edited by David Parnham

National Library of Australia Cataloguing-in-Publication entry

Thomson, S. (Sue), 1958– author.

TIMSS 2015: reporting Australia's results / Sue Thomson, Nicole Wernert, Elizabeth O'Grady, Sima Rodrigues.

ISBN: 978-1-74286-420-4 (ebook: PDF)

Trends in International Mathematics and Science Study.
Mathematical ability—Testing.
Scientific ability—Testing.
Educational tests and measurements—Australia.
Students—Rating of—Australia.
Educational evaluation—Australia.

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Australian Council for Educational Research, issuing body.

The views expressed in this report are those of the authors and not necessarily those of the Commonwealth, state and territory governments.

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Executive summary

The Trends in International Mathematics and Science Study (TIMSS) is an international comparative study of student achievement directed by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS 2015 represents the sixth such study since TIMSS was first conducted in 1995. Forty-nine education systems tested at Year 4 level and 39 tested at Year 8 level. In Australia, TIMSS is managed by the Australian Council for Educational Research (ACER) and is jointly funded by the Australian Government and the state and territory governments.

The goal of TIMSS is to provide comparative information about educational achievement across countries in order to improve teaching and learning in mathematics and science. TIMSS is designed, broadly, to align with the mathematics and science curricula used in the participating education systems and countries, and focuses on assessment at Year 4 and Year 8. A further dimension of TIMSS is its provision of comparative perspectives on trends in achievement in the contexts of different education systems, school organisational approaches and instructional practices; and in order to present this material, TIMSS collects a rich array of background data from students, schools and teachers, and also collects data about the education systems themselves.

This report analyses and interprets the Australian data collected as part of the TIMSS study. Where appropriate, this report makes comparisons with the results of other countries and with the international average to better understand Australian achievement and its context.

Who was assessed?

Across the world, over 580,000 Year 4 and Year 8 students in 57 countries and seven benchmarking participants took part in TIMSS 2015.

Within Australia, a stratified random sample of 287 primary schools and 285 secondary schools participated in the data collection for TIMSS 2015. The stratification of the sample ensured that the TIMSS sample was representative of the Australian Year 4 and Year 8 populations (according to jurisdiction, school sector, geographic location of each school and socioeconomic category for the area of each school).

One intact class from the relevant year level at each sampled school – along with all Indigenous students in that year level – was selected to participate in TIMSS 2015. This resulted in a sample of 6057 Year 4 students and 10,338 Year 8 students. Statistical weighting enables these students to represent the total student population at each year level.

What was assessed?

TIMSS is organised around two dimensions – a content dimension, which specifies the domains or subject matter to be assessed in mathematics and science, and a cognitive dimension, which specifies the thinking processes and sets of behaviours expected of students as they engage with the content.

At Year 4, there are three content domains in mathematics – *number*, *geometric shapes and measures* and *data display* – and three in science – *life science*, *physical science* and *Earth science.*

At Year 8, there are four content domains in mathematics – *number*, *algebra*, *geometry* and *data and chance* – and four in science – *biology*, *chemistry*, *physics* and *Earth science*.

At both year levels, there are three cognitive domains in each curriculum area: *knowing*, *applying* and *reasoning*.

What did TIMSS 2015 participants do?

As TIMSS focuses on international curricula in mathematics and science, a large number of test items were required to cover the range of topics and abilities. These items were grouped into blocks, which were then distributed across a number of assessment booklets. There were 14 TIMSS booklets, each containing multiple-choice and constructed-response items. Each participating student completed one of these booklets, which were evenly distributed within classes. This meant that only two or three students in each class completed each particular TIMSS booklet. After the assessment booklets were completed, students completed a questionnaire designed to provide rich background and attitudinal data.

Teachers, principals and curriculum experts also completed questionnaires, which enabled the collection of information about what is intended to be taught and about how it actually is taught in Australian classrooms.

How are the results reported?

Results are reported as average scores with standard errors, as distributions of scores and as percentages of students who attain the international benchmarks, for countries and for specific groups of students within Australia.

The international benchmarks were developed using scale-anchoring techniques. Internationally, it was decided that performance should be measured at four levels: the ‘Advanced international benchmark’, which was set at 625 score points; the ‘High international benchmark’, which was set at 550 score points; the ‘Intermediate international benchmark’, which was set at 475 score points; and the ‘Low international benchmark’, which was set at 400 score points.

Australia's results in TIMSS 2015

Year 4 mathematics

Key findings

- With an average score of 517 score points on the TIMSS Year 4 mathematics scale, Australian students significantly outperformed students in 20 other countries, such as Italy, Spain and New Zealand.
- However, Australian Year 4 students were outperformed by students in 21 other countries, including Northern Ireland, Ireland, England and the United States, as well as the participating East Asian countries Singapore, Hong Kong, Korea, Chinese Taipei and Japan.
- Australia's 2015 Year 4 mathematics score is significantly higher than the corresponding score in 1995. This, however, is due to a single increase recorded in TIMSS 2007 with no change in following years; for the past three cycles, Australia's Year 4 mathematics scores have remained the same.
- Nine per cent of Australian Year 4 students achieved the Advanced international benchmark in mathematics – compared to 50 per cent of students in Singapore and 27 per cent of students in Northern Ireland.
- Seventy per cent of Australian Year 4 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 4 students scored significantly higher than the overall mathematics score in *data display* and *geometric shapes and measures*, but were weaker in *number*.
- Australian Year 4 students scored significantly higher than the overall mathematics score in *applying* and *reasoning*, but were weaker in *knowing*.
- The performance of students in the Australian Capital Territory was significantly higher than that of students in all jurisdictions except Victoria. Students in the Northern Territory performed at a level significantly below those of students in all other jurisdictions.
- The TIMSS 2015 result was the first since 1995 that revealed a significant sex difference in Year 4 mathematics achievement in Australia.
- Students who have *many books* in the home were found to score 19 score points higher than students with an *average number of books* in the home, and 74 score points higher than those who reported having a *few books* in the home.
- Sixty-one per cent of Indigenous students compared to 28 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- There were no significant differences in mean achievement between students who speak mainly English at home and those that speak a language other than English at home.
- Fifty-six per cent of students in remote schools, compared to 37 per cent of provincial students and 26 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

Year 8 mathematics

Key findings

- With an average score of 505 score points on the TIMSS Year 8 mathematics scale, Australian students significantly outperformed students in 21 other countries, such as Italy, New Zealand and Malaysia.
- However, Australian Year 8 students were outperformed by students in 12 other countries, including Canada, Ireland, England and the United States, as well as the top five countries from Asia – Singapore, Korea, Chinese Taipei, Hong Kong and Japan.
- Australia's result dipped in TIMSS 2007 and was followed by a recovery in TIMSS 2011. Australia's 2015 Year 8 mathematics score is not significantly different from the corresponding score in 1995.
- Seven per cent of Australian Year 8 students achieved the Advanced international benchmark in mathematics – compared to more than one-third of students in the top five countries and 54 per cent of students in Singapore.
- Sixty-four per cent of Australian Year 8 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 8 students scored significantly higher than the overall mathematics score in *data and chance* and *number* but were weaker in *algebra* and *geometry*.
- Australian Year 8 students performed at a level that was statistically similar to the overall mathematics score in *knowing*, but were weaker in *applying* and stronger in *reasoning*.
- Students in Victoria and the Australian Capital Territory significantly outperformed students in Queensland, Tasmania and the Northern Territory, but their results were not significantly different to those of students in Western Australia, New South Wales and South Australia. The average scores for Western Australia, New South Wales, South Australia, Queensland and Tasmania were not significantly different to each other but were significantly higher than that of the Northern Territory.
- There was no significant difference between Australian male and female students in Year 8 mathematics achievement.
- Students who have *many books* in the home were found to score 26 score points higher than students with an *average number of books* in the home, and 73 score points higher than those who reported having a *few books* in the home.
- Fifty-nine per cent of students whose parents did not complete secondary school did not reach the Intermediate international benchmark, compared to 18 per cent of students with at least one parent holding a university degree.
- Fifteen per cent of students with *many educational resources* at home achieved the Advanced international benchmark, compared to five per cent of those with *some resources* and three per cent of students with only a *few educational resources*.
- Sixty-eight per cent of Indigenous students compared to 34 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- There were no significant differences in mean achievement between students who speak mainly English at home and those that speak a language other than English at home. However, 17 per cent of students who speak a language other than English at home achieved the Advanced international benchmark, compared to six per cent of students who speak mainly English at home.
- Fifty-nine per cent of students in remote schools, compared to 40 per cent of provincial students and 34 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

Year 4 science

Key findings

- With an average score of 524 score points on the TIMSS Year 4 science scale, Australian students significantly outperformed students in 17 other countries, such as Portugal, New Zealand and France.
- However, Australian Year 4 students were outperformed by students in 17 other countries, including the United States and England, as well as the participating East Asian countries Singapore, Korea, Japan, Hong Kong and Chinese Taipei.
- Notwithstanding a 2015 recovery following the dip in TIMSS 2011, Australia's TIMSS 2015 Year 4 science score is not significantly different to that of TIMSS 1995.
- Eight per cent of Australian Year 4 students achieved the Advanced international benchmark in science – compared to 37 per cent of students in Singapore.
- Seventy-five per cent of Australian Year 4 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 4 students scored significantly higher than the overall science score in *life science*, but were weaker in *physical science* and, to a lesser degree, *Earth science*.
- Australian Year 4 students performed at a level that was statistically similar to the overall science score in *knowing* and *applying*, while scoring significantly higher in *reasoning*.
- The performance of students in the Australian Capital Territory was significantly higher than that of students in all other jurisdictions. Students in the Northern Territory performed significantly below students in all other jurisdictions.
- The difference between Australian male and female students in Year 4 science was not statistically significant.
- Students who have *many books* in the home were found to score 19 score points higher than students with an *average number of books* in the home, and 70 score points higher than those who reported having a *few books* in the home.
- Fifty-three per cent of Indigenous students compared to 23 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- Students who spoke English 'always' or 'almost always' at home scored significantly higher than students whose main language at home was not English.
- Fifty-five per cent of students in remote schools, compared to 70 per cent of provincial students and 78 per cent of metropolitan students, performed at or above the Intermediate international benchmark – the proficient standard for Australia.

Year 8 science

Key findings

- With an average score of 512 score points on the TIMSS Year 8 science scale, Australian students significantly outperformed students in 20 other countries, such as Italy, Turkey and Malaysia.
- However, Australian Year 8 students were outperformed by students in 14 other countries, including Canada, the United States, England and Ireland, as well as the top five Asian countries – Singapore, Japan, Chinese Taipei, Korea and Hong Kong.
- Australia recorded an improved score in TIMSS 2003, which was followed by a weaker result in TIMSS 2007. Australia's 2015 Year 8 science score is not significantly different to that of TIMSS 1995.
- Seven per cent of Australian Year 8 students achieved the Advanced international benchmark in science – compared to more than one-fifth of students in Chinese Taipei and Japan, and 42 per cent of students in Singapore.
- Sixty-nine per cent of Australian Year 8 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 8 students performed significantly higher than the overall science score in the content domains of *biology* and *Earth science* and lower in *chemistry* and *physics*.
- Australian Year 8 students performed at a similar level to the overall science score in all three of the cognitive domains.
- The Australian Capital Territory was the highest-performing jurisdiction. Its students performed significantly higher, on average, than students in all jurisdictions except Victoria and Western Australia. Students in the Northern Territory performed significantly below students in all other jurisdictions.
- There was no significant difference between Australian male and female students in Year 8 science achievement. The 2015 cycle of TIMSS is the first in which there are no sex differences in science achievement at the Year 8 level.
- Students who have *many books* in the home were found to score 33 score points higher than students with an *average number of books* in the home, and 88 score points higher than those who reported having a *few books* in the home.
- Fifty-seven per cent of students whose parents did not complete secondary school did not reach the Intermediate international benchmark, compared to 15 per cent of students with at least one parent holding a university degree.
- Eighteen per cent of students with *many educational resources* at home achieved the Advanced international benchmark, compared to five per cent of those with *some resources* and less than one per cent of students with only a *few educational resources*.
- Fifty-eight per cent of Indigenous students compared to 30 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- Students who spoke mainly English at home achieved an average scale score that was a statistically significant 16 points higher than that for students who did not speak English at home 'always' or 'almost always'.
- Fifty-three per cent of students in remote schools, compared to 35 per cent of provincial students and 30 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

Schools and the school environment for learning

Key findings

- Thirty-eight per cent of Year 4 students and 56 per cent of Year 8 students attended schools with a principal who had completed a postgraduate university degree.
- Students attending schools with a *more affluent* student body had average achievement more than 60 score points higher than those attending a school with a *more disadvantaged* student body.
- Students in schools whose principals indicated that 50 per cent or less of the students had English as their first language tended to have lower average achievement than students in schools whose principals indicated that more than 50 per cent of the student population had English as their first language.
- Students attending schools where less than 25 per cent of students had literacy and numeracy skills upon entry to school had lower achievement than students attending schools where more than 25 per cent of students had literacy and numeracy skills upon entry to school.
- Forty-four per cent of Year 4 students and 51 per cent of Year 8 students attended schools where mathematics instruction was *not affected* by resource shortages, while 30 per cent of Year 4 students and 53 per cent of Year 8 students attended schools where science instruction was *not affected* by resource shortages.
- Around 50 per cent of students at both Year 4 and Year 8 were taught by mathematics and science teachers that reported *hardly any problems* with school conditions and resources.
- Australian Year 4 students with a *high sense of school belonging* scored around 40 score points higher than those with *little sense of school belonging*, while Australian Year 8 students with a *high sense of school belonging* scored around 70 score points higher than those with *little sense of school belonging*.
- There was a clear relationship between the achievement of Australian students and principals' and teachers' reports of school emphasis on academic success, with a higher school emphasis on academic success associated with higher achievement.
- Teacher job satisfaction was relatively high, with only three per cent of Year 4 students being taught by a teacher that was *less than satisfied*, while 11 per cent of Year 8 students were taught by a mathematics teacher that was *less than satisfied* and 15 per cent were taught by a science teacher that was *less than satisfied*.
- Around a quarter of Australian Year 4 students and just under one-third of Year 8 students were taught by teachers that faced *few challenges* in teaching. There were no statistically significant differences in achievement according to the degree to which teachers experienced challenges in teaching.
- There was a clear relationship between the achievement of Australian students and principals' reports of school discipline problems, with fewer discipline problems associated with higher achievement.
- There was a clear relationship between the achievement of Australian students and teachers' reports of their school being safe and orderly, with more *safe and orderly* schools associated with higher achievement.
- Twenty per cent of Australian Year 4 students and nine per cent of Year 8 students reported being bullied *almost weekly*. Students reporting *almost never* being bullied had average achievement more than 30 score points higher than those reporting being bullied *almost weekly*.

Teachers and classroom instruction

Key findings

- Eighty-three per cent of Australian Year 4 students and around 55 per cent of Australian Year 8 students were taught mathematics and science by a female teacher.
- Eighty-six per cent of Australian Year 4 students and 22 per cent of Australian Year 8 students were taught mathematics by a teacher that did not major in or take a specialisation in mathematics.
- At both Year 4 and Year 8 in Australia, emphasis was clearly placed on professional development in mathematics content, pedagogy and instruction, and curriculum, with between 60 and 70 per cent of students being taught by a mathematics teacher that had attended professional development in these areas.
- At both Year 4 and Year 8 in Australia, emphasis was clearly placed on professional development in science curriculum, with 40 per cent of Year 4 students and 68 per cent of Year 8 students being taught by a science teacher that had attended professional development in this area. At Year 8, professional development addressing individual students' needs and science pedagogy/instruction were also popular.
- In Australia, the average time spent on Year 4 mathematics instruction was 202 hours per year. At Year 8, the average time spent on mathematics instruction was 139 hours per year.
- In Australia, the average time spent on Year 4 science instruction was 57 hours per year. At Year 8, the average time spent on science instruction was 126 hours per year.
- Eighty-seven per cent of Australian Year 4 students had been taught all of the TIMSS mathematics topics before or during Year 4. At Year 8, 76 per cent of Australian students had been taught all of the TIMSS mathematics topics before or during Year 8.
- Sixty-one per cent of Australian Year 4 students had been taught all of the TIMSS science topics before or during Year 4. At Year 8, 59 per cent of Australian students had been taught all of the TIMSS science topics before or during Year 8.
- Twenty-two per cent of Australian Year 4 students and 16 per cent of Australian Year 8 students were taught science by a teacher that emphasised science investigation in *about half the lessons or more.* There was no relationship between the degree to which science teachers emphasised science investigation and average science achievement.
- Ninety-nine per cent of Australian Year 8 students but only 13 per cent of Australian Year 4 students attended a school that had a science laboratory available for use by students in that year level.
- At both Year 4 and Year 8, between 60 and 66 per cent of Australian students had computers available to use in both mathematics and science lessons.
- Australian Year 8 students were far more likely, on average, than students from other countries to use the internet to *access assignments posted online by the teacher* or to *communicate with the teacher.*
- The majority (56%) of Australian Year 8 students spent *45 minutes or less* on mathematics homework each week. However, those Australian Year 8 students that spent *more than 45 minutes* a week on mathematics homework had significantly higher average achievement than those students that spent *less than 45 minutes* a week on mathematics homework.
- The majority (73%) of Australian Year 8 students spent *45 minutes or less* on science homework each week. However, those Australian Year 8 students that spent *between 45 minutes and three hours* a week on science homework had significantly higher average achievement than those students that spent *less than 45 minutes* a week on science homework.

- There was a clear relationship between the achievement of Australian students and teachers' reports that their teaching was limited by student needs, with fewer limitations associated with higher mathematics and science achievement.
- There was a clear relationship between the achievement of Australian students and the frequency of student absences, with fewer absences associated with higher mathematics and science achievement.

Students: Attitudes, engagement and aspirations

Key findings

- In general, students who indicated that they liked mathematics or science, were confident learning it, valued it and felt that they were taught in an engaging way scored higher on average in the assessments than students who did not.
- Australian students generally showed quite negative attitudes towards mathematics, particularly at Year 8. Attitudes towards science were slightly less negative.
- Twenty-seven per cent of Year 4 students in Australia and 50 per cent of Year 8 students reported that they *do not like learning mathematics*, while 12 per cent of Australian Year 4 students and 29 per cent of Year 8 students reported that they *do not like learning science*.
- Twenty-seven per cent of Year 4 students in Australia and 43 per cent of Year 8 students reported that they were *not confident in mathematics*, while 20 per cent of Australian Year 4 students and 45 per cent of Year 8 students reported that they were *not confident in science*.
- Australian Year 8 students tended to value mathematics, with close to 90 per cent valuing or strongly valuing mathematics (similar to the international average). However, levels of valuing science were low, with 68 per cent of Australian Year 8 students valuing or strongly valuing science, compared to the international average of 81 per cent.
- From Year 4 to Year 8 the proportion of students who thought that they were exposed to *very engaging teaching* in either subject declined substantially, from just over 60 per cent at Year 4 to around 35 per cent at Year 8.
- Males liked mathematics and science more than females, they were more confident learning these subjects, and valued them more. However, despite these differences, equal comparisons show that females on the same level of confidence, liking or valuing mathematics or science as males scored at the same level as their male peers.
- The differences between advantaged and disadvantaged students were quite stark. Disadvantaged students liked mathematics and science less, they were less confident and they valued mathematics and science to a lesser extent than did their advantaged peers. Of concern is that – unlike the achievement parity noted in the analysis of sex differences – whether they liked a subject or not, were confident or not, valued it or not, disadvantaged students had average mathematics or science achievement that was substantially lower than that of advantage students.
- Disadvantaged students were also more likely to report lower levels of *very engaging teaching* in mathematics and science at Year 8 than were advantaged students. When they did experience *very engaging teaching*, both disadvantaged and advantaged students scored substantially higher than those students who faced *less than engaging teaching*; however, there is more of a booster effect for disadvantaged students at Year 8.
- Females held higher ambitions than males, with a greater percentage aiming for university study. Students from an advantaged background were far more likely than those from a disadvantaged background to aspire to university, with the majority of those from a disadvantaged background willing to settle for completion of secondary school.

Acknowledgements

The funding for the Australian component of TIMSS 2015 was provided jointly by the Australian Government and the state and territory governments. All of Australia's share of the international overheads and half of the basic funding for TIMSS within Australia was defrayed by the Australian Government Department of Education and Training (DET), while each state and territory government school system provided funding in proportion to the size of its student population.

In Australia, TIMSS is managed by a team from the Australian Council for Educational Research (ACER) and guided by the International Assessments Joint National Advisory Committee (IAJNAC). ACER wishes to thank the IAJNAC members for their continued interest in, and commitment to, the project throughout each of its phases. The IAJNAC members' involvement included assisting with the implementation of TIMSS in schools in their jurisdiction, reviewing the report and providing valuable information to ensure the continued success of TIMSS in Australia.

The undertaking of TIMSS 2015 was a collaborative effort. A national survey such as TIMSS could not be successfully undertaken without the cooperation of the school systems, principals, teachers, parents and, of course, the students. Data of the quality collected and analysed in TIMSS depends upon a high participation rate of the randomly selected schools and students. Australia was able to satisfy the internationally set response criteria for schools and students for TIMSS 2015. ACER gratefully recognises the assistance both of education-system officials Australia wide, and of the principals, teachers, parents and students in the participating schools – who gave generously of their time and support in contributing to the project.

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- Mullis, I. V. S., Martin, M. O., Foy, P. & Hooper, M. (2016). *TIMSS 2015 International Results in Mathematics*. Retrieved from http://timssandpirls.bc.edu/timss2015/international-results.
- Martin, M. O., Mullis, I. V. S., Foy, P. & Hooper, M. (2016). *TIMSS 2015 International Results in Science*. Retrieved from http://timssandpirls.bc.edu/timss2015/international-results.
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Reader's Guide

Sample surveys

TIMSS is conducted as a sample survey in most participating countries. In surveys such as this, a sample of students is selected to represent the population of students at a particular year level in a given country. The samples are designed and conducted so that they provide reliable estimates about the population that they represent. Sample surveys are cheaper to undertake and less of a burden for schools than a full census of the particular population.

The basic sample design for TIMSS is generally referred to as 'a two-stage stratified cluster sample design'. The first stage consists of a sample of schools and the second stage consists of the identification of a single mathematics classroom selected at random from the target year level in sampled schools.

The students in the selected classroom are representative of the students in the population, and weights are used to adjust for any differences arising from intended features of the design (e.g. to over-sample minorities) or non-participation by students who were selected. In this way we can provide measures of achievement for the population, based on the responses of a sample.

TIMSS achievement scales

TIMSS 2015 used item response theory (IRT) methods to summarise the achievement of students on a scale with a mean of 500 and a standard deviation of 100 (please refer to the international TIMSS website for more information about IRT methods: http://timss.bc.edu/publications/timss/2015-methods.html). It should be noted that the results for Year 4 and Year 8 should not be compared, nor should the results for mathematics and science at a particular year level. While the scales are expressed in the same numerical units, they are not directly comparable such that conclusions could be drawn about how much learning in mathematics equals how much learning in science (or how much learning at Year 4 equals how much learning at Year 8). That is, achievement on the TIMSS scales cannot be described in absolute terms (like all such scales developed using IRT technology). Comparisons can be made only in terms of relative performance (higher or lower), for example, among countries and population groups as well as over time.

The TIMSS mathematics and science scales for Year 4 and Year 8 were based on the 1995 assessments and the methodology enables comparable trend measures from assessment to assessment within each year level.

International comparison statistics

Several international comparison statistics are given in the report: the *TIMSS scale centrepoint*, the *international average* and the *international median*.

The *TIMSS scale centrepoint* is the mean of the scales (for each of Year 4 mathematics, Year 4 science, Year 8 mathematics and Year 8 science) established in the first cycle of the study, calibrated to be 500, with a standard deviation of 100 score points.

The *international average* is the mean score or percentage of all countries participating in TIMSS 2015 at that year level.

The *international median* is the midpoint in a ranking of countries by score or percentage. By definition, half of the countries will have a score or percentage above the median and half below.

It should be noted that both the international average and the international median will be different depending on the set of countries included. Therefore, these statistics should be used in the context of a number of comparison statistics.

Standard errors and confidence intervals

In this and other reports, student achievement is often described by a mean score. For TIMSS, each mean score is calculated from the sample of students who undertook the assessments. These sample means are an approximation of the actual mean score (known as the population mean) that would have been derived had all students in Australia participated in the TIMSS assessment.

If another sample of students was chosen on a different day, it is highly likely that the sample mean would be slightly different. Indeed, the sample mean is just one point along the range of student achievement scores, and so more information is needed to gauge whether the sample mean is an underestimation or overestimation of the population mean.

In this report, means are presented with an associated standard error. The standard error is an estimate of the error in the estimate of the population mean from the sample and is based on the standard deviation of sampling distribution of the mean. The size of the sample, as well as the variance in the scores within the sample, can affect the size of the standard error. Smaller samples, or samples with a greater variance in scores, will have larger standard errors.

The calculation of confidence intervals can assist our assessment of a sample mean's precision as a population mean. Confidence intervals provide a range of scores within which we are 'confident' that the population mean actually lies. The confidence interval is within plus or minus 1.96 standard errors of the sample mean. A larger standard error results in a larger confidence interval, and a greater likelihood that the confidence intervals of two means will overlap and, therefore, reduce any difference to non-significance (see the next section on statistical significance).

Statistical significance

The term 'significantly' is used throughout the report to describe a difference that meets the requirements of statistical significance at the 0.05 level, indicating that the difference is real, and would be found in at least 95 analyses out of 100 if the comparison were to be repeated. It is not to be confused with the term 'substantial', which is qualitative and based on judgement rather than statistical comparisons. A difference may appear substantial but not be statistically significant (due to factors that affect the size of the standard errors around the estimate, for example) while another difference may seem small but reach statistical significance because the estimate was more accurate.

Trends

It should be noted that a change in 2015 to the method of calculating standard errors means that standard errors for data from past cycles will not match those presented in earlier reports (please refer to the international TIMSS website for more information on calculation of standard errors: http://timss.bc.edu/publications/timss/2015-methods.html).

Please note that there was no fourth-grade assessment in 1999. Additionally, the Australian eighth-grade sample that participated in 1999 was not comparable to that in other cycles, so no trend results are provided for Australia at Year 8 in 1999.

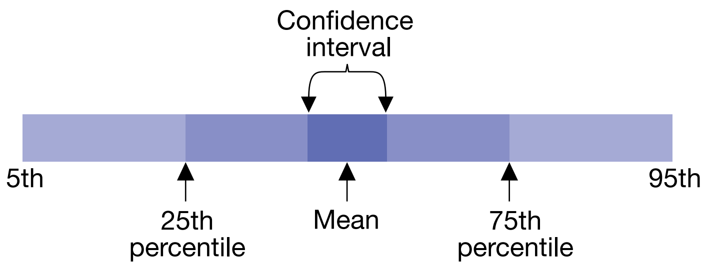
Trend data for the content and cognitive domains are available only from 2007, as earlier cycles did not include enough common items within each domain with which to establish trends.

Where cohort trends are discussed, please note that while the population of students eligible to participate in TIMSS 2011 at Year 4 was the same population (excluding minimal changes due to migration and the acceleration or holding back of students) as that eligible to participate in TIMSS 2015 at Year 8, the sample of students that actually participated in 2015 was different from that of 2011. Statistical methods that enable the estimation of population-level achievement from a representative sample allow for exploration of cohort trends.

Rounding of figures

Due to rounding to eliminate decimals, some percentages in tables and figures may not exactly add to the totals. Totals, differences and averages are always calculated on the basis of exact numbers and are rounded only after calculation. When standard errors have been rounded to one decimal place and the value 0.0 is shown, this does not imply that the standard error is zero, but that it is smaller than 0.05.

Reading the distribution graphs



Distribution graphs are presented alongside mean achievement in Chapters 2–5. These distribution graphs are presented as horizontal bars with degrees of shading. The left end of the bar marks the 5th percentile – this is the score below which five per cent of the students have scored. The lightest shading on the left-hand end of the bar covers the range between the 5th and the 25th percentiles. The next band, a slightly darker shade, covers the range between the 25th percentile and the lower limit of the confidence interval for the mean. The dark band in the middle of the distribution graph is the confidence interval for the mean – that is, the dark band indicates a range within which analysts can claim to be 'confident' that the mean will lie. On the right-hand side of the bar, the medium level of shading indicates the range between the upper limit of the confidence interval and the 75th percentile. The lightest shading on the right-hand end of the bar covers the range between the 75th and the 95th percentiles, while the right end of the bar marks the 95th percentile – this is the score below which ninety-five per cent of the students have scored (with the remaining 5% scoring above this).

Notes about participating countries

A number of countries have official names that are longer than those by which they are usually designated in conversation. In order to facilitate the reading of the TIMSS reports, these countries are referred to by their shortened form (e.g. Hong Kong, Korea, Iran) in the text, but are referred to by their official name (e.g. Hong Kong SAR; Korea, Republic of; Iran, Islamic Republic of) in the box displaying participating countries in Figure 1.2.

Seven countries participated in TIMSS Numeracy – namely, Bahrain, Indonesia, Iran, Jordan, Kuwait, Morocco and South Africa (please refer to the international TIMSS website for more information about TIMSS Numeracy: http://timssandpirls.bc.edu/timss2015/frameworks.html). Except for Jordan and South Africa, they also participated in the TIMSS fourth-grade assessment, and their Year 4 mathematics results are based on an average of both assessments. As Jordan and South Africa participated only in TIMSS Numeracy, their Year 4 mathematics results are based solely on the results of TIMSS Numeracy and, additionally, they will not appear in the results for Year 4 science.

Norway chose to assess fifth and ninth grades to obtain better comparisons with Sweden and Finland, but also collected benchmark data at fourth and eighth grades to enable trend measurement. Where trends are reported, results for Norway (4) and Norway (8) are used, otherwise reporting is for Norway (5) and Norway (9). Botswana and South Africa assessed ninth grade to better match their curricula and to maintain trend measurement.

The proficient standard

The *Measurement Framework for Schooling in Australia 2015* (Australian Curriculum, Assessment and Reporting Authority, 2015) has set the proficient standard for TIMSS mathematics and science as the Intermediate international benchmark. The *Measurement Framework for Schooling in Australia* is the basis for reporting on progress towards the *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA, 2008). Proficient standards represent a 'challenging but reasonable' expectation of student achievement.

Definitions of background characteristics

There are various definitions used in this report that are particular to the Australian context, as well as many that are used internationally. This section provides an explanation for those that are not self-evident.

Number of books in the home

This variable is used as a proxy for socioeconomic status, where information about parents' occupations, education and wealth are not available. It is derived from student self-reports of the number of books in their homes. Their responses have been grouped so that a *few books* equals 25 or fewer books, an *average number of books* equals between 26 and 200 books and *many books* equals more than 200 books. While the relationship between the number of books in the home and student achievement is not definitive, there is a very strong relationship between the two.

Parental education

Parental education is a component of socioeconomic status. Year 8 students were asked to indicate the highest level of education attained by each of their parents or guardians. For the analyses in this report, the responses from both questions were combined to identify the highest level of education attained by either parent. Where no response is given for one parent, the response for the other parent was used. Where no information was given for either parent, parental education was recorded as missing.

Please note that, due to a very low response rate to the Early Learning Survey, completed by parents, information about parental education is not available for Year 4 students.

Educational resources in the home

The presence or absence of educational resources in the home expresses potential advantage or disadvantage for students that may reflect the ability of parents to provide materially for their children or indicate differences in practical and psychological support for academic achievement. These resources may be physical, such as books or an internet connection, or take the form of more intangible attributes such as parental education or occupation.

The Home Educational Resources scale was created, using Year 8 students' responses to three items:

- parents' educational background
- number of books in the home
- home study supports – students having their own room and an internet connection at home.

Students with *many resources* had a score on the scale of at least 12.4, which corresponds to their reporting that they had more than 100 books in the home along with both home study supports (own room and an internet connection), and that at least one of their parents had finished university, on average. In contrast, students with *few resources* had a scale score no higher than 8.3, which corresponds to their reporting that they had 25 or fewer books in the home, that they had neither their own room nor an internet connection, and that neither of their parents had proceeded beyond upper secondary school. All other students were classified as having *some resources*.

Please note that, due to a very low response rate to the Early Learning Survey, completed by parents, information about parental education, and therefore the Home Educational Resources scale, is not available for Year 4 students.

Indigenous background

Indigenous background is derived from school records – collected from parents and guardians in accordance with the nationally agreed definitions as set out in the 2012 *Data Standards Manual* of the Australian Curriculum, Assessment and Reporting Authority – that identify students as being of Australian Aboriginal or Torres Strait Islander origin. Students were identified as either Indigenous or not Indigenous for the purpose of TIMSS.

Language spoken at home

The language spoken at home variable is derived from student self-report of how often English was spoken at home. Where the student spoke English 'never' or only 'sometimes', the student was considered to speak a language other than English at home. Those who indicated that they spoke English 'always' or 'almost always' were considered to be English speakers in the home environment.

Geographic location of the school

In Australia, the participating schools were coded with respect to the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) Schools Geographic Location Classification. For the analysis in this report, only the broadest categories are used:

- *metropolitan* – including mainland state capital cities or major urban districts with a population of 100,000 or more (e.g. Queanbeyan, Cairns, Geelong, Hobart)
- *provincial* – including provincial cities and other non-remote provincial areas (e.g. Darwin, Ballarat, Bundaberg, Geraldton, Tamworth)
- *remote* – remote areas and very remote areas. Remote: very restricted accessibility of goods, services and opportunities for social interaction (e.g. Coolabah, Mallacoota, Capella, Mt Isa, Port Lincoln, Port Hedland and Alice Springs). Very remote: very little accessibility of goods, services and opportunities for social interaction (e.g. Bourke, Thursday Island, Yalata, Condingup, Nhulunbuy).

Teacher education

One path to becoming a qualified teacher in Australia is to complete a graduate diploma in education, following completion of an undergraduate degree. For the purposes of this report, given that the graduate diploma is necessary for teacher accreditation, the graduate diploma has been included in the same category as the bachelor's degree or equivalent. Please note that this was not the case in TIMSS 2011 (when the graduate diploma was included as a postgraduate degree). Accordingly, responses to the teacher-education variable cannot be compared across cycles.

Chapter 1

Introduction

In 2015, Australia participated in the Trends in International Mathematics and Science Study (TIMSS), an international study directed by the International Association for the Evaluation of Educational Achievement (IEA), an independent international cooperative of national research institutions and government agencies that has been conducting studies of cross-national achievement in a wide range of subjects since 1959.

TIMSS is an assessment of mathematics and science that has been conducted at Year 4 and Year 8 on a four-year cycle since 1995. Australia has participated in TIMSS since its inception, gathering rich data about trends in mathematics and science achievement over 20 years.

To inform educational policy in the participating countries, TIMSS also routinely collects extensive background information that addresses concerns about the quantity, quality and content of instruction. This background information is collected through a series of questionnaires for students, parents, teachers, principals and curriculum specialists.

Australia was one of 57 countries, and seven regions or benchmarking participants,[1] that participated in TIMSS 2015. In Australia, just over 6000 Year 4 students and 10,000 Year 8 students participated in TIMSS. These students completed tests in mathematics and science achievement, and answered questionnaires on their background and experiences in learning mathematics and science at school. School principals and the students' mathematics and science teachers also completed detailed questionnaires.

Why TIMSS?

The main goal of TIMSS is to assist countries to monitor and evaluate their mathematics and science teaching across time and across year levels. TIMSS offers countries an opportunity to:

- collect comprehensive and internationally comparable data about the mathematics and science concepts, processes and attitudes that students have learnt by Year 4 and Year 8
- assess progress internationally in mathematics and science learning across time for students in Year 4 and for students in Year 8

1 A benchmarking participant is a province or region that participated in TIMSS for its own internal benchmarking. Data from these provinces are not included in the international averages or medians and are not included in this national report.

- examine changes over time within a cohort of students, given that the cohort of Year 4 students in one cycle is assessed again as Year 8 students in the next cycle
- understand the contexts in which students learn best, since TIMSS enables international comparisons of the key policy variables in relation to school curricula, modes of instruction and provision of resources that result in higher levels of student achievement
- use TIMSS to address internal policy issues – within countries, for example, TIMSS provides an opportunity to examine the performance of population sub-groups and address equity concerns.

Research model for IEA studies

TIMSS is based on a research model that uses the curriculum, in broad terms, as its foundation. The TIMSS Curriculum Model includes three curriculum levels, considered in relation to the context in which they occur. These levels are shown in Figure 1.1.

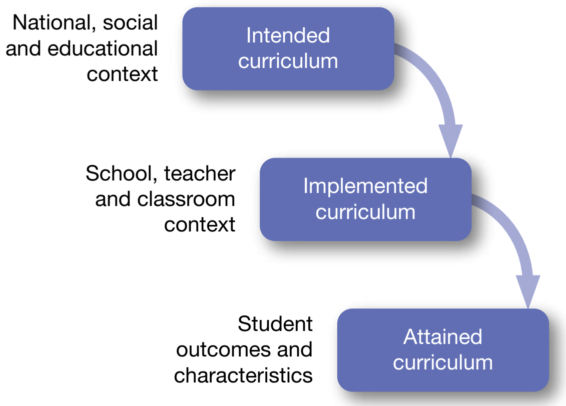


FIGURE 1.1 The TIMSS Curriculum Model

The research questions associated with each of the curriculum levels are:

- The *intended* curriculum – defined as the curriculum as specified at national or system level. *What are mathematics and science students around the world expected to learn? How do countries vary in their intended goals, and what characteristics of education systems, schools and students influence the development of these goals? How should the education system be organised to facilitate this learning?*
- The *implemented* curriculum – defined as the curriculum as interpreted and delivered by classroom teachers. *What is actually taught in classrooms? Who teaches it? What opportunities are provided for students to learn mathematics and science? How do instructional practices vary among countries and what factors influence these variations?*
- The *attained* curriculum – which is that part of the curriculum that is learnt by students, as demonstrated by their attitudes and achievements. *What mathematics and science concepts, processes and attitudes have students learnt? What factors are linked to students' opportunity to learn, and how do these factors influence students' achievements?*

The data describing the intended curriculum were gathered through the curriculum questionnaire, which asked about the mathematics and science curricula, school organisational approaches and instructional practices. This extensive questionnaire was developed in Australia by the Australian Council for Educational Research (ACER), reviewed by curriculum experts in each state and territory education department, and then submitted to the International Study Center. Further information about the curriculum and education policies is available through the *TIMSS 2015 Encyclopedia* (http://timssandpirls.bc.edu/timss2015/encyclopedia/).

The TIMSS assessment framework

The TIMSS assessment framework provides the conceptual underpinning of the TIMSS 2015 assessment instruments. As TIMSS assesses both mathematics and science, the two subjects are treated separately within the assessment framework. Each subject is organised around two dimensions – a content dimension and a cognitive dimension. The content dimension of the assessment specifies the subject matter to be assessed within mathematics or science, while the cognitive dimension specifies thinking processes to be assessed.

The content domains differ for Year 4 and Year 8 students, reflecting the nature and difficulty of the mathematics and science widely taught at each year level. For example, in science at Year 8, physics and chemistry are assessed as separate content domains, and receive more emphasis than at Year 4, where they are assessed as one content domain, physical science. In contrast, the cognitive domains are the same for Year 4 and Year 8 (nuanced to accommodate the particular requirements of the two year levels), and encompass a range of cognitive processes involved in working mathematically or scientifically and in solving problems – these processes hold their currency throughout the primary and middle school years.

Further details about the content and cognitive domains covered in each subject at Year 4 and Year 8 are provided in Chapters 2–5.

What did participants do?

Students who participated in TIMSS 2015 completed a paper-based assessment booklet containing an even distribution of both mathematics and science items. The booklets were designed to be administered in two sessions, separated by a short break. Each session was of 36 minutes' duration at Year 4 and 45 minutes' duration at Year 8. In addition to completing the assessment booklet, each student was asked to fill in a questionnaire.

The assessment task

As TIMSS focuses on international curricula in mathematics and science, a large number of test items were required to cover the range of topics and abilities. Given that no individual student could be expected to complete the total number of items in a reasonable length of time, mathematics and science items were grouped into clusters. These clusters were rotated through 14 booklets (at each year level), such that each cluster was addressed in more than one booklet. Each booklet contained four clusters – two for mathematics and two for science – and comprised both multiple-choice and constructed-response items.

Each participating student completed only one of the 14 booklets, which were evenly distributed within classes. Accordingly, only two or three students in each class completed each particular booklet. Further information on the TIMSS assessment booklets and the types of items students attempted to complete is presented in Appendix A.

The context questionnaires

Central to the TIMSS research model is the idea that it is important to understand the contexts in which students learn, as well as to assess achievement. After the achievement data were collected from students, each student completed a background questionnaire. Teacher and school questionnaires were also administered to the mathematics and science teacher(s) of each selected class and to the principal of the school.

The student questionnaire sought information on home contexts, and on students' characteristics and attitudes towards learning mathematics and science.

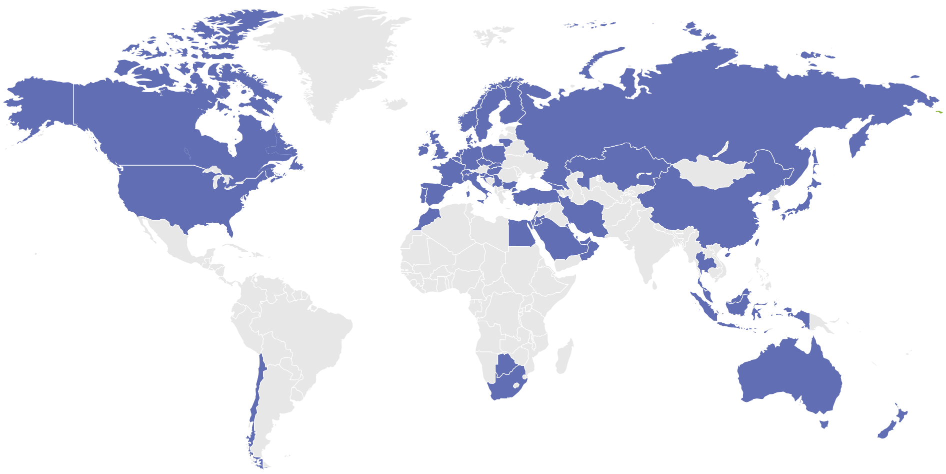
The teacher questionnaire asked about teacher preparation and experience, pedagogical practices, use of technology, assessment, assignment of homework, school and classroom climate, and whether the TIMSS topics had been covered in class.

The school questionnaire, answered by the principal (or the principal's designate), sought descriptive information about school characteristics, instructional time, resources and technology, school climate for learning, students' school readiness, and principal preparation and experience.

Who participated?

Countries

A total of 49 countries at Year 4 and 39 countries at Year 8 participated in TIMSS 2015. In addition, seven benchmarking participants administered the TIMSS assessment at both Year 4 and Year 8. In total, over 580,000 students participated worldwide. The participating countries are shown in Figure 1.2.



Participating countries

Australia
Bahrain
Belgium (Flemish)*
Botswana (9)^
Bulgaria*
Canada
Chile
Chinese Taipei
Croatia*
Cyprus*
Czech Republic*
Denmark*
Egypt^
England
Finland*
France*
Georgia
Germany*
Hong Kong SAR
Hungary
Indonesia*
Iran, Islamic Republic of
Ireland, Republic of
Israel^
Italy
Japan
Jordan
Kazakhstan
Korea, Republic of
Kuwait
Lebanon^
Lithuania
Malaysia^
Malta^
Morocco
Netherlands*
New Zealand
Northern Ireland*
Norway (5, 9)
Oman
Poland*
Portugal*
Qatar
Russian Federation
Saudi Arabia
Serbia*
Singapore
Slovak Republic*
Slovenia
South Africa (5, 9)
Spain*
Sweden
Thailand^
Turkey
United Arab Emirates
United States

Benchmarking participants

Buenos Aires, Argentina
Ontario, Canada
Quebec, Canada
Norway (4, 8)
Abu Dhabi, UAE
Dubai, UAE
Florida, US

* Country participated at grade 4 only. See the Reader's Guide for more information.
^ Country participated at grade 8 only. See the Reader's Guide for more information.

FIGURE 1.2 Map of participating countries

Time of testing

For comparability across countries and across assessments, testing was conducted at the end of the school year. Southern-hemisphere countries tested in the period from October to November 2014. The remaining countries tested at the end of the northern-hemisphere school year, from May to June 2015.

Schools and students

The international sample design for TIMSS is generally referred to as 'a two-stage stratified cluster sample design'. The first stage consists of a sample of schools, which in Australia is stratified by jurisdiction,[2] sector, geographic location and a socioeconomic variable. The intention is that the sample drawn will be representative of each of these strata. The second stage of sampling consists of a sample of one or two intact classrooms from the target year in sampled schools.

In most countries, 150 schools and one classroom in each school (resulting in at least 4500 participating students per country) were selected to participate in TIMSS 2015. In some countries, including Australia, a larger sample of schools and students participated in order to allow for meaningful comparisons to be made between different sections of the school population. In Australia, a larger sample of schools and students participated in TIMSS in order to enable the production of reliable estimates for each of the Australian jurisdictions and also for Indigenous students.

In Australia, 287 primary schools and 285 secondary schools participated in the data collection for TIMSS 2015. From each school at least one intact class from the relevant year level – along with all Indigenous students in that year level – was selected to participate in the 2015 assessment. This resulted in a sample of 6057 Year 4 students and 10,338 Year 8 students. For more information about sampling and the Australian TIMSS sample, please refer to Appendix A.

Statistical weighting enables the sampled students to represent the total student population at each year level (for more information about weighting, please refer to the Reader's Guide). The weighted numbers for Australia for Year 4 and Year 8, along with the numbers of participating schools and students, are shown in Table 1.1.[3]

TABLE 1.1 Australian designed and achieved school and student sample, Year 4 and Year 8

Year 4	Designed school sample	N schools	N students	Weighted N students	Weighted % of total Australian students
ACT	30	30	535	4886	1.8
NSW	45	45	1057	92,855	34.0
VIC	45	45	798	62,187	22.8
QLD	45	43	1135	57,370	21.0
SA	40	39	693	16,999	6.2
WA	40	40	938	30,399	11.1
TAS	30	30	615	5662	2.1
NT	15	15	286	2548	0.9
Australia	*290*	*287*	*6057*	*272,907*	*100.0*

Year 8	Designed school sample	N schools	N students	Weighted N students	Weighted % of total Australian students
ACT	30	28	1129	4393	1.6
NSW	45	45	1972	84,266	31.6
VIC	45	45	1248	67,334	25.3
QLD	45	44	1787	57,134	21.4
SA	40	40	1236	17,922	6.7
WA	40	40	1834	26,912	10.1
TAS	30	30	717	6392	2.4
NT	15	13	415	2101	0.8
Australia	*290*	*285*	*10,338*	*266,454*	*100.0*

2 In this report, the Australian states and territories are referred to, collectively, as the 'jurisdictions'.

3 Sample numbers are weighted by jurisdiction in order to indicate the proportional distribution across each of the eight jurisdictions of the total Australian population of Year 4 and Year 8 students.

Due to differences between the jurisdictions in school starting ages, the average age of students at the time of testing varied across jurisdictions, ranging from 9.9 years in Queensland and Western Australia to 10.3 years in Tasmania at Year 4, and from 13.5 years in Queensland to 14.3 years in Tasmania at Year 8.

TABLE 1.2 Average age for Year 4 and Year 8 students, Australia and by jurisdiction

	ACT	NSW	VIC	QLD	SA	WA	TAS	NT	*AUS*
Year 4	10.1	10.0	10.2	9.9	10.1	9.9	10.3	10.0	*10.0*
Year 8	14.1	14.1	14.2	13.5	14.1	13.8	14.3	13.9	*14.0*

Internationally, the average age of students participating in the Grade 4 cohort varied from 9.6 years in Oman to 11.5 years in South Africa (although South Africa is an outlier – the next highest average age was 10.9 years in Denmark). The average age of students in Year 8 varied from 13.7 years in Georgia and Kuwait to 14.7 years in Hungary, Lithuania, Norway, the Russian Federation and Sweden (with outliers of 15.6 years and 15.7 years in Botswana and South Africa, respectively). For more information about the age of participating students, please refer to Chapter 5 of *Methods and Procedures in TIMSS 2015* (http://timssandpirls.bc.edu/publications/timss/2015-methods/chapter-5.html).

Organisation of TIMSS 2015

TIMSS 2015 was organised by the IEA and managed by the TIMSS & PIRLS International Study Center, Lynch School of Education, at Boston College in the United States. Sampling procedures were overseen by Statistics Canada and the IEA Data Processing and Research Center (DPC); the IEA Secretariat and the TIMSS & PIRLS International Study Center oversaw the translation and verification process as well as the quality-assurance program; and the IEA DPC was responsible for oversight of the data collection, data processing and data analysis.

In Australia, the study was funded by the Australian Government Department of Education and Training (DET) and by state and territory departments of education proportional to the size of their student populations. The study was managed in Australia by ACER, which represents Australia to the IEA.

Appendix A provides more information about the operations and procedures involved in TIMSS 2015.

TIMSS in Australia

TIMSS is a key part of the National Assessment Program (NAP). Components of NAP include the National Assessment Program – Literacy and Numeracy (NAPLAN), which is conducted annually for every student in Years 3, 5, 7 and 9; the national sample assessments of civics and citizenship, information and communication technology (ICT) literacy, and science literacy; and the international assessments, which comprise – in addition to TIMSS – the IEA's Progress in International Reading Literacy Study (PIRLS) and the OECD's Programme for International Student Assessment (PISA).

Results collected from these assessments allow for nationally comparable reporting of progress towards the *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA, 2008), which set goals for high-quality schooling in Australia designed to secure for students the necessary knowledge, understanding, skills and values for a productive and rewarding life.

The Australian Curriculum, Assessment and Reporting Authority (ACARA) reports on the NAP assessments annually in its *National Report on Schooling in Australia*, which is the main vehicle for reporting against nationally agreed key performance measures defined in the *Measurement Framework for Schooling in Australia 2015* (Australian Curriculum, Assessment and Reporting Authority, 2015).

The *Measurement Framework for Schooling in Australia 2015* outlines national standards for each of the elements of the NAP, including TIMSS. The national standard for TIMSS is a *proficient standard*, which represents a 'challenging but reasonable' expectation of student achievement. The proficient standard for TIMSS mathematics and science is the TIMSS Intermediate international benchmark (please refer to Chapters 2–5 for more information about the TIMSS Intermediate international benchmarks for mathematics and science at Year 4 and Year 8).

Structure of report

A preliminary report on the 2015 assessment – entitled *TIMSS 2015: A first look at Australia's results* – was released in November 2016. The present report expands on the results presented in that preliminary report.

Chapters 2 to 5 reproduce, with extra detail, the results presented in *TIMSS 2015: A first look at Australia's results*. These chapters describe, respectively, the results for Year 4 mathematics, Year 8 mathematics, Year 4 science and Year 8 science.

Each of these chapters describes the assessment framework for the relevant subject at its particular year level before detailing Australia's results within the international context. This material is followed by a detailed presentation of results for the Australian jurisdictions and for different demographic groups within Australia, including male and female students. The final section of each of these chapters provides the TIMSS 2015 results in the content and cognitive domains.

The final three chapters of this report present the results from the contextual questionnaires. Each chapter focuses on a different element of the contexts in which learning and achievement occur. Chapter 6 examines the school environment, while Chapter 7 focuses on teachers and classrooms, and Chapter 8 reports on student attitudes.

Chapter 2

Year 4 mathematics

Key findings

- With an average score of 517 score points on the TIMSS Year 4 mathematics scale, Australian students significantly outperformed students in 20 other countries, such as Italy, Spain and New Zealand.
- However, Australian Year 4 students were outperformed by students in 21 other countries, including Northern Ireland, Ireland, England and the United States, as well as the participating East Asian countries Singapore, Hong Kong, Korea, Chinese Taipei and Japan.
- Australia's 2015 Year 4 mathematics score is significantly higher than the corresponding score in 1995. This, however, is due to a single increase recorded in TIMSS 2007 with no change in following years; for the past three cycles, Australia's Year 4 mathematics scores have remained the same.
- Nine per cent of Australian Year 4 students achieved the Advanced international benchmark in mathematics – compared to 50 per cent of students in Singapore and 27 per cent of students in Northern Ireland.
- Seventy per cent of Australian Year 4 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 4 students scored significantly higher than the overall mathematics score in *data display* and *geometric shapes and measures*, but were weaker in *number*.
- Australian Year 4 students scored significantly higher than the overall mathematics score in *applying* and *reasoning*, but were weaker in *knowing*.
- The performance of students in the Australian Capital Territory was significantly higher than that of students in all jurisdictions except Victoria. Students in the Northern Territory performed at a level significantly below those of students in all other jurisdictions.
- The TIMSS 2015 result was the first since 1995 that revealed a significant sex difference in Year 4 mathematics achievement in Australia.
- Students who have *many books* in the home were found to score 19 score points higher than students with an *average number of books* in the home, and 74 score points higher than those who reported having a *few books* in the home.

- Sixty-one per cent of Indigenous students compared to 28 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- There were no significant differences in mean achievement between students who speak mainly English at home and those that speak a language other than English at home.
- Fifty-six per cent of students in remote schools, compared to 37 per cent of provincial students and 26 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

This chapter presents the TIMSS 2015 international and national results for mathematics at Year 4 level. The first section provides a summary of the TIMSS 2015 mathematics framework at Year 4, along with a description of the international benchmarks for Year 4 mathematics. The second section examines the performance of Australian Year 4 students in mathematics in the international context. Turning the focus to domestic outcomes, the third section looks at Year 4 mathematics performance across the Australian educational jurisdictions and the fourth provides the results for demographic groups within Australia. The final section looks at the results for the content and cognitive domains for Year 4 mathematics.

The TIMSS 2015 mathematics framework

Mullis and Martin (2013) contend that all children can benefit from studying and developing strong skills in mathematics, as mathematics is essential in daily life. Learning mathematics improves problem solving, and working through problems can teach persistence and perseverance. In TIMSS, students' mathematical understanding is assessed by having participating students read selected questions and stimulus materials and respond to a variety of questions.

The TIMSS 2015 mathematics framework is organised around two dimensions – a content dimension, which specifies the subject matter to be assessed within mathematics (e.g. *number*, *algebra* etc.) and the cognitive dimension, which specifies the thinking processes and sets of behaviours expected of students as they engage with the mathematics content.

Mathematics content and cognitive domains

In the TIMSS 2015 mathematics framework for Year 4 students, three content domains are defined:

- *number*
- *geometric shapes and measures*
- *data display*.

Each of these content domains has several topic areas. For example, the domain *number* includes whole numbers; fractions and decimals; and expressions, simple equations and relationships. These topic areas are shown in Table 2.1.

For a detailed description of each of the content domains in mathematics, please refer to Mullis and Martin (2013).

TABLE 2.1 TIMSS mathematics content domains and percentage of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Number	Whole numbers Fractions and decimals Expressions, simple equations and relationships	50
Geometric shapes and measures	Point, lines and angles Two- and three-dimensional shapes	35
Data display	Reading, interpreting and representing	15

To respond correctly to TIMSS test items, students need to be familiar with the mathematics content of the items. Just as importantly, however, items were designed to elicit the use of particular cognitive skills. The TIMSS 2015 assessment framework presents detailed descriptions of the skills and abilities that make up the cognitive domains and that are assessed in conjunction with the content. The student behaviours encompassed by the cognitive dimension have been classified into three domains within the assessment framework.

The three domains can be described as follows:

- *knowing* – which covers the facts, procedures and concepts students need to know
- *applying* – which focuses on the ability of students to apply knowledge and conceptual understanding to solve problems or answer questions
- *reasoning* – which goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts and multi-step problems.

Table 2.2 shows the percentage of assessment devoted to each cognitive domain at Year 4. These three cognitive domains are used for both Year 4 and Year 8, but the balance of testing time differs in these two year levels, reflecting the difference in age and experience of the students tested. In TIMSS 2015, each content domain included items developed to address each of the three cognitive domains; for example, the *number* domain included *knowing*, *applying* and *reasoning* items, as did the other content domains.

TABLE 2.2 TIMSS mathematics cognitive domains and percentage of assessment for each domain

Cognitive domains	Target % of TIMSS assessment
Knowing	40
Applying	40
Reasoning	20

The TIMSS international benchmarks

The TIMSS mathematics achievement scale summarises Year 4 students' performance when interacting with a variety of mathematical tasks and questions (please see the Reader's Guide for more information about the achievement scales). Students' achievement is based on their responses to test questions designed to assess a range of content areas. When comparing groups of students across and within countries, summary statistics such as the average, or mean, scale score are often used. This score, however, does not provide detailed information as to what types of mathematical tasks the students were able to undertake successfully. Instead, TIMSS uses international benchmarks to provide descriptions of achievement on the scale in relation to performance on the questions asked.

Internationally, it was decided that performance should be measured at four levels. These four levels summarise the achievement reached by:

- the 'Advanced international benchmark', which was set at 625 score points
- the 'High international benchmark', which was set at 550 score points
- the 'Intermediate international benchmark', which was set at 475 score points
- the 'Low international benchmark', which was set at 400 score points.

The descriptions of the levels are cumulative, so that a student who reached the High benchmark can typically demonstrate the knowledge and skills for both the Intermediate and the Low benchmarks. Table 2.3 provides a summary of the TIMSS 2015 Year 4 mathematics benchmarks.

TABLE 2.3 The TIMSS 2015 international benchmarks for Year 4 mathematics

625	**Advanced international benchmark** *Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.* They can solve a variety of multi-step word problems involving whole numbers. Students at this level show an increasing understanding of fractions and decimals. They can apply knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can interpret and represent data to solve multi-step problems.
550	**High international benchmark** *Students can apply their knowledge and understanding to solve problems.* They can solve word problems involving operations with whole numbers, simple fractions and two-place decimals. Students demonstrate understanding of geometric properties of shapes and of angles that are less than or greater than a right angle. Students can interpret and use data in tables and a variety of graphs to solve problems.
475	**Intermediate international benchmark** *Students can apply basic mathematical knowledge in simple situations.* They demonstrate an understanding of whole numbers and some understanding of fractions and decimals. Students can relate two- and three-dimensional shapes and identify and draw shapes with simple properties. They can read and interpret bar graphs and tables.
400	**Low international benchmark** *Students have some basic mathematical knowledge.* They can add and subtract whole numbers, have some understanding of multiplication by one-digit numbers and can solve simple word problems. They have some knowledge of simple fractions, geometric shapes and measurement. Students can read and complete simple bar graphs and tables.

At Year 4, students at the Advanced benchmark can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can find more than one solution to a problem and can interpret and represent data to solve multi-step problems.

As an example, Figure 2.1 shows an item from *number*. Students were asked to explain why they had chosen a specific diagram as a representation of the fraction $\frac{3}{8}$. To get full credit, students would need to provide an explanation that included a reference to both the denominator and the numerator. Internationally, 24 per cent of students on average across all countries answered this correctly. In Australia, 23 per cent of students answered the question correctly, which was not significantly different to the international average.

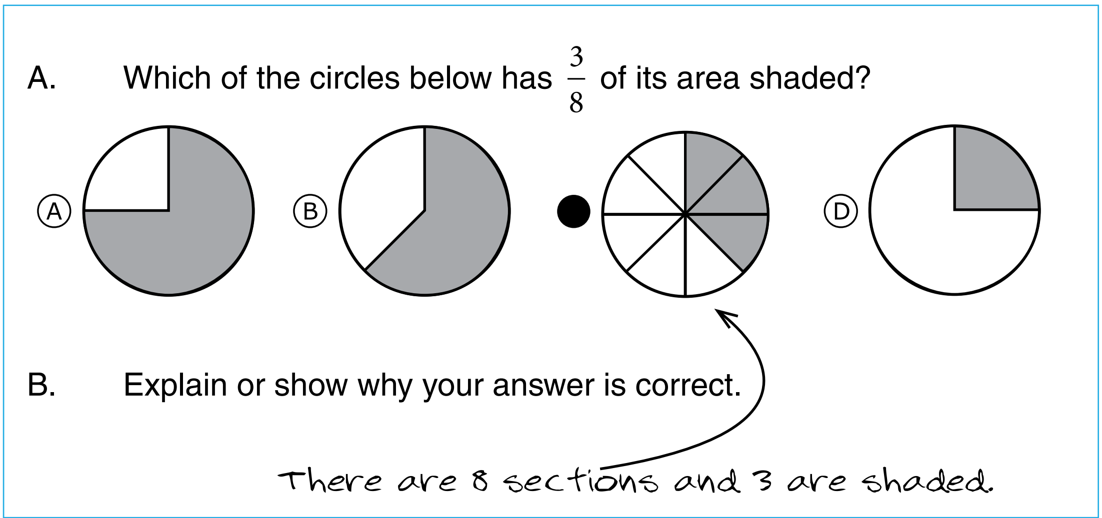


FIGURE 2.1 Advanced international benchmark, Year 4 mathematics – example item

At the Low benchmark, students have some basic mathematical knowledge and can add and subtract whole numbers. They have some recognition of simple shapes and basic measurement ideas, and they can read and complete simple bar graphs and tables.

As an example, Figure 2.2 shows another item from *number*. Students were asked to identify a four-digit number given in words. This is quite easy for Year 4 students internationally, with 87 per cent of students on average across all countries answering this correctly. In Australia, 89 per cent of students answered the question correctly, which was not significantly different to the international average.

Three thousand and twenty three can be written as:

Ⓐ 323

● 3,023

Ⓒ 30,023

Ⓓ 300,023

FIGURE 2.2 Low international benchmark, Year 4 mathematics – example item

Further information about the types of mathematics skills and strategies demonstrated by Year 4 students who performed at each of the international benchmarks, along with examples of the types of responses given by students at each of the benchmarks, is provided in the *TIMSS 2015 International Results in Mathematics* (http://timss2015.org/timss-2015/mathematics/performance-at-international-benchmarks/).

Australia's Year 4 mathematics results within the international context

This section reports the TIMSS 2015 mathematics results as average scores and distributions on the TIMSS Year 4 mathematics scale (please see the Reader's Guide for more information about the achievement scales).

Figure 2.3 provides a summary of the overall performance of students in Year 4 across different countries on the TIMSS 2015 mathematics achievement scale, in terms of the mean scores achieved by students in each country, the standard error of each mean, and the range of scores achieved between the 5th and 95th percentiles.

Countries are positioned in Figure 2.3 according to decreasing level of achievement; however, this should not be interpreted as a simple ranking, as the differences between countries may not be statistically significant. The shading in this figure indicates whether the score for a given country is significantly different to that of Australia. To determine whether or not differences between other countries are statistically significant, please refer to the multiple-comparisons tables available in the *TIMSS 2015 International Results in Mathematics* (http://timss2015.org/timss-2015/mathematics/student-achievement/multiple-comparisons-of-mathematics-achievement/).

Singapore and Hong Kong were the top-performing countries of TIMSS 2015, scoring at the upper levels of the High benchmark, and almost at the Advanced benchmark, the cut point of which is set at 625 score points. The scores for these countries were not significantly different to each other but were significantly higher than those for all other countries.

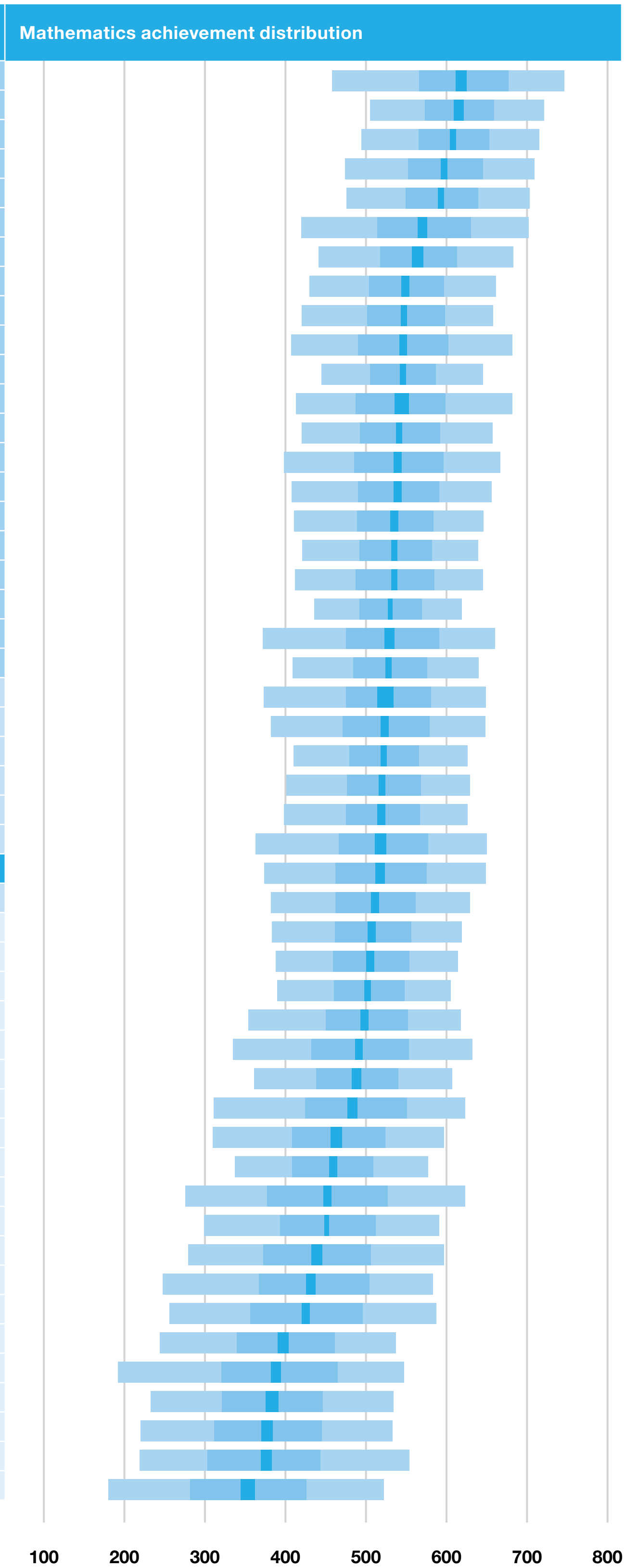
Australia's average score of 517 score points was significantly higher than the scores for 20 other countries, such as Italy, Spain and New Zealand, and places average achievement at the Intermediate benchmark.

Australia's average score was significantly lower than the average scores for 21 other countries, including Northern Ireland, Ireland, England and the United States, as well as the participating Asian countries Singapore, Hong Kong, Korea, Chinese Taipei and Japan.

Figure 2.3 also shows the range of achievement within countries, with 288 score points separating the 5th and 95th percentiles for Singapore, but more than 340 score points separating highest and lowest in Kuwait (342 score points), the United Arab Emirates (347 score points) and Jordan (355 score points).

Australia's gap between high and low achievers – of 275 score points – was mid-range, similar to that of Singapore (288 score points). New Zealand had a 297 score-points gap between high and low performers. As a comparison, the gap for students in the Netherlands was the lowest, at 183 score points.

	Country	Mean	SE	Gap 95th–5th percentiles
Achievement significantly higher than Australia's	Singapore	618	3.8	288
	Hong Kong	615	2.9	216
	Korea	608	2.2	221
	Chinese Taipei	597	1.9	235
	Japan	593	2.0	227
	Northern Ireland	570	2.9	282
	Russian Federation	564	3.4	242
	Norway (5)	549	2.5	231
	Ireland	547	2.1	238
	England	546	2.8	275
	Belgium (Flemish)	546	2.1	200
	Kazakhstan	544	4.5	269
	Portugal	541	2.2	237
	United States	539	2.3	269
	Denmark	539	2.7	248
	Lithuania	535	2.5	235
	Finland	535	2.0	218
	Poland	535	2.1	233
	Netherlands	530	1.7	183
	Hungary	529	3.2	288
	Czech Republic	528	2.2	231
Achievement not different to Australia's	Bulgaria	524	5.3	276
	Cyprus	523	2.7	266
	Germany	522	2.0	216
	Slovenia	520	1.9	228
	Sweden	519	2.8	228
	Serbia	518	3.5	287
	Australia	**517**	**3.1**	**275**
	Canada	511	2.3	247
Achievement significantly lower than Australia's	Italy	507	2.6	236
	Spain	505	2.5	226
	Croatia	502	1.8	215
	Slovak Republic	498	2.5	264
	New Zealand	491	2.3	297
	France	488	2.9	246
	Turkey	483	3.1	312
	Georgia	463	3.6	287
	Chile	459	2.4	240
	United Arab Emirates	452	2.4	347
	Bahrain	451	1.6	292
	Qatar	439	3.4	318
	Iran	431	3.2	335
	Oman	425	2.5	331
	Indonesia	397	3.7	293
	Jordan	388	3.1	355
	Saudi Arabia	383	4.1	301
	Morocco	377	3.4	313
	South Africa (5)	376	3.5	335
	Kuwait	353	4.6	342



Note: See Reader's Guide for interpretation of graph.

FIGURE 2.3 Mean scores and distribution of Year 4 mathematics achievement, by country

Performance at the international benchmarks

In addition to analysing performance according to mean scores, it is beneficial to use the international benchmarks described previously to gain further insight into student achievement. Figure 2.4 shows the percentage of students in each country at each of the international benchmarks.

The countries are ordered by the percentages of students reaching the Intermediate international benchmark, which is the proficient standard set for TIMSS mathematics in Australia (please see the Reader's Guide for more information about the proficient standard).

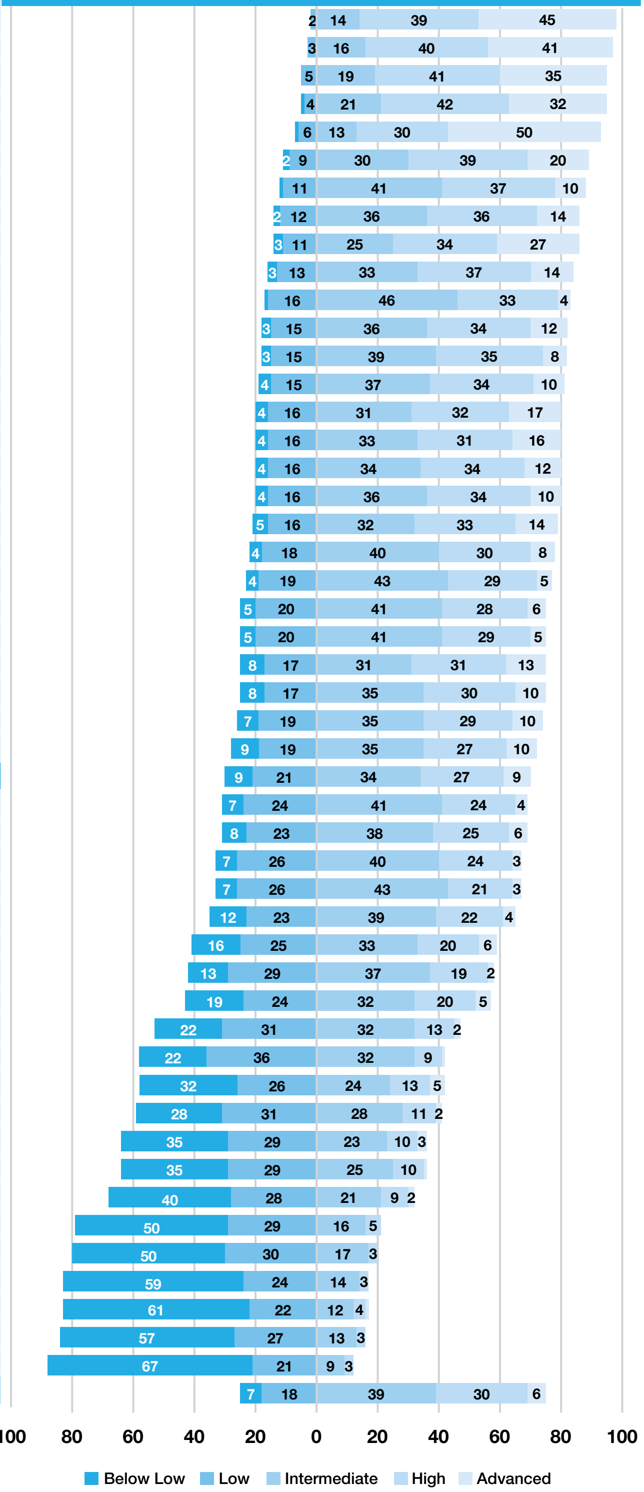
Hong Kong, Korea, Chinese Taipei, Japan and Singapore again head the table, with between 32 and 50 per cent of their Year 4 students achieving at or above the Advanced benchmark, and very low proportions – between two and seven per cent – of their students at or below the Low benchmark. Northern Ireland was the best-performing of the non-Asian countries, with 27 per cent of students at the Advanced benchmark; however, unlike the high-performing Asian countries, 14 per cent of its students were achieving either at or below the Low benchmark.

England and the United States had 17 and 14 per cent (respectively) of their students achieving the Advanced benchmark, and 20 and 21 per cent (respectively) at or below the Low benchmark. In the Netherlands, the country with the narrowest gap between high and low achievers, four per cent of students achieved the Advanced benchmark, while 16 per cent were at the Low benchmark and only one per cent did not achieve this level.

Nine per cent of Australian students achieved the Advanced benchmark, while 27 per cent performed at the High benchmark and a further 34 per cent performed at the Intermediate benchmark. This means that 70 per cent of Australian students achieved at least the Intermediate benchmark, which is the proficient standard for Australia. Of concern are the 30 per cent of Australian Year 4 students achieving at or below the Low benchmark (21% performed at the Low benchmark and a further 9% did not reach the Low benchmark).

The percentage of Australian Year 4 students achieving at each of the international benchmarks is similar to that of the international median.

Country	% of students at or above the proficient standard for Australia	SE
Hong Kong	98	0.4
Korea	97	0.4
Chinese Taipei	95	0.4
Japan	95	0.4
Singapore	93	0.9
Russian Federation	89	1.1
Belgium (Flemish)	88	0.9
Norway (5)	86	1.0
Northern Ireland	86	1.1
Ireland	84	1.0
Netherlands	83	1.0
Portugal	82	1.1
Finland	82	1.0
Lithuania	81	1.1
England	80	1.2
Kazakhstan	80	1.5
Denmark	80	1.3
Poland	80	1.0
United States	79	1.0
Czech Republic	78	1.1
Germany	77	1.1
Slovenia	75	1.2
Sweden	75	1.6
Hungary	75	1.5
Bulgaria	75	2.1
Cyprus	74	1.3
Serbia	72	1.6
Australia	70	1.3
Italy	69	1.4
Canada	69	1.2
Spain	67	1.4
Croatia	67	1.2
Slovak Republic	65	1.4
New Zealand	59	1.2
France	58	1.8
Turkey	57	1.3
Georgia	47	1.7
Chile	42	1.4
United Arab Emirates	42	1.0
Bahrain	41	0.8
Qatar	36	1.4
Iran	36	1.1
Oman	32	1.1
Jordan	21	1.1
Indonesia	20	1.2
Morocco	17	1.1
South Africa (5)	17	1.0
Saudi Arabia	16	1.2
Kuwait	12	1.2
International median	75	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.4 Percentages of students at the international benchmarks for Year 4 mathematics, by country

Trends in Year 4 mathematics achievement

Looking at the overall trends in Year 4 mathematics achievement during the 1995–2015 period, there have been more countries with increases than with decreases. Of the 17 participating countries with data spanning this period, 14 countries had increases in average mathematics achievement, two countries had decreases and one country had no difference. Among the countries with the greatest increase from 1995 to 2015 were Cyprus, England, Hong Kong, Iran, Portugal and Slovenia, with average mathematics achievement increases of between 45 and 99 score points.

Figure 2.5 shows trends in Year 4 mathematics achievement for some selected countries that have comparable data from previous TIMSS assessments. Rather than include graphs showing changes for all countries, we have provided just a few, for interest and comparison. The countries that have been included are those with which we usually make comparisons: the United States, England and New Zealand, along with one of the higher-achieving countries, Singapore, and the Czech Republic, which showed a large change over this time. The figure provides a graphical depiction of change in Year 4 average achievement in mathematics across the TIMSS assessment years (1995–2015).

Figure 2.5 shows that Australia's 2015 Year 4 mathematics score was significantly higher than the corresponding score in 1995; however, this was due to a single increase between 2003 and 2007, with no following decline. For the past three cycles, Australia's scores have been the same.

Scores for students in the United States significantly increased over the period 2003 to 2011, but did not change over the last cycle. Similarly, England and New Zealand showed significant growth in early cycles but this has slowed over recent years.

Singapore's score has increased steadily since TIMSS 1995, such that the mean score for 2015 is significantly higher than for all other cycles. In comparison, the score for the Czech Republic has rebounded over the past two cycles after a sharp decline in TIMSS 2007.

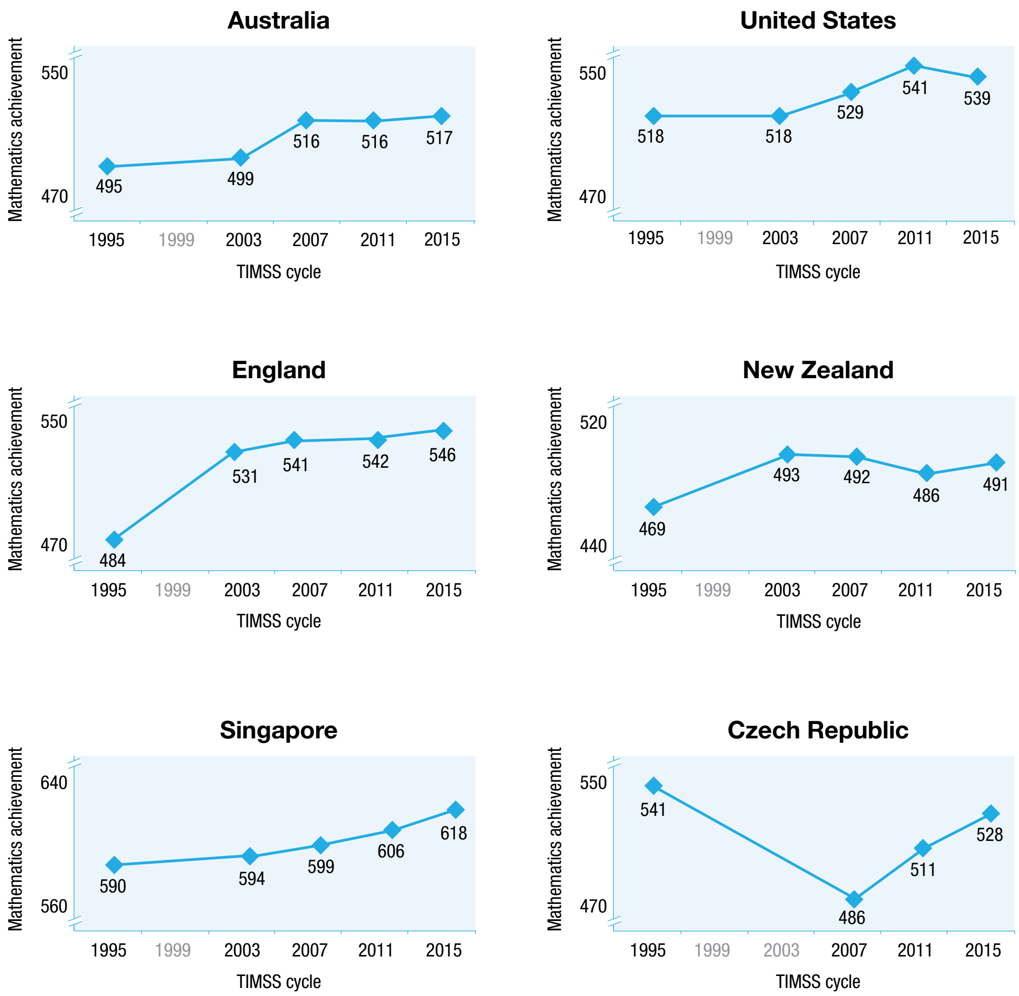
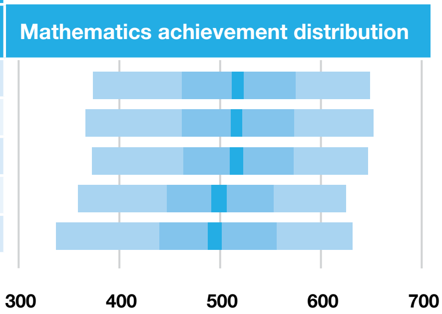


FIGURE 2.5 Trends in Year 4 mathematics achievement scores, 1995–2015, selected countries

Figure 2.6 presents the trends in the distribution of mathematics achievement at Year 4 in Australia since 1995. It shows that the largest change in the mean achievement of Australian Year 4 students was between 2003 and 2007. Not only has there been a shift up the scale, but the distribution of achievement appears to have contracted somewhat since 1995, with the difference between the 5th and 95th percentiles dropping from 294 score points in 1995 to 275 score points in 2015.

			Differences between years			
	Mean	SE	2011	2007	2003	1995
2015	517	3.1	1	1	19 ↑	23 ↑
2011	516	3.0		0	17 ↑	21 ↑
2007	516	3.5			17 ↑	22 ↑
2003	499	3.9				4
1995	495	3.5				



Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

See Reader's Guide for interpretation of graph.

FIGURE 2.6 Trends in Year 4 mathematics achievement score and distribution, 1995–2015, Australia

Table 2.4 displays each country's position relative to that of Australia in each TIMSS cycle (please see Appendix B for the mean scores by cycle for each country). The table shows that Australia was outperformed at Year 4 in 2015 by most of the Asian countries, as well as England and the United States. Sweden, whose position was significantly lower than Australia's in 2007 and 2011, achieved a score in TIMSS 2015 that is not significantly different to that of Australia, while Hungary and the Czech Republic, which had the same position as that of Australia in 2011, have now outperformed Australia. Kazakhstan, which scored at a level significantly lower than Australia's in 2011, scored significantly higher than Australia in 2015.

In terms of trends since 1995, England, Portugal, Cyprus and Slovenia all scored significantly lower than Australia in 1995 but have since improved to score at a level the same as, or significantly higher than, Australia's in 2015.

TABLE 2.4 Relative trends in Year 4 mathematics achievement, by country

Country	Position relative to Australia 2015	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Singapore	↑	↑	↑	↑	↑
Hong Kong	↑	↑	↑	↑	↑
Korea	↑	↑	–	–	↑
Chinese Taipei	↑	↑	↑	↑	–
Japan	↑	↑	↑	↑	↑
Northern Ireland	↑	↑	–	–	–
Russian Federation	↑	↑	↑	↑	–
Norway (5)	↑	–	–	–	–
Ireland	↑	↑	–	–	↑
England	↑	↑	↑	↑	↓
Belgium (Flemish)	↑	↑	–	↑	–
Kazakhstan	↑	↓	–	–	–
Portugal	↑	↑	–	–	↓
United States	↑	↑	↑	↑	↑
Denmark	↑	↑	•	–	–
Lithuania	↑	↑	↑	↑	–
Finland	↑	↑	–	–	–
Poland	↑	–	–	–	–
Netherlands	↑	↑	↑	↑	↑
Hungary	↑	•	•	↑	↑
Czech Republic	↑	•	↓	–	↑
Bulgaria	•	–	–	–	–
Cyprus	•	–	–	↑	↓
Germany	•	↑	↑	–	–
Slovenia	•	•	↓	↓	↓
Sweden	•	↓	↓	–	–
Serbia	•	•	–	–	–
Australia					
Canada	•	–	–	–	–
Italy	↓	↓	•	•	–
Spain	↓	↓	–	–	–
Croatia	↓	↓	–	–	–
Slovak Republic	↓	↓	↓	–	–
New Zealand	↓	↓	↓	•	↓
France	↓	–	–	–	–
Turkey	↓	↓	–	–	–
Georgia	↓	↓	↓	–	–
Chile	↓	↓	–	–	–
United Arab Emirates	↓	↓	–	–	–
Bahrain	↓	↓	–	–	–
Qatar	↓	↓	–	–	–
Iran	↓	↓	↓	↓	↓
Oman	↓	↓	–	–	–
Indonesia	↓	–	–	–	–
Jordan	↓	–	–	–	–
Saudi Arabia	↓	↓	–	–	–
Morocco	↓	↓	–	–	–
South Africa (5)	↓	–	–	–	–
Kuwait	↓	↓	–	–	–

↑ Score significantly higher than Australia's.

↓ Score significantly lower than Australia's.

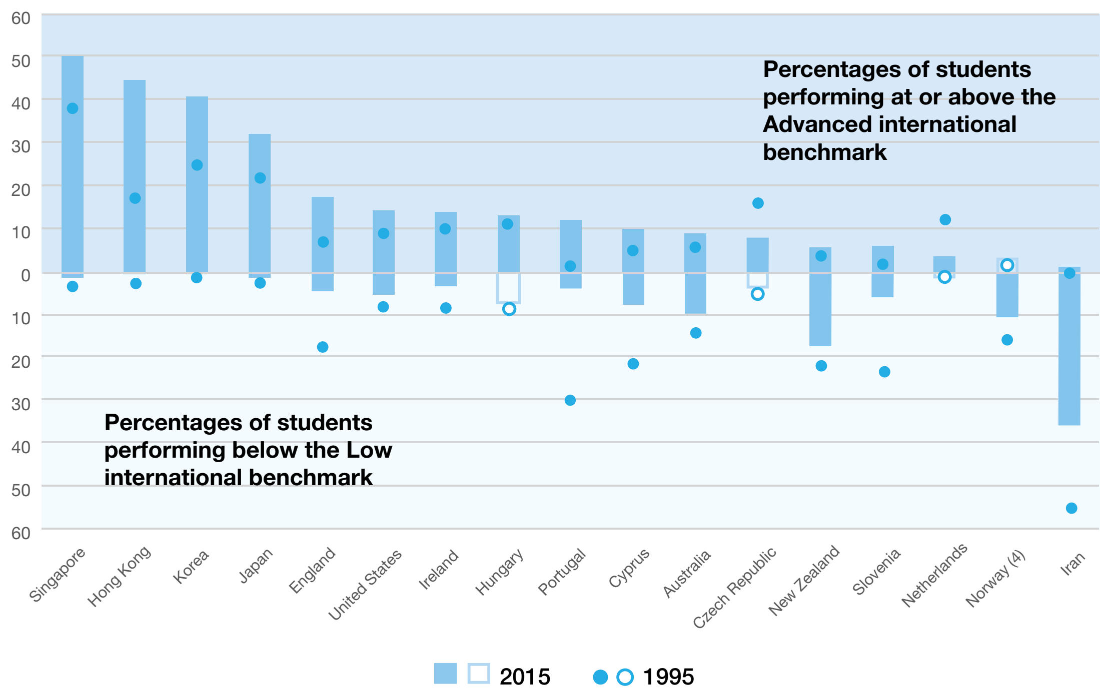
• Score not significantly different to that of Australia.

– Did not participate in this cycle.

Figure 2.7 shows the trends in the percentages of students achieving the Advanced international benchmark and those not achieving the Low international benchmark for countries that participated in both TIMSS 1995 and TIMSS 2015.

In the majority of the countries (14 out of 17) that participated in both TIMSS 1995 and TIMSS 2015, the number of Year 4 students achieving the Advanced benchmark has significantly increased between 1995 and 2015.

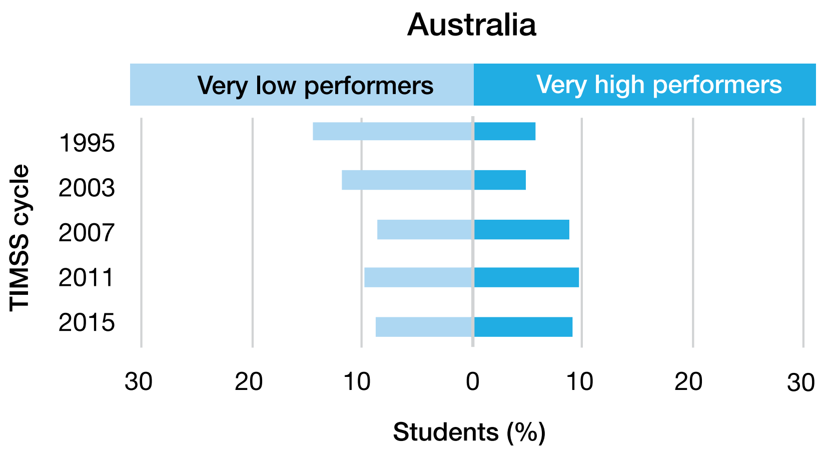
Similarly, in 14 of the 17 countries, a higher percentage of students achieved the Low benchmark in 2015 than in 1995.



Note: A coloured bar and a coloured circle indicate that the difference in the percentages of students between TIMSS 1995 and TIMSS 2015 was significant.

FIGURE 2.7 Percentages of very high- and very low-achieving students in Year 4 mathematics in TIMSS 1995 and TIMSS 2015, by country

Figure 2.8 shows the trends in the percentages of Australian Year 4 students achieving the Advanced international benchmark and those not achieving the Low international benchmark in mathematics in all cycles since TIMSS 1995. As would be expected, given the improvement in mean score between 2003 and 2007, the percentage of students achieving the Advanced benchmark has significantly increased since 1995. Likewise, the percentage of students performing below the Low benchmark has significantly decreased since 1995.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 2.8 Percentages of very high- and very low-achieving students in Year 4 mathematics in TIMSS 1995 to TIMSS 2015, Australia

Australia's Year 4 mathematics results at the national level

Figure 2.9 presents the distribution of Year 4 mathematics achievement for each of the Australian jurisdictions for TIMSS 2015. To place the jurisdiction results in perspective, the means and distributions for Australia as a whole, and for Singapore, the highest-achieving country at Year 4 in mathematics, are also included in the figure. The jurisdictions are shown in order of highest to lowest mean score.

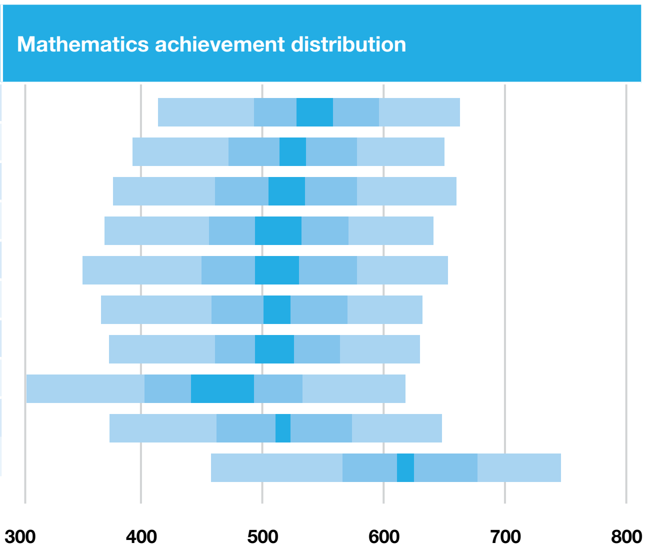
Figure 2.9 should be read in conjunction with Table 2.5, which presents the multiple comparisons of mean mathematics performance between jurisdictions and indicates which jurisdiction's performance does, or does not, differ significantly from the performance of each of the other jurisdictions.

Figure 2.9 and Table 2.5 together show that the spread of average scores across the jurisdictions was 77 score points (about three-quarters of a standard deviation) between the highest-performing jurisdiction, the Australian Capital Territory, and the lowest-performing jurisdiction, the Northern Territory.

The performance of students in the Australian Capital Territory was significantly higher than that of students in all jurisdictions except Victoria. Students in the Northern Territory performed at a level significantly below those of students in all other jurisdictions.

The largest range of student performance was seen in Western Australia and the Northern Territory, where the gap between the 5th and 95th percentiles was around 300 score points. The highest-achieving jurisdiction, the Australian Capital Territory, had the narrowest gap of all the jurisdictions, at 251 score points.

Jurisdiction	Mean	SE	Gap 95th–5th percentiles
ACT	544	7.9	251
VIC	525	5.5	257
NSW	519	7.5	282
TAS	513	9.6	269
WA	512	9.1	300
QLD	511	5.6	265
SA	510	7.9	255
NT	467	13.3	311
Australia	517	3.1	275
Singapore	618	3.8	288



Note: See Reader's Guide for interpretation of graph.

FIGURE 2.9 Mean scores and distribution of Year 4 mathematics achievement, by jurisdiction

TABLE 2.5 Multiple comparisons of Year 4 mathematics achievement, by jurisdiction

Jurisdiction	Mean	SE	ACT	VIC	NSW	TAS	WA	QLD	SA	NT
ACT	544	7.9		•	↑	↑	↑	↑	↑	↑
VIC	525	5.5	•		•	•	•	•	•	↑
NSW	519	7.5	↓	•		•	•	•	•	↑
TAS	513	9.6	↓	•	•		•	•	•	↑
WA	512	9.1	↓	•	•	•		•	•	↑
QLD	511	5.6	↓	•	•	•	•		•	↑
SA	510	7.9	↓	•	•	•	•	•		↑
NT	467	13.3	↓	↓	↓	↓	↓	↓	↓	

Note: Read across the row to compare a state/territory's performance with the performance of each jurisdiction listed in the column heading.

↑ Average performance statistically significantly higher than in comparison jurisdiction.

• No statistically significant difference from comparison jurisdiction.

↓ Average performance statistically significantly lower than in comparison jurisdiction.

Performance at the international benchmarks by jurisdiction

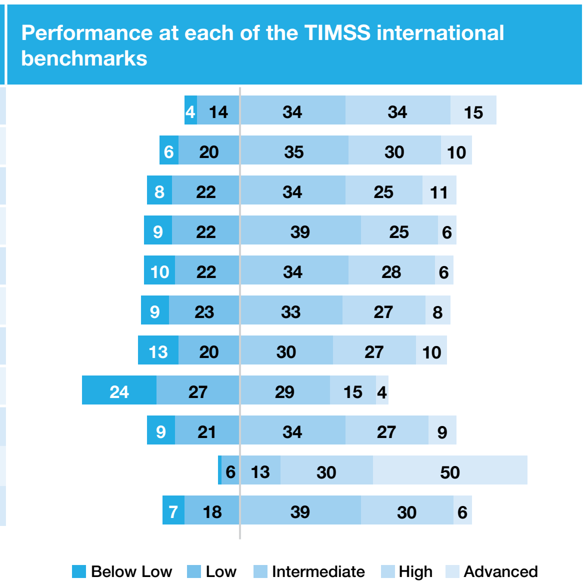
Figure 2.10 shows the percentage of students in each jurisdiction at each of the international benchmarks for Year 4 mathematics, along with the percentages for Australia as a whole, Singapore (as the highest-scoring country) and the international median for comparison.

The jurisdiction with the highest percentage of students achieving the Advanced benchmark was the Australian Capital Territory, in which 15 per cent of students achieved the highest level. In New South Wales 11 per cent of students achieved this benchmark, and in Western Australia and Victoria 10 per cent of students achieved it. The Northern Territory had the lowest proportion of students at this level, with just four per cent achieving the Advanced benchmark.

Fifty-one per cent of students in the Northern Territory did not reach the Intermediate benchmark, which is the proficient standard for Australia. In the other Australian jurisdictions, this proportion ranged from 18 per cent in the Australian Capital Territory to 33 per cent in Western Australia.

Twenty-four per cent of students in the Northern Territory and between four and 13 per cent in all other jurisdictions did not reach the Low benchmark.

Jurisdiction	% of students at or above the proficient standard for Australia	SE
ACT	82	3.5
VIC	74	2.2
NSW	70	3.0
SA	69	4.1
QLD	69	2.8
TAS	68	5.2
WA	67	3.5
NT	49	7.0
Australia	70	1.3
Singapore	93	0.9
International median	75	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

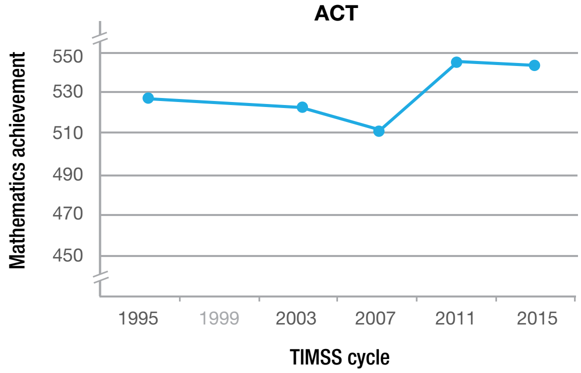
FIGURE 2.10 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by jurisdiction

Trends in Year 4 mathematics achievement by jurisdiction

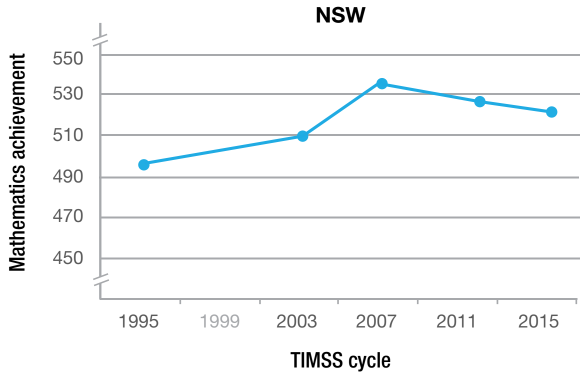
Figure 2.11 presents the trends in mathematics achievement for each of the jurisdictions for each cycle of TIMSS (1995, 2003, 2007, 2011 and 2015) and also an indication of the statistical significance of the difference between cycles (please see Appendix C for the mean scores by cycle for each jurisdiction).

Between 1995 and 2015, there has been a significant improvement in five of the eight jurisdictions. Western Australia has shown the greatest improvement of 29 score points, followed by Queensland and Tasmania with a 27 score-point improvement. South Australia and New South Wales recorded gains of 25 and 23 score points, respectively.

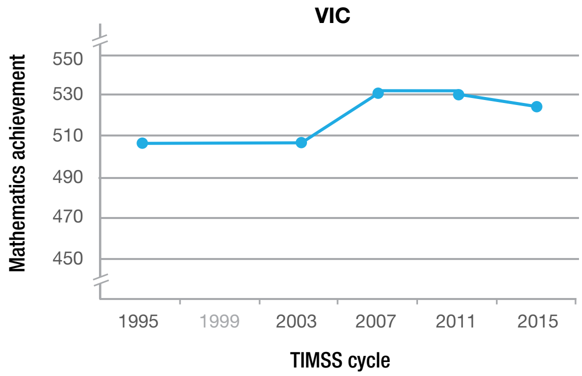
None of the jurisdictions showed a significant change in average score between 2011 and 2015.



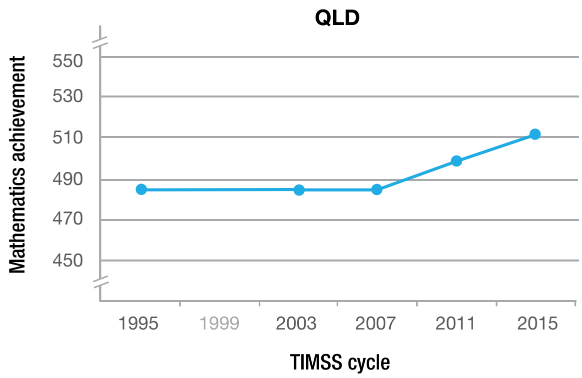
Differences between years				
	2011	2007	2003	1995
2015	-1	31 ↑	21	16
2011		32 ↑	22	18
2007			-10	-14
2003				-4



Differences between years				
	2011	2007	2003	1995
2015	-6	-15	9	23 ↑
2011		-9	15	29 ↑
2007			24 ↑	38 ↑
2003				14



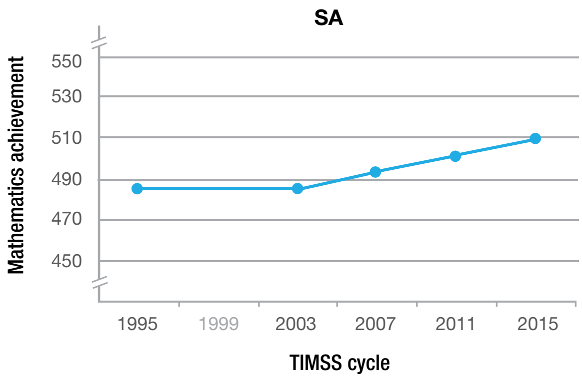
Differences between years				
	2011	2007	2003	1995
2015	-6	-7	17 ↑	18
2011		-1	23 ↑	24 ↑
2007			24 ↑	25 ↑
2003				1



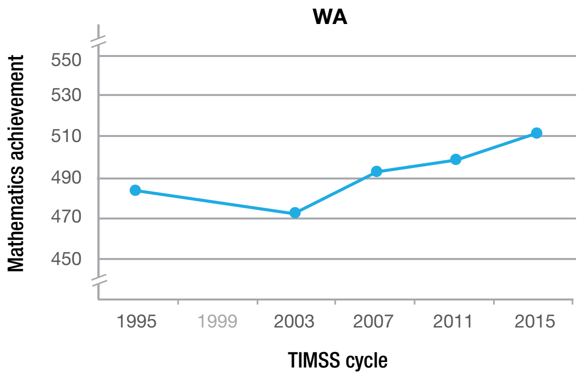
Differences between years				
	2011	2007	2003	1995
2015	12	26 ↑	27 ↑	27 ↑
2011		14	15	15
2007			1	1
2003				0

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

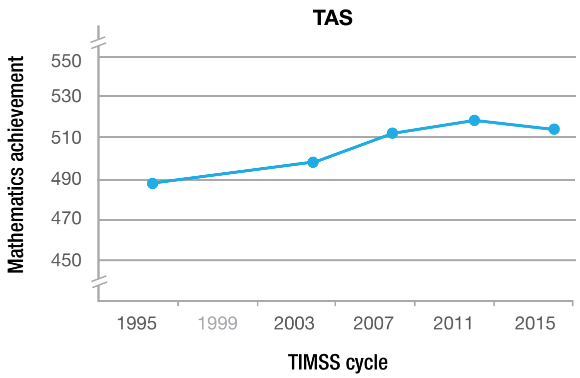
FIGURE 2.11 Trends in Year 4 mathematics achievement within Australia, 1995–2015, by jurisdiction



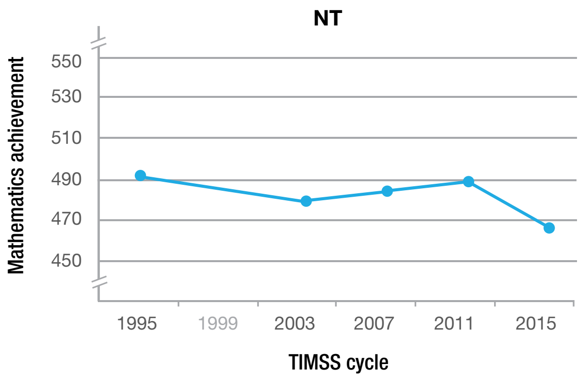
Differences between years				
	2011	2007	2003	1995
2015	8	17	25 ↑	25 ↑
2011		9	17	17
2007			8	8
2003				0



Differences between years				
	2011	2007	2003	1995
2015	13	19	40 ↑	29 ↑
2011		6	27 ↑	16
2007			21 ↑	10
2003				-11



Differences between years				
	2011	2007	2003	1995
2015	-4	3	16	27 ↑
2011		7	20	31 ↑
2007			13	24 ↑
2003				11



Differences between years				
	2011	2007	2003	1995
2015	-22	-17	-12	-23
2011		5	10	-2
2007			5	-7
2003				-12

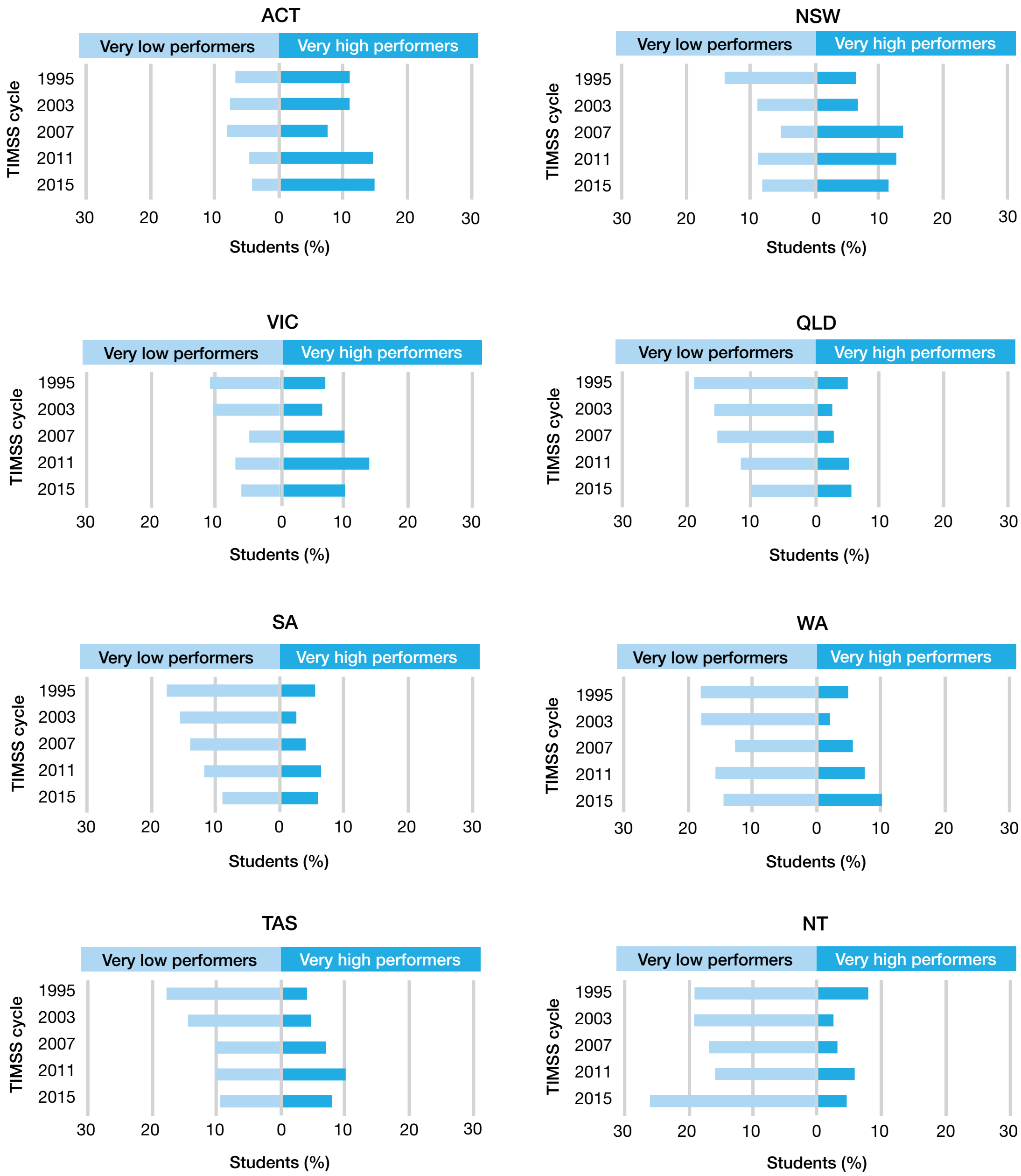
Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

FIGURE 2.11 Trends in Year 4 mathematics achievement within Australia, 1995–2015, by jurisdiction (cont.)

Figure 2.12 shows the percentage of students achieving the Advanced international benchmark in Year 4 mathematics, as well as the percentage of students not achieving the Low benchmark, for each Australian jurisdiction for all TIMSS cycles from 1995 through to 2015.

Only in the Northern Territory was there a higher percentage of students who did not achieve the Low benchmark in 2015 than in 1995. The reduction in the proportion of low-performing students was statistically significant in Queensland, South Australia and Tasmania, where the improvement was largest (from almost 20% in 1995 to around 10% in 2015).

The percentage of students achieving the Advanced benchmark has increased from 1995 to 2015 in each jurisdiction except the Northern Territory and South Australia. The gain (of around five percentage points) was statistically significant in New South Wales and Tasmania.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 2.12 Percentages of very high- and very low-achieving students in Year 4 mathematics in TIMSS 1995 to TIMSS 2015, by jurisdiction

Australia's Year 4 mathematics achievement for different demographic groups

Year 4 mathematics achievement by sex

Figure 2.13 shows the performance of male and female Year 4 students in mathematics achievement across the countries participating in TIMSS 2015. This figure presents average achievement separately for females and males, as well as the differences between the averages. Sex differences are shown by a bar indicating the size and direction of each difference (in favour of males or females) and whether the difference was statistically significant (indicated by a darkened bar). Countries are presented in the figure in increasing order of the difference between females and males in average achievement.

Figure 2.13 shows that 23 countries had no significant sex difference in mathematics achievement. Eighteen of the 26 remaining countries, including Australia, had significant differences favouring male students. These differences ranged in size from six score points in, for example, England, through to nine score points in Australia and 20 score points in Italy.

There were fewer countries, on average, in which females outperformed males than in which males outperformed females. Where females did outperform males, the differences were generally larger. Eight countries had larger differences favouring female over male students (from nine score points in Finland through to 22 score points in Oman and 43 score points in Saudi Arabia).

In Australia, both male and female students achieved at a significantly higher level than their respective international means.

Country	Female				Male				Difference (absolute value)	SE
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE		
Saudi Arabia	49	1.0	405	4.4	51	1.0	363	6.5	43	7.7
Oman	50	0.7	436	3.0	50	0.7	415	2.8	22	2.9
Jordan	46	2.4	399	3.3	54	2.4	379	4.9	20	5.8
South Africa (5)	48	0.8	384	3.8	52	0.8	368	4.4	15	4.2
Bahrain	50	0.7	459	1.7	50	0.7	443	2.3	15	2.5
Kuwait	51	2.0	359	5.4	49	2.0	347	5.6	12	6.2
Iran	50	0.9	437	4.5	50	0.9	426	4.5	10	6.3
Indonesia	48	0.6	403	4.0	52	0.6	393	3.9	10	2.7
Finland	48	0.8	540	2.3	52	0.8	531	2.6	9	2.9
Bulgaria	49	0.8	527	5.7	51	0.8	522	5.1	5	2.9
Norway (5)	49	0.9	551	2.6	51	0.9	547	3.1	4	2.9
Singapore	48	0.5	620	3.9	52	0.5	616	4.3	4	3.0
United Arab Emirates	48	2.2	453	3.9	52	2.2	450	3.4	3	5.4
Georgia	49	0.9	465	3.9	51	0.9	461	4.4	3	4.0
Serbia	48	0.8	520	3.7	52	0.8	517	4.7	3	4.7
Qatar	51	2.5	440	4.1	49	2.5	438	4.9	3	5.9
Lithuania	50	0.9	537	2.8	50	0.9	534	3.1	2	3.3
Kazakhstan	49	0.8	546	4.6	51	0.8	543	4.8	2	2.8
Morocco	48	0.7	378	3.5	52	0.7	377	3.9	1	2.8
Sweden	49	1.0	519	3.2	51	1.0	518	3.2	1	3.0
Russian Federation	49	0.9	564	3.7	51	0.9	564	3.7	1	2.8
Japan	50	0.5	593	2.0	50	0.5	593	2.5	0	2.3
Chile	49	1.7	458	2.8	51	1.7	459	3.0	1	3.2
Poland	50	0.8	534	2.3	50	0.8	536	2.7	1	2.5
Turkey	49	0.6	482	3.2	51	0.6	484	3.5	2	2.7
Northern Ireland	50	1.1	569	3.8	50	1.1	571	3.1	2	3.8
New Zealand	49	0.7	489	2.8	51	0.7	492	2.6	2	2.8
Germany	48	0.7	520	2.4	52	0.7	523	2.3	3	2.3
Ireland	47	1.5	545	2.6	53	1.5	549	2.9	4	3.4
Slovenia	49	0.8	518	2.1	51	0.8	522	2.4	4	2.6
Chinese Taipei	49	0.6	594	2.2	51	0.6	599	2.3	6	2.5
Belgium (Flemish)	50	0.9	543	2.4	50	0.9	549	2.4	6	2.4
Hungary	49	0.9	526	3.4	51	0.9	532	3.8	6	3.4
France	49	0.7	485	3.2	51	0.7	491	3.2	6	2.8
Denmark	49	0.8	536	3.1	51	0.8	542	3.0	6	2.8
England	51	0.7	543	3.0	49	0.7	549	3.3	6	2.9
Cyprus	49	0.7	520	2.9	51	0.7	526	3.1	6	2.7
United States	51	0.6	536	2.3	49	0.6	543	2.6	7	1.9
Czech Republic	49	0.9	525	3.0	51	0.9	532	2.5	7	3.2
Korea	48	0.5	604	2.3	52	0.5	612	2.5	7	1.9
Netherlands	50	0.9	526	1.8	50	0.9	534	2.2	8	2.2
Australia	49	1.0	513	3.1	51	1.0	522	3.9	9	3.5
Canada	49	0.5	506	2.5	51	0.5	515	2.6	9	2.1
Hong Kong	46	1.5	609	3.8	54	1.5	619	2.8	10	3.3
Portugal	49	0.8	536	2.4	51	0.8	547	2.5	11	2.2
Slovak Republic	48	0.9	493	3.0	52	0.9	504	2.6	11	2.6
Spain	49	0.9	499	2.7	51	0.9	511	2.7	12	2.4
Croatia	49	0.8	496	2.1	51	0.8	508	2.3	12	2.7
Italy	49	0.7	497	2.7	51	0.7	517	3.0	20	2.7
International average	49	0.2	505	0.5	51	0.2	505	0.5		

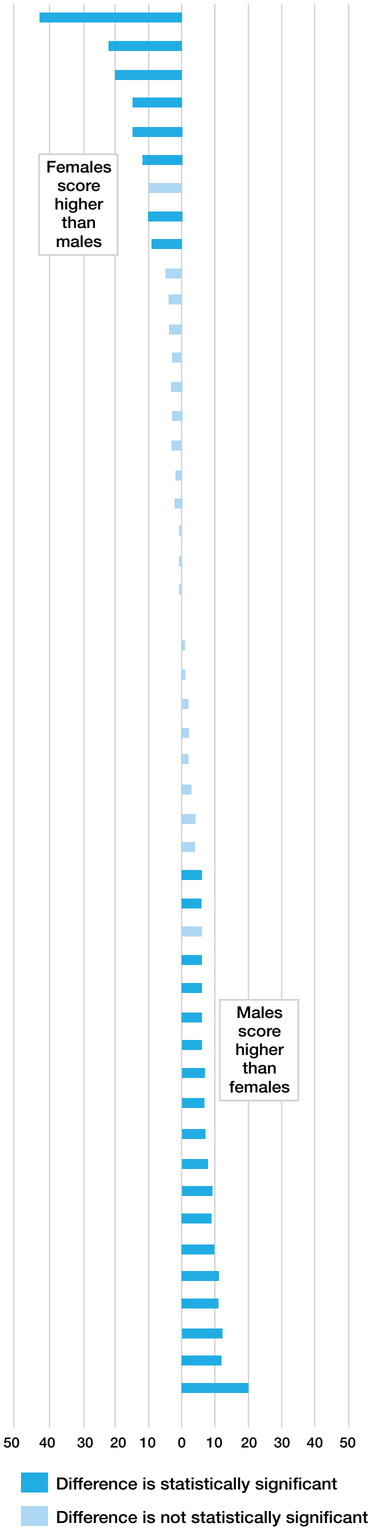
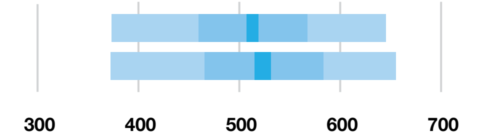


FIGURE 2.13 Sex differences in Year 4 mathematics achievement, by country

Figure 2.14 shows that there was a statistically significant difference in the average mathematics score of Australian male and female students. The range of scores was slightly greater for Australian Year 4 male students (280 points) than for Year 4 female students (270 points).

Sex	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Female	49	513	3.1	270	
Male	51	522	3.9	280	



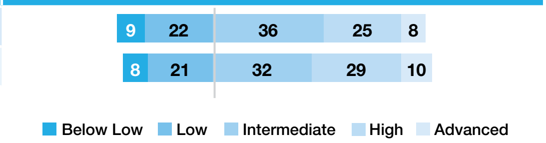
Note: See Reader's Guide for interpretation of graph.

FIGURE 2.14 Mean scores and distribution of Year 4 mathematics achievement within Australia, by sex

Performance at the international benchmarks by sex

Figure 2.15 shows that there is only a slight difference in the percentages of Australian male and female Year 4 students reaching the Advanced benchmark, and that the difference in the percentages of males and females below the Intermediate benchmark is also small (2% or less). However, the difference in favour of males appears to occur at the High benchmark, with 39 per cent of male students and only 33 per cent of female students achieving at or above this level.

Sex	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Female	69	1.5	
Male	71	1.8	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.15 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by sex

Trends in mathematics achievement by sex

Figure 2.16 provides a graphic representation of trends from 1995 to 2015 in the mathematics achievement of male and female Year 4 students in Australia. The 2015 result showed – for the first time since 1995 – a significant sex difference in Year 4 mathematics achievement in Australia.

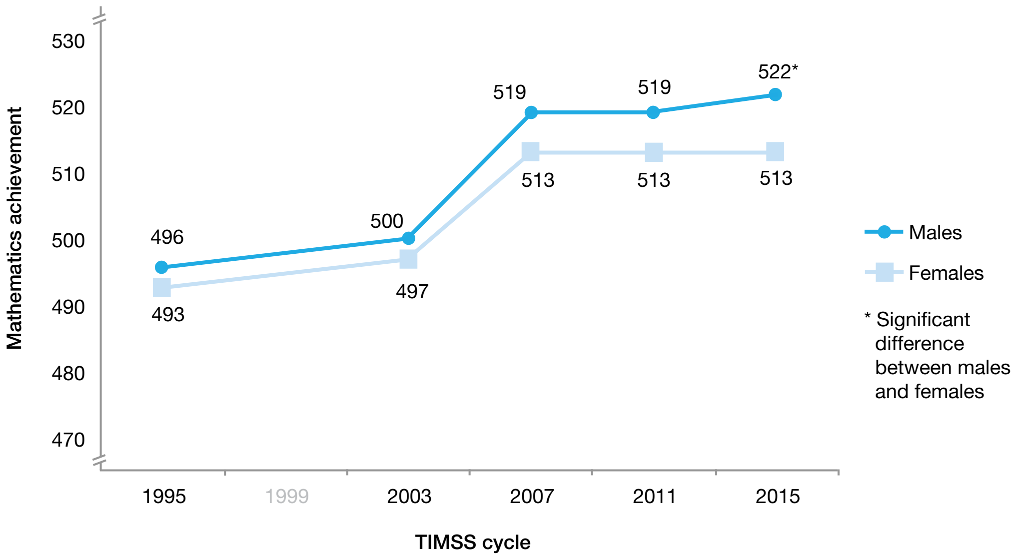


FIGURE 2.16 Trends in Year 4 mathematics achievement within Australia, 1995–2015, by sex

Sex difference in mathematics achievement by jurisdiction

Figure 2.17 shows the sex differences in Year 4 mathematics by jurisdiction. Differences between males and females were significant only in Victoria, South Australia and Queensland, each in favour of male students. In all other jurisdictions, the differences were not statistically significant (partly due to large standard errors).

Jurisdiction	Female		Male		Difference (absolute value)	SE
	Mean	SE	Mean	SE		
NT	469	15.6	465	15.1	4	15.1
NSW	520	7.0	518	9.6	1	7.7
TAS	510	10.7	516	10.8	7	9.7
QLD	505	5.4	517	6.6	12	5.1
ACT	536	7.6	550	10.0	14	9.8
SA	502	9.2	518	8.7	15	7.8
WA	504	8.9	520	11.1	16	8.5
VIC	516	7.0	533	5.6	17	6.4

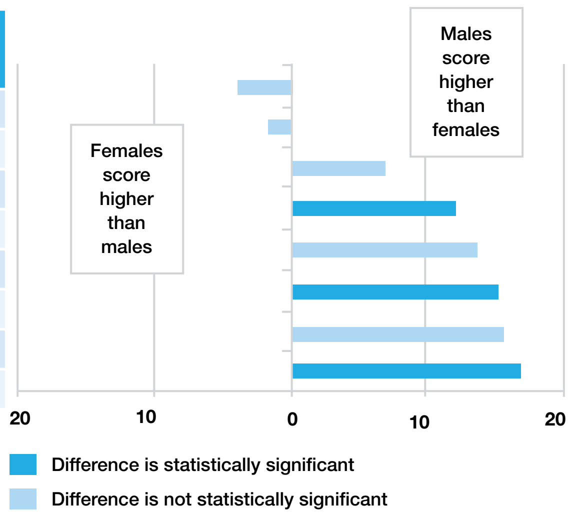
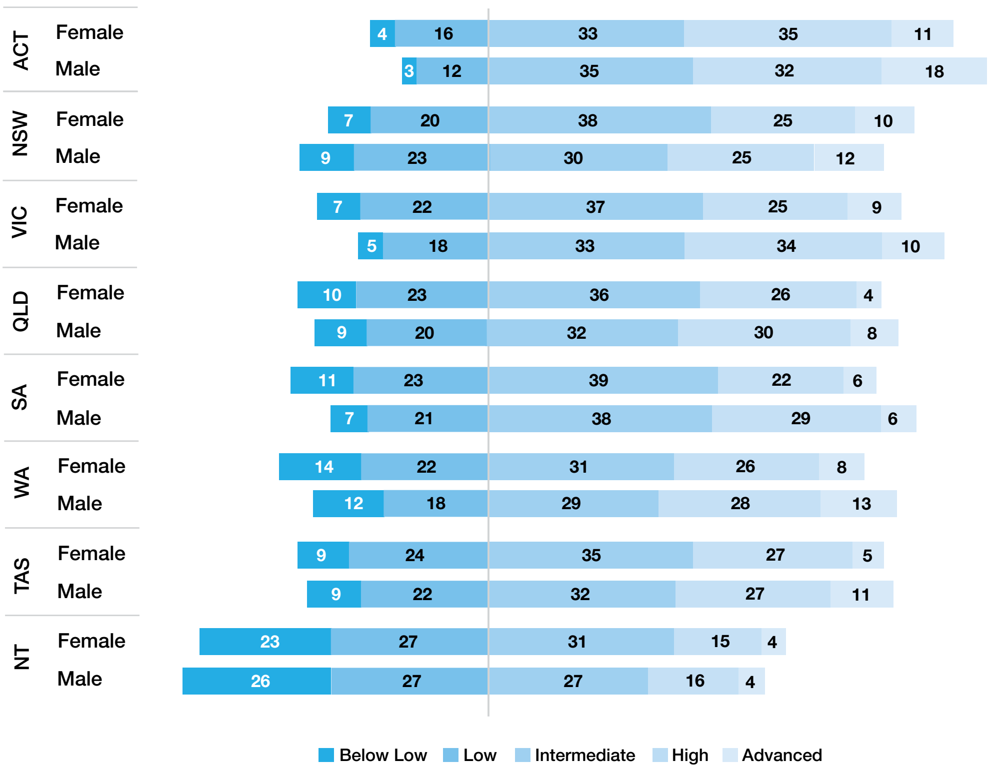


FIGURE 2.17 Sex differences in Year 4 mathematics achievement within Australia, by jurisdiction

Figure 2.18 shows the percentages of students at each of the international benchmarks in Year 4 mathematics in each jurisdiction, by sex. There was no significant difference in the percentages of males and females achieving the Intermediate benchmark (the proficient standard for Australia) in any jurisdiction. In terms of the percentages of students achieving the Advanced benchmark, only Queensland had a significant difference in favour of males (other jurisdictions had larger differences but also had larger standard errors, so the differences were not significant).



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.18 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by sex within jurisdiction

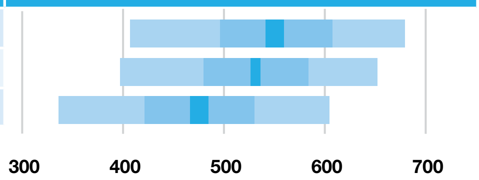
Year 4 mathematics achievement by books in the home

Socioeconomic status has been found (in TIMSS and other studies) to be related to achievement. In TIMSS, the number of books in the home is used as a proxy for socioeconomic status. This section presents Australian students' mathematics achievement according to the number of books in the home. For more information about this variable, please refer to the Reader's Guide.

As shown in Figure 2.19, the majority of Australian students (57%) reported having an *average number of books* and only 16 per cent reported having *many books* at home. Students who have *many books* in the home recorded the highest levels of mathematics achievement, scoring, on average, 19 score points higher than students with an *average number of books* in the home, and 74 score points higher than those with a *few books* in the home. This is consistent with previous cycles of TIMSS that have shown that students from homes with more literacy resources achieve, on average, at higher levels in mathematics than students from less well-resourced homes.

Figure 2.19 shows the substantial spread of scores in mathematics for students according to their report of the number of books in the home. The largest range between the 5th and 95th percentiles was for students in the group who reported having *many books* in the home (269 score points) and the smallest range was for those students with an *average number of books* (253 score points).

Number of books in the home	% of students	Mean	SE	Gap 95th–5th percentiles
Many books	16	548	4.4	269
Average number of books	57	529	2.6	253
A few books	26	474	4.4	264



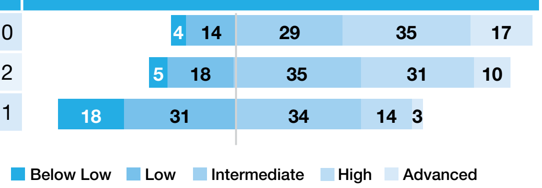
Note: See Reader's Guide for interpretation of graph.

FIGURE 2.19 Mean scores and distribution of Year 4 mathematics achievement within Australia, by number of books in the home

Percentages of students at each of the international benchmarks serve to indicate the capacities of students grouped according to number of books in the home. Figure 2.20 shows that of those students who reported having *many books* in the home, 17 per cent achieved the Advanced benchmark. The proportion achieving this highest benchmark falls to 10 per cent for students in the *average number of books* category and just three per cent for those with a *few books*.

However, the data also make it evident that there is no definitive relationship between performing at a high level of mathematical achievement and living in a home with *many books* (or by implication, in a home environment that values literacy, the acquisition of knowledge and general academic support). At the other end of the achievement scale, a total of 18 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark, with 14 per cent reaching only the Low benchmark and four per cent not achieving even this very basic level. However, the performance of these students is still substantially better than that of students with access to fewer resources. Of those students with an *average number of books* in the home, a total of 24 per cent did not achieve the Intermediate benchmark – comprising 18 per cent who achieved the Low benchmark and five per cent who did not achieve this level. Half of the students who reported having a *few books* in the home did not achieve the Intermediate benchmark, with 31 per cent of these achieving the Low benchmark and a further 18 per cent falling below the Low benchmark.

Number of books in the home	% of students at or above the proficient standard for Australia	SE
Many books	82	2.0
Average number of books	76	1.2
A few books	51	2.1



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.20 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by number of books in the home

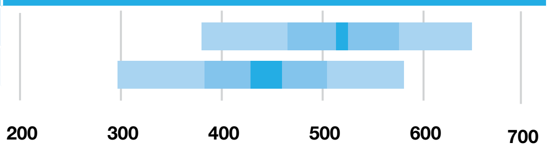
Year 4 mathematics achievement by Indigenous background

The education attainment of Australian Indigenous students in core subject areas such as mathematics is an important issue, and previous TIMSS studies have provided a picture of Indigenous achievement in this area. This section presents Australian students' mathematics achievement according to Indigenous status. For more information about this variable, please refer to the Reader's Guide.

As shown in Figure 2.21, four per cent of the TIMSS Year 4 sample identified as Indigenous. These students attained an average score of 446 score points in mathematics, which is 74 score points lower than the average score for non-Indigenous students of 520. The mean score for Indigenous students is lower than the Intermediate benchmark, while the average mathematics score of non-Indigenous students is approaching the High benchmark (set at 550 points).

Figure 2.21 also presents the distribution of Year 4 achievement scores for Indigenous and non-Indigenous students. The spread of scores between the 5th and 95th percentiles was slightly wider for Indigenous students, at 288 score points, compared to 270 for non-Indigenous students.

Indigenous background	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Non-Indigenous	96	520	2.9	270	
Indigenous	4	446	8.3	288	

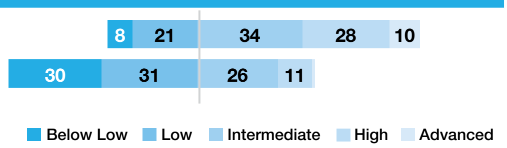


Note: See Reader's Guide for interpretation of graph.

FIGURE 2.21 Mean scores and distribution of Year 4 mathematics achievement within Australia, by Indigenous background

Figure 2.22 adds to the picture of performance by providing the percentages of Indigenous and non-Indigenous students at each of the international benchmarks. The differences are apparent at both ends of the distribution. Ten per cent of non-Indigenous students reached the Advanced benchmark compared to one per cent of Indigenous students. Of even greater concern is that 61 per cent of Indigenous students compared to 28 per cent of non-Indigenous students did not achieve the Intermediate benchmark, with 30 per cent of Indigenous students not reaching even the Low benchmark.

Indigenous background	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Non-Indigenous	72	1.3	
Indigenous	39	4.6	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.22 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by Indigenous background

Figure 2.23 shows trends in mathematics achievement at Year 4 by Indigenous background for TIMSS cycles from 1995 to 2015.

While there has been some change over time for Indigenous students, due to large standard errors, none of these changes have been significant. In comparison, the average score for non-Indigenous students has not changed for the past three cycles. From TIMSS 1995 the increase in the average score for non-Indigenous students has been 21 score points.

The gap in average mathematics performance of Indigenous and non-Indigenous Year 4 students has changed little over 20 years: from 69 score points in 1995 to 74 score points in 2015.

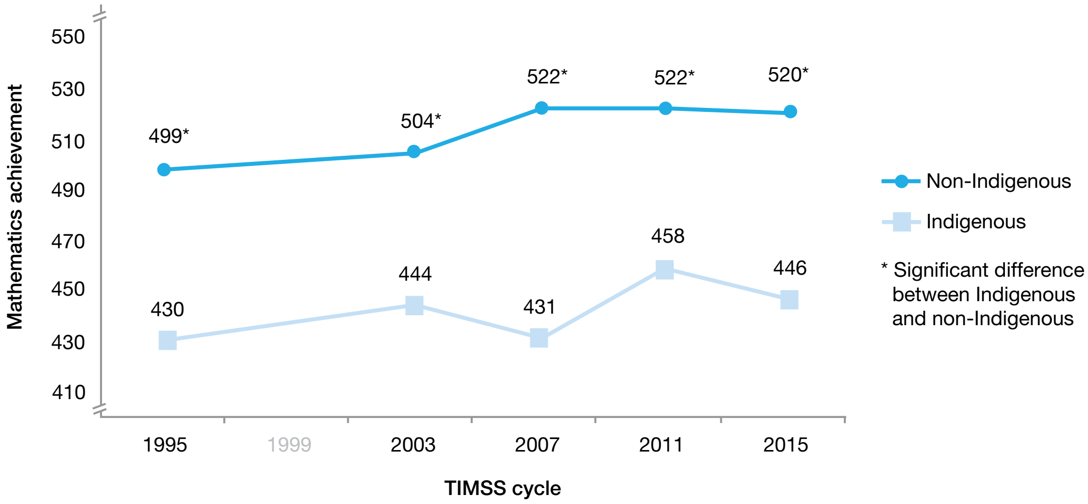


FIGURE 2.23 Trends in Year 4 mathematics achievement within Australia, 1995–2015, by Indigenous background

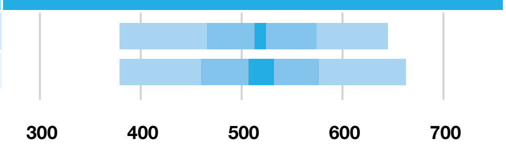
Year 4 mathematics achievement by language spoken at home

How often English is spoken at home is a factor that has been associated with Year 4 mathematics achievement in past cycles of TIMSS. Students who come from homes in which English is not spoken frequently have less exposure to the language of instruction and test, which could place them at a disadvantage. This section presents Australian students' mathematics achievement according to whether a language other than English is spoken as the main language at home. For more information about this variable, please refer to the Reader's Guide.

Figure 2.24 shows that 15 per cent of students in the TIMSS Year 4 sample indicated that they did not speak English at home 'always' or 'almost always'. There was no significant difference in the average score in Year 4 mathematics between those who spoke English at home and those who spoke a language other than English most of the time.

Figure 2.24 also shows the distribution of mathematics scores for students by their language background. The spread of scores between the 5th and 95th percentiles was larger for students who spoke a language other than English at home, with a range of 288 score points, compared to 271 score points for students who spoke mainly English at home.

Language spoken at home	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
English	85	518	3.1	271	
Other	15	518	6.6	288	



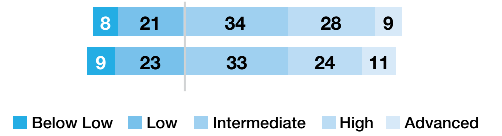
Note: See Reader's Guide for interpretation of graph.

FIGURE 2.24 Mean scores and distribution of Year 4 mathematics achievement within Australia, by language spoken at home

Figure 2.25 shows the percentages of students achieving at each of the international benchmarks according to the language spoken at home. At the top end of achievement, nine per cent of students who spoke mainly English at home, and 11 per cent of students who spoke a language other than English at home, achieved the Advanced benchmark. At the lower levels of achievement, 29 per cent of students who spoke English at home compared to 31 per cent who spoke a language other than English at home did not achieve the Intermediate benchmark, which is the proficient standard for Australia.

Language spoken at home	% of students at or above the proficient standard for Australia	SE
English	71	1.4
Other	69	3.1

Performance at each of the TIMSS international benchmarks



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.25 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by language spoken at home

Year 4 mathematics achievement by geographic location of the school

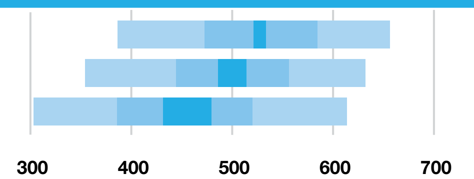
Past cycles of TIMSS have found that students attending schools in remote or regional areas of Australia are often at an educational disadvantage compared to students attending metropolitan schools. This section presents Australian students' mathematics achievement according to the geographic location of the school. For more information about this variable, please refer to the Reader's Guide.

As shown in Figure 2.26, students attending school in remote areas make up only one per cent of the Year 4 TIMSS sample, while those attending school in metropolitan areas make up 69 per cent of the sample. Students attending schools in metropolitan areas scored, on average, 29 score points higher than students attending schools in provincial areas, and 70 score points, on average, higher than students attending schools in remote areas. Students attending schools in provincial areas scored, on average, 41 score points higher than students attending schools in remote areas. All these differences are statistically significant.

Figure 2.26 also provides the spread of scores in mathematics achievement for Year 4 students according to the geographic location of the school. The range of scores from the 5th to 95th percentiles was larger for provincial than metropolitan schools (274 and 267 score points, respectively). The spread for remote schools was substantially larger again, at 310 score points.

Geographic location	% of students	Mean	SE	Gap 95th–5th percentiles
Metropolitan	69	526	3.2	267
Provincial	30	498	7.0	274
Remote	1	456	12.5	310

Mathematics achievement distribution



Note: See Reader's Guide for interpretation of graph.

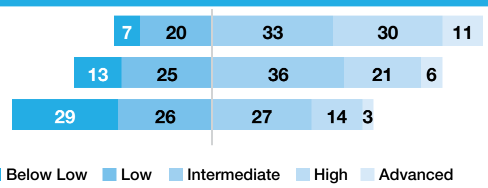
FIGURE 2.26 Mean scores and distribution of Year 4 mathematics achievement within Australia, by geographic location

Figure 2.27 shows the percentages of Year 4 students at each of the international benchmarks in mathematics, by geographic location. Fifty-six per cent of students in remote schools did not reach the Intermediate benchmark, which is the proficient standard for Australia. Twenty-nine per cent of these students performed below the Low benchmark. In contrast, only 13 per cent of students from provincial schools and seven per cent from metropolitan schools were performing at a level below that of the Low international benchmark.

The difference in achievement is also evident at the higher end of the achievement spectrum. Only three per cent of students in remote schools achieved at the Advanced benchmark, compared to six per cent from provincial schools and 11 per cent from metropolitan schools. The proportion of students from remote schools who attained the Intermediate benchmark was 44 per cent, compared to 74 and 63 per cent of students from metropolitan and provincial schools, respectively.

Geographic location	% of students at or above the proficient standard for Australia	SE
Metropolitan	74	1.4
Provincial	63	3.2
Remote	44	5.7

Performance at each of the TIMSS international benchmarks



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 2.27 Percentages of Australian students at the international benchmarks for Year 4 mathematics, by geographic location

This chapter so far has reported on achievement on the TIMSS Year 4 mathematics scale, examining achievement in terms of jurisdiction, sex, number of books in the home, Indigenous background, language spoken at home and geographic location of the school. The next section of this chapter examines achievement in the Year 4 mathematics content and cognitive domains.

Achievement in the TIMSS mathematics content and cognitive domains

As noted earlier in the chapter, the TIMSS mathematics assessment can be described in terms of content and cognitive domains. The content domains outline the subject matter to be assessed and include *number*, *geometric shapes and measures* and *data display* at Year 4. The cognitive domains detail the thinking processes that students will need to use. The cognitive domains are *knowing*, *applying* and *reasoning*. Each item is associated with a single content domain and a single cognitive domain. This allows student performance to be described in terms of achievement in each of the domains.

To allow comparisons of student achievement across the domains, the content and cognitive achievement scales at each year level were constructed to have the same average level of difficulty. The following tables present the average achievement in each of the Year 4 mathematics content and cognitive domains for Australia as a whole, for each of the Australian jurisdictions, for males and females, and for Indigenous and non-Indigenous students, as well as showing trends for Australia in the content and cognitive domains since 2007.

Mathematics content domains

Table 2.6 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 4 achievement in the mathematics content domains.

Australian Year 4 students scored significantly higher than the overall mathematics score in *data display* and *geometric shapes and measures* but were weaker in *number*.

This pattern was found for all jurisdictions and for both males and females.

At Year 4 level, there were no statistically significant differences between males and females in *data display* or *geometric shapes and measures*. However, in *number* males performed significantly higher than females.

The results recorded by Indigenous students across the domains indicate that while the pattern of performance is the same as for the whole of Australia, Indigenous students – unlike their non-Indigenous peers – do not show a significant difference in performance between their mathematics overall score and their score for *data display* or *geometric shapes and measures.* This is due to large standard errors.

TABLE 2.6 Relative mean achievement in the Year 4 mathematics content domains, for Australia and by jurisdiction, sex and Indigenous background

	Mathematics overall		*Number*		Differences between mathematics overall and *number*		*Geometric shapes and measures*		Differences between mathematics overall and *geometric shapes and measures*		*Data display*		Differences between mathematics overall and *data display*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	517	3.1	509	3.1	**-8**	**0.7**	527	3.3	**10**	**1.6**	533	3.6	**15**	**2.2**
ACT	544	7.9	536	8.8	**-8**	**2.9**	553	9.1	**10**	**3.3**	557	7.6	**13**	**5.1**
NSW	519	7.5	510	7.6	**-9**	**1.5**	531	7.5	**12**	**2.3**	535	8.0	**16**	**2.4**
VIC	525	5.5	518	5.7	**-7**	**2.0**	534	5.7	**9**	**2.9**	542	5.6	**16**	**3.8**
QLD	511	5.6	503	5.9	**-9**	**1.7**	521	6.1	**10**	**2.4**	527	6.2	**16**	**3.9**
SA	510	7.9	498	8.5	**-12**	**2.2**	517	8.8	**7**	**3.5**	521	8.0	**12**	**3.9**
WA	512	9.1	504	9.7	**-7**	**2.6**	520	9.8	**8**	**3.4**	524	8.8	**12**	**3.7**
TAS	513	9.6	503	10.3	**-9**	**2.4**	520	10.6	**7**	**2.6**	532	10.1	**19**	**4.1**
NT	467	13.3	457	14.2	**-10**	**4.8**	475	14.1	**8**	**3.8**	482	13.6	**15**	**7.1**
Female	513	3.1	503	3.3	**-10**	**1.5**	523	3.7	**11**	**2.1**	530	4.6	**18**	**3.5**
Male	522	3.9	515	4.2	**-7**	**1.4**	531	3.8	**9**	**1.7**	535	5.6	**13**	**4.3**
Non-Indigenous	520	2.9	512	3.0	**-8**	**0.7**	531	3.2	**10**	**1.6**	536	3.4	**15**	**2.0**
Indigenous	446	8.3	436	8.7	**-10**	**4.3**	452	9.3	6	5.8	463	11.0	17	8.8

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 2.7 shows the trends in achievement for the content domains for Australia as a whole. There was no significant change over time for either *number* or *geometric shapes and measures.* However, *data display* showed a significant decline between 2007 and 2011, followed by an equal recovery in 2015, so that there was essentially no overall change from 2007 to 2015.

TABLE 2.7 Trends in mean achievement in the Year 4 mathematics content domains, for Australia

	Number				*Geometric shapes and measures*				*Data display*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	509	3.1	1	6	527	3.3	-7	-9	533	3.6	17 ↑	0
2011	508	3.2		5	534	3.0		-3	515	3.1		-17 ↓
2007	503	3.6			536	3.6			532	4.3		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Mathematics cognitive domains

Table 2.8 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 4 achievement in the mathematics cognitive domains.

Australian Year 4 students scored significantly higher than the overall mathematics score in *applying* and *reasoning* but were weaker in *knowing*.

The best-performing jurisdiction, the Australian Capital Territory, recorded no significant difference between the three cognitive domains and mathematics overall. In contrast, Queensland and the Northern Territory reported significant differences between mathematics overall and all three cognitive domains. Students in Victoria, Tasmania and New South Wales displayed a relatively weak performance in *knowing* (compared to mathematics overall). Students in Victoria and Tasmania performed relatively strongly in *reasoning* but showed no significant difference in performance for *applying*, whereas for students in New South Wales, *applying* was a strength but their performance for *reasoning* did not differ significantly from mathematics overall. In South Australia and Western Australia there was no significant difference between results for *applying* and *reasoning* and for mathematics overall, but the performance of students in these states was relatively weak for *knowing*.

There was a statistically significant difference in favour of males for both *knowing* and *applying*; however, the difference between males and females was not significantly different for *reasoning*.

The results recorded by Indigenous students across the domains indicate that while the pattern of performance is the same as for the whole of Australia, Indigenous students – unlike their non-Indigenous peers – do not show a significant difference in performance between their mathematics overall score and their score for *applying* or *reasoning*. This is due to large standard errors. Interestingly, in terms of magnitude of the difference from mathematics overall, Indigenous students display a greater weakness in *knowing* than do non-Indigenous students.

TABLE 2.8 Relative mean achievement in the Year 4 mathematics cognitive domains, for Australia and by jurisdiction, sex and Indigenous background

	Mathematics overall		*Knowing*		Differences between mathematics overall and *knowing*		*Applying*		Differences between mathematics overall and *applying*		*Reasoning*		Differences between mathematics overall and *reasoning*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	517	3.1	509	3.5	**-8**	**1.6**	521	3.0	**4**	**1.2**	524	3.0	**6**	**1.7**
ACT	544	7.9	537	9.2	-7	4.1	545	8.1	1	2.5	546	8.3	3	4.2
NSW	519	7.5	511	7.9	**-8**	**2.5**	524	6.8	**6**	**2.0**	524	6.8	5	3.1
VIC	525	5.5	519	6.5	**-7**	**3.2**	528	5.4	3	2.7	533	5.4	**7**	**3.1**
QLD	511	5.6	502	6.3	**-10**	**2.2**	515	5.7	**4**	**1.9**	519	5.7	**7**	**2.7**
SA	510	7.9	497	9.1	**-13**	**2.4**	511	7.9	1	2.4	515	8.0	6	3.5
WA	512	9.1	504	10.4	**-8**	**3.5**	516	9.0	4	3.2	516	8.6	4	3.0
TAS	513	9.6	501	10.9	**-12**	**3.1**	517	9.6	4	3.1	524	10.0	**11**	**4.0**
NT	467	13.3	456	15.1	**-11**	**4.6**	474	13.0	**7**	**3.1**	480	12.8	**12**	**4.4**
Female	513	3.1	503	3.5	**-10**	**1.7**	516	3.5	**4**	**1.8**	519	3.5	**6**	**2.3**
Male	522	3.9	515	4.7	**-7**	**2.4**	526	3.5	**4**	**1.2**	528	3.8	**6**	**1.8**
Non-Indigenous	520	2.9	513	3.3	**-8**	**1.4**	524	2.9	**4**	**1.2**	526	2.9	**6**	**1.6**
Indigenous	446	8.3	428	10.1	**-18**	**7.4**	452	9.3	6	6.5	458	9.0	12	7.4

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 2.9 shows the trends in achievement for the cognitive domains for Australia as a whole. The only significant change over time was an increase in *reasoning* performance, of 10 score points, since 2011.

TABLE 2.9 Trends in mean achievement in the Year 4 mathematics cognitive domains, for Australia

	Knowing				*Applying*				*Reasoning*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	509	3.5	-7	-2	521	3.0	2	-1	523	3.0	10 ↑	7
2011	516	3.4		5	519	3.0		-3	513	2.7		-3
2007	511	4.1			522	3.6			516	3.7		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Chapter 3

Year 8 mathematics

Key findings

- With an average score of 505 score points on the TIMSS Year 8 mathematics scale, Australian students significantly outperformed students in 21 other countries, such as Italy, New Zealand and Malaysia.
- However, Australian Year 8 students were outperformed by students in 12 other countries, including Canada, Ireland, England and the United States, as well as the top five countries from Asia – Singapore, Korea, Chinese Taipei, Hong Kong and Japan.
- Australia's result dipped in TIMSS 2007 and was followed by a recovery in TIMSS 2011. Australia's 2015 Year 8 mathematics score is not significantly different from the corresponding score in 1995.
- Seven per cent of Australian Year 8 students achieved the Advanced international benchmark in mathematics – compared to more than one-third of students in the top five countries and 54 per cent of students in Singapore.
- Sixty-four per cent of Australian Year 8 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 8 students scored significantly higher than the overall mathematics score in *data and chance* and *number* but were weaker in *algebra* and *geometry*.
- Australian Year 8 students performed at a level that was statistically similar to the overall mathematics score in *knowing*, but were weaker in *applying* and stronger in *reasoning*.
- Students in Victoria and the Australian Capital Territory significantly outperformed students in Queensland, Tasmania and the Northern Territory, but their results were not significantly different to those of students in Western Australia, New South Wales and South Australia. The average scores for Western Australia, New South Wales, South Australia, Queensland and Tasmania were not significantly different to each other but were significantly higher than that of the Northern Territory.
- There was no significant difference between Australian male and female students in Year 8 mathematics achievement.
- Students who have *many books* in the home were found to score 26 score points higher than students with an *average number of books* in the home, and 73 score points higher than those who reported having a *few books* in the home.

- Fifty-nine per cent of students whose parents did not complete secondary school did not reach the Intermediate international benchmark, compared to 18 per cent of students with at least one parent holding a university degree.
- Fifteen per cent of students with *many educational resources* at home achieved the Advanced international benchmark, compared to five per cent of those with *some resources* and three per cent of students with only a *few educational resources*.
- Sixty-eight per cent of Indigenous students compared to 34 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- There were no significant differences in mean achievement between students who speak mainly English at home and those that speak a language other than English at home. However, 17 per cent of students who speak a language other than English at home achieved the Advanced international benchmark, compared to six per cent of students who speak mainly English at home.
- Fifty-nine per cent of students in remote schools, compared to 40 per cent of provincial students and 34 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

This chapter presents the TIMSS 2015 international and national results for mathematics at Year 8 level. The first section provides a summary of the TIMSS 2015 mathematics framework at Year 8, along with a description of the international benchmarks for Year 8 mathematics. The second section examines the performance of Australian Year 8 students in mathematics in the international context. Turning the focus to domestic outcomes, the third section looks at Year 8 mathematics performance across the Australian educational jurisdictions and the fourth provides the results for demographic groups within Australia. The final section looks at the results for the content and cognitive domains for Year 8 mathematics.

The TIMSS 2015 mathematics framework

Mullis and Martin (2013) contend that all children can benefit from studying and developing strong skills in mathematics, as mathematics is essential in daily life. Learning mathematics improves problem solving, and working through problems can teach persistence and perseverance. In TIMSS, students' mathematical understanding is assessed by having participating students read selected questions and stimulus materials and respond to a variety of questions.

The TIMSS 2015 mathematics framework is organised around two dimensions – a content dimension, which specifies the subject matter to be assessed within mathematics (e.g. *number*, *algebra* etc.) and the cognitive dimension, which specifies the thinking processes and sets of behaviours expected of students as they engage with the mathematics content.

Mathematics content and cognitive domains

In the TIMSS 2015 mathematics framework for Year 8 students, four content domains are defined:

- *number*
- *algebra*
- *geometry*
- *data and chance*.

Each of these content domains has several topic areas. For example, the domain *number* includes whole numbers; fractions, decimals and integers; and ratio, proportion and per cent. These topic areas are shown in Table 3.1.

For a detailed description of each of the content domains in mathematics, please refer to Mullis and Martin (2013).

TABLE 3.1 TIMSS Year 8 mathematics content domains and percentage of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Number	Whole numbers Fractions, decimals and integers Ratio, proportion and per cent	30
Algebra	Expressions and operations Equations and inequalities Relationships and functions	30
Geometry	Geometric shapes Geometric measurement Location and movement	20
Data and chance	Characteristics of data sets Data interpretation Chance	20

To respond correctly to TIMSS test items, students need to be familiar with the mathematics content of the items. Just as importantly, however, items were designed to elicit the use of particular cognitive skills. The TIMSS 2015 assessment framework presents detailed descriptions of the skills and abilities that make up the cognitive domains and that are assessed in conjunction with the content. The student behaviours encompassed by the cognitive dimension have been classified into three domains within the assessment framework.

The three domains can be described as follows:

- *knowing* – which covers the facts, procedures and concepts students need to know
- *applying* – which focuses on the ability of students to apply knowledge and conceptual understanding to solve problems or answer questions
- *reasoning* – which goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts and multi-step problems.

Table 3.2 shows the percentage of assessment devoted to each cognitive domain at Year 8. These three cognitive domains are used for both Year 4 and Year 8, but the balance of testing time differs in these two year levels, reflecting the difference in age and experience of the students tested. In TIMSS 2015, each content domain included items developed to address each of the three cognitive domains; for example, the *number* domain included *knowing*, *applying* and *reasoning* items, as did the other content domains.

TABLE 3.2 TIMSS Year 8 mathematics cognitive domains and percentage of assessment for each domain

Cognitive domains	Target % of TIMSS assessment
Knowing	35
Applying	40
Reasoning	25

The TIMSS international benchmarks

The TIMSS mathematics achievement scale summarises Year 8 students' performance when interacting with a variety of mathematical tasks and questions (please see the Reader's Guide for more information about the achievement scales). Students' achievement is based on their responses to test questions designed to assess a range of content areas. When comparing groups of students across and within countries, summary statistics such as the average, or mean, scale score are often used. This score, however, does not provide detailed information as to what types of mathematical tasks the students were able to undertake successfully. Instead, to provide descriptions of achievement on the scale in relation to performance on the questions asked, TIMSS uses points on the scale as international benchmarks.

Internationally, it was decided that performance should be measured at four levels. These four levels summarise the achievement reached by:

- the 'Advanced international benchmark', which was set at 625
- the 'High international benchmark', which was set at 550
- the 'Intermediate international benchmark', which was set at 475
- the 'Low international benchmark', which was set at 400.

The descriptions of the levels are cumulative, so that a student who reached the High benchmark can typically demonstrate the knowledge and skills for both the Intermediate and the Low benchmarks. Table 3.3 provides a summary of the TIMSS 2015 Year 8 mathematics benchmarks.

TABLE 3.3 The TIMSS 2015 international benchmarks for Year 8 mathematics

625	**Advanced international benchmark** *Students can apply and reason in a variety of problem situations, solve linear equations and make generalisations.* They can solve a variety of fraction, proportion and per cent problems, and justify their conclusions. Students can use their knowledge of geometric figures to solve a wide range of problems about area. They demonstrate understanding of the meaning of averages and can solve problems involving expected values.
550	**High international benchmark** *Students can apply their understanding and knowledge in a variety of relatively complex situations.* They can use information to solve problems involving different types of numbers and operations. They can relate fractions, decimals and percentages to each other. Students at this level show basic procedural knowledge related to algebraic expressions. They can solve a variety of problems with angles, including those involving triangles, parallel lines, rectangles and similar figures. Students can interpret data in a variety of graphs and solve simple problems involving outcomes and probabilities.
475	**Intermediate international benchmark** *Students can apply basic mathematical knowledge in a variety of situations.* They can solve problems involving negative numbers, decimals, percentages and proportions. Students have some knowledge of linear expressions and two- and three-dimensional shapes. They can read and interpret data in graphs and tables. They have some basic knowledge of chance.
400	**Low international benchmark** *Students have some knowledge of whole numbers and basic graphs.* There were too few items at this level to enable a description.

At Year 8, students at the Advanced benchmark are able to apply and reason in a variety of problem situations, solve linear equations and make generalisations. In the example shown in Figure 3.1, from the content domain *data and chance*, students are asked to show their understanding of finding an average number to solve a problem. Internationally, 25 per cent of students on average across all countries answered this correctly. The percentage of Australian students who obtained full credit for this item was 23 per cent, which was not significantly different to the international average.

Ahmed had the following scores out of 10 on his first 4 mathematics tests: 9, 7, 8, 8. Ahmed has 1 more test with a maximum of 10 points and says he wants to get an overall average of 9. Is it possible for him to do this?

Explain your answer.

No, Ahmed would have to score 13 to do this.

FIGURE 3.1 Advanced international benchmark, Year 8 mathematics – example item

In contrast, students at the Low benchmark have an elementary knowledge of whole numbers and can match tables to bar graphs and pictographs. In the example shown in Figure 3.2, from the content domain *number*, students are asked to show their understanding of whole numbers and evaluate the power of a given number. This item was relatively easy for students in most countries, with 70 per cent of students internationally answering correctly. In Australia, 66 per cent of students answered this question correctly, which is significantly below the international average.

What is the value of 3^3?

(A) 6

(B) 9

● 27

(D) 33

FIGURE 3.2 Low international benchmark, Year 8 mathematics – example item

Further information about the types of mathematics skills and strategies demonstrated by Year 8 students who performed at each of the international benchmarks, along with examples of the types of responses given by students at each of the benchmarks, is provided in the *TIMSS 2015 International Results in Mathematics* (http://timss2015.org/timss-2015/mathematics/performance-at-international-benchmarks/).

Chapter 3

Australia's Year 8 mathematics results within the international context

This section reports the TIMSS 2015 mathematics results as average scores and distributions on the TIMSS Year 8 mathematics scale (please see the Reader's Guide for more information about the achievement scales).

Figure 3.3 provides a summary of the overall performance of students in Year 8 across different countries on the TIMSS 2015 mathematics achievement scale, in terms of the mean scores achieved by students in each country, the standard error of each mean, and the range of scores achieved between the 5th and 95th percentiles.

Countries are positioned in Figure 3.3 according to decreasing level of achievement; however, this should not be interpreted as a simple ranking, as the differences between countries may not be statistically significant. The shading in this figure indicates whether the score for a given country is significantly different to that of Australia. To determine whether or not differences between other countries are statistically significant, please refer to the multiple-comparisons tables available in the *TIMSS 2015 International Results in Mathematics* (http://timss2015.org/timss-2015/mathematics/student-achievement/multiple-comparisons-of-mathematics-achievement/).

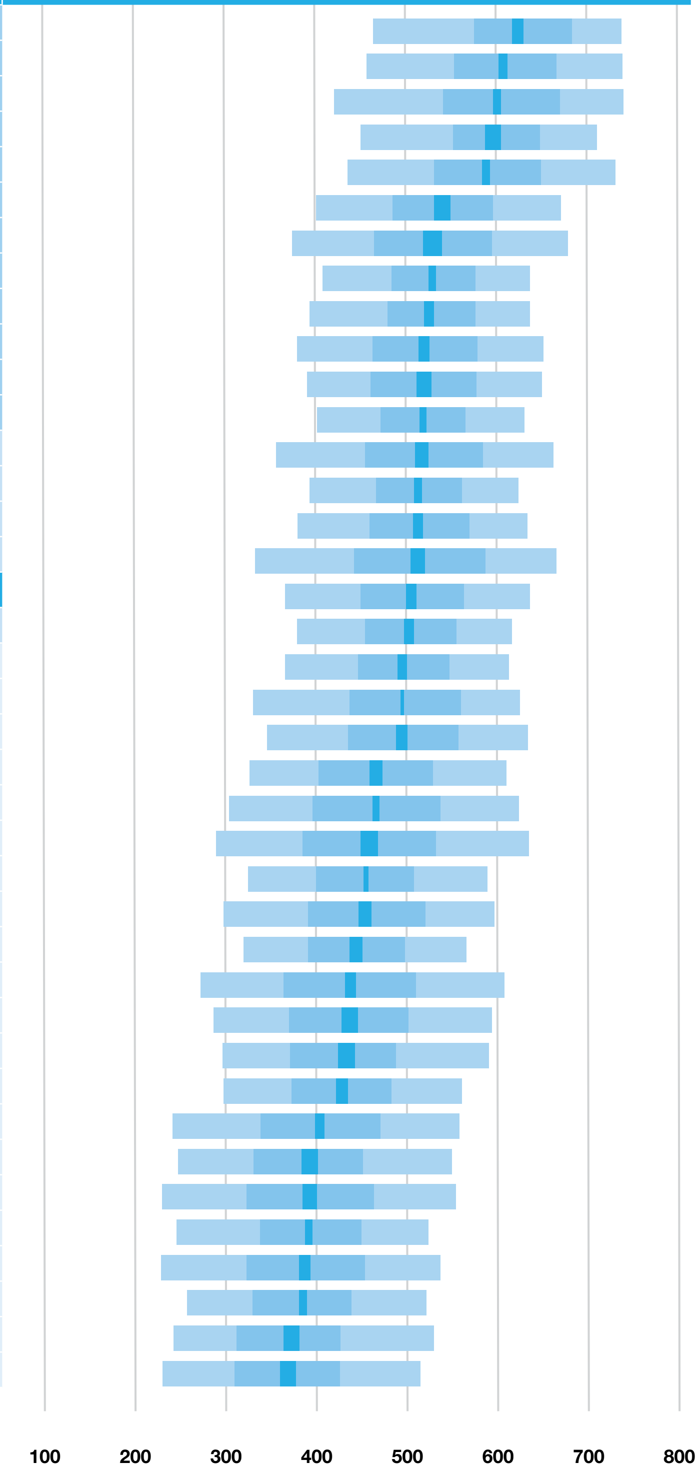
The results in Figure 3.3 show that Singapore, Korea, Chinese Taipei, Hong Kong and Japan, which are also the countries with the highest average mathematics achievement at Year 4, have the highest achievement at Year 8, with average achievement above the High benchmark of 550. Singapore's score of 621 is significantly higher than that of all other countries, followed by Korea (606) and Chinese Taipei (599), whose scores were not significantly different to each other but were significantly higher than those of all other countries.

In TIMSS 2015, Australian Year 8 students attained an average mathematics score of 505 score points, which places Australia on average at the Intermediate benchmark. Australia was significantly outperformed by 12 countries, including Canada, Ireland, England and the United States, as well as the top five East Asian countries mentioned above and the Russian Federation, Kazakhstan and Slovenia. Australia's performance was not significantly different to that of five countries, including Sweden, which Australia outperformed in 2011. Australia significantly outperformed 21 other countries, including Italy, New Zealand and Malaysia.

Figure 3.3 also shows the range of achievement within countries. Canada and Slovenia, both relatively high-achieving countries, had the smallest gap between high and low achievers (229 score points), while Turkey had the largest gap (345 score points). Australia's gap – about mid-range at 272 score points – was similar to that of Singapore and the United States.

	Country	Mean	SE	Gap 95th–5th percentiles
Achievement significantly higher than Australia's	Singapore	621	3.2	273
	Korea	606	2.6	283
	Chinese Taipei	599	2.4	320
	Hong Kong	594	4.6	262
	Japan	586	2.3	295
	Russian Federation	538	4.7	270
	Kazakhstan	528	5.3	304
	Canada	527	2.2	229
	Ireland	523	2.7	242
	United States	518	3.1	273
	England	518	4.2	260
	Slovenia	516	2.1	229
Achievement not different to Australia's	Hungary	514	3.8	305
	Norway (9)	512	2.3	230
	Lithuania	511	2.8	253
	Israel	511	4.1	332
	Australia	505	3.1	272
	Sweden	501	2.8	235
Achievement significantly lower than Australia's	Italy	494	2.5	247
	Malta	494	1.0	293
	New Zealand	493	3.4	288
	Malaysia	465	3.6	283
	United Arab Emirates	465	2.0	320
	Turkey	458	4.7	345
	Bahrain	454	1.4	264
	Georgia	453	3.4	299
	Lebanon	442	3.6	246
	Qatar	437	3.0	335
	Iran	436	4.6	308
	Thailand	431	4.8	294
	Chile	427	3.2	263
	Oman	403	2.4	316
	Kuwait	392	4.6	303
	Egypt	392	4.1	324
	Botswana (9)	391	2.0	278
	Jordan	386	3.2	307
	Morocco	384	2.3	265
	South Africa (9)	372	4.5	287
	Saudi Arabia	368	4.6	284

Mathematics achievement distribution



Note: See Reader's Guide for interpretation of graph.

FIGURE 3.3 Mean scores and distribution of Year 8 mathematics achievement, by country

Performance at the international benchmarks

In addition to analysing performance according to mean scores, it is beneficial to use the international benchmarks described previously to gain further insight into student achievement. Figure 3.4 shows the percentage of students in each country at each of the international benchmarks.

The countries are ordered by the percentages of students reaching the Intermediate international benchmark, which is the proficient standard set for TIMSS mathematics in Australia (please see the Reader's Guide for more information about the proficient standard).

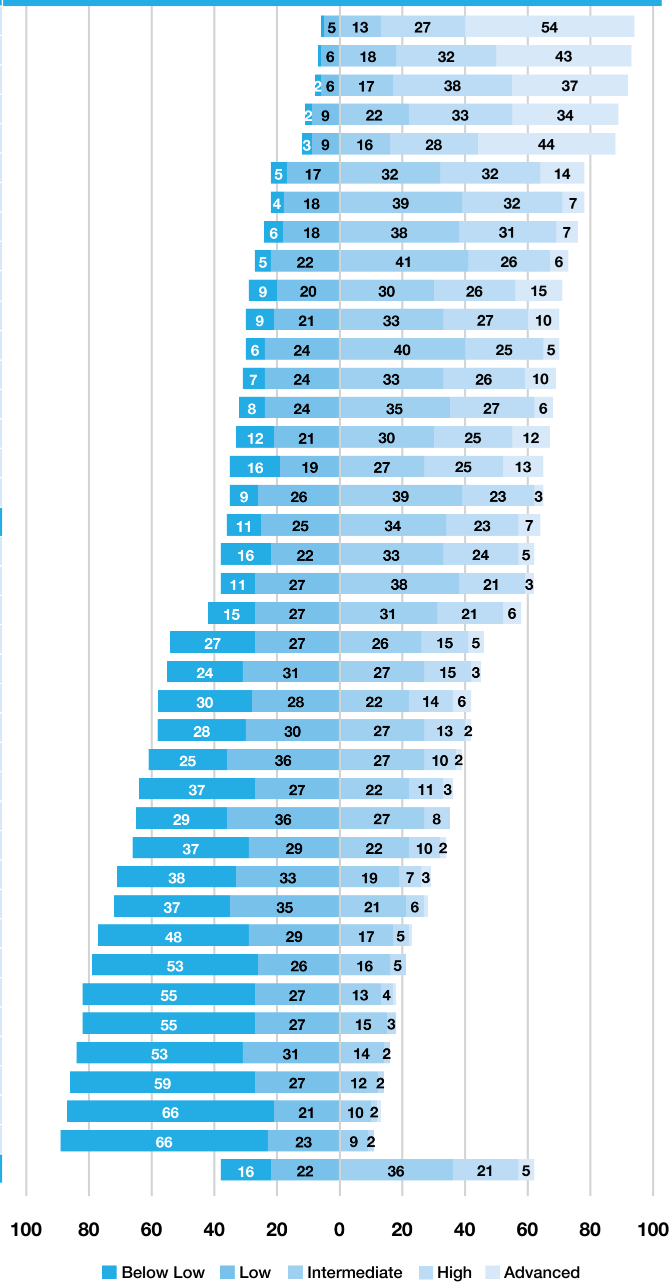
As would be expected, given their high average achievement, the East Asian countries of Singapore, Chinese Taipei, Korea, Hong Kong and Japan have an impressive percentage of Year 8 students reaching the Advanced benchmark. In the top five countries, over one-third of Year 8 students achieved the Advanced benchmark, with over 50 per cent of Year 8 students in Singapore doing so. Kazakhstan (15%), the Russian Federation (14%), Israel (13%) and Hungary (12%) were the next best at reaching the Advanced benchmark, while 10 per cent of students in England and the United States achieved this standard. In all other countries, including Australia, the percentage of Year 8 students reaching the Advanced benchmark in mathematics was seven per cent or less. The international median was five per cent of students attaining this level.

Figure 3.4 also provides useful information about the distribution of achievement in the TIMSS countries. For example, some countries such as Turkey are doing reasonably well at the high end of achievement, with six per cent of students attaining the Advanced benchmark, but not so well at the low end, with 70 per cent of students reaching only the Low benchmark. In comparison, Italy and Sweden had only three per cent of students achieving the Advanced benchmark, but nearly all students (around 90%) achieving the Low benchmark. In Australia, 89 per cent of students achieved the Low benchmark; however, 36 per cent failed to achieve the Intermediate benchmark and thus the proficient standard for Australia.

The percentage of Australian Year 8 students achieving at each of the international benchmarks is similar to that of the international median.

Country	% of students at or above the proficient standard for Australia	SE
Singapore	94	0.9
Korea	93	0.5
Hong Kong	92	1.3
Japan	89	0.7
Chinese Taipei	88	0.6
Russian Federation	78	1.9
Canada	78	1.1
Ireland	76	1.3
Slovenia	73	1.2
Kazakhstan	71	2.1
United States	70	1.4
Norway (9)	70	1.3
England	69	2.4
Lithuania	68	1.4
Hungary	67	1.7
Israel	65	1.7
Sweden	65	1.6
Australia	64	1.6
Malta	62	0.7
Italy	62	1.7
New Zealand	58	1.5
United Arab Emirates	46	1.0
Malaysia	45	1.9
Turkey	42	1.9
Georgia	42	1.7
Bahrain	39	0.8
Qatar	36	1.2
Lebanon	35	1.9
Iran	34	1.9
Thailand	29	2.2
Chile	28	1.3
Oman	23	0.9
Egypt	21	1.4
Kuwait	18	1.9
Jordan	18	1.0
Botswana (9)	16	0.8
Morocco	14	0.7
South Africa (9)	13	1.7
Saudi Arabia	11	1.3
International median	62	

Performance at each of the TIMSS international benchmarks



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.4 Percentages of students at the international benchmarks for Year 8 mathematics, by country

Trends in Year 8 mathematics achievement

Looking at the overall trends in Year 8 mathematics achievement during the 1995–2015 period, there have been more countries with increases than with decreases. Of the 16 participating countries with data spanning this period, nine countries had increases in average mathematics achievement, three countries had decreases and four countries had no difference. Lithuania had the greatest improvement from 1995 to 2015, with an increase in average mathematics achievement of 41 score points.

Figure 3.5 shows trends in Year 8 mathematics achievement for some selected countries that have comparable data from previous TIMSS assessments. Rather than include graphs showing changes for all countries, we have provided just a few, for interest and comparison. The countries that have been included are those with which we usually make comparisons: the United States, England and New Zealand, along with one of the higher-achieving countries, Singapore, and Slovenia, which showed consistent change over this time. The figure provides a graphical depiction of change in Year 8 average achievement in mathematics across the TIMSS assessment years (1995–2015).

Australia's score at Year 8 in 2015 was the same as when last measured in 2011. In fact, Australia's 2015 score was very close to that recorded in TIMSS 1995, which was followed by a slight dip in 2007 and then a recovery in 2011. Similarly, New Zealand's score remained unchanged since 1995, while Singapore, the highest-scoring country, has improved significantly since 2011 (when it was already high scoring). The United States and England have improved over recent cycles so that their average performance is now significantly higher than that of Australia. Slovenia's score has improved slowly and steadily since 2003 and is now also significantly higher than that of Australia.

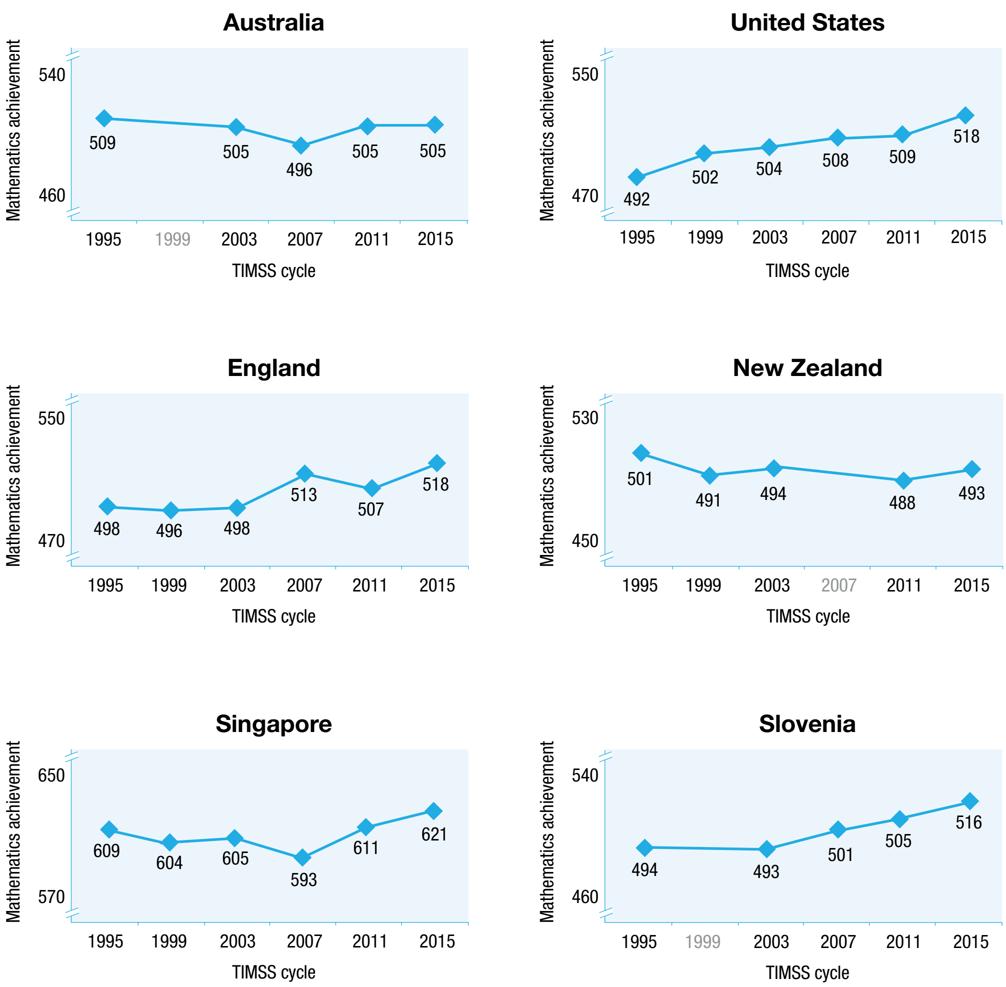
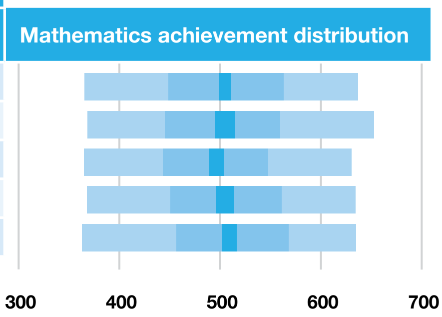


FIGURE 3.5 Trends in Year 8 mathematics achievement scores, 1995–2015, selected countries

Figure 3.6 presents the trends in the distribution of mathematics achievement at Year 8 in Australia since 1995. While there has been little change in the mean achievement of Australian Year 8 students since 1995, the distribution of achievement shows some change over time. In particular, it appears that the top five per cent of students were not performing as well on the TIMSS Year 8 mathematics scale in 2015 as they were in 2011, with the 95th percentile dropping from 652 to 636.

			Differences between years			
	Mean	SE	2011	2007	2003	1995
2015	505	3.1	0	9	0	-4
2011	505	5.2		9	0	-4
2007	496	3.8			-8	-13 ↓
2003	505	4.7				-4
1995	509	3.7				



Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

See Reader's Guide for interpretation of graph.

FIGURE 3.6 Trends in Year 8 mathematics achievement score and distribution, 1995–2015, Australia

Table 3.4 displays each country's position relative to that of Australia in each TIMSS cycle (please see Appendix B for the mean scores by cycle for each country). The performance of the United States, England and Slovenia was not significantly different to Australia's in TIMSS 2011, but these countries performed at a significantly higher level than that of Australia in TIMSS 2015. Kazakhstan and Sweden scored significantly lower than Australia in 2011; in 2015, Sweden's score was not significantly different to Australia's, while that of Kazakhstan was significantly higher.

In terms of trends since 1995, England, the United States and Slovenia scored lower than Australia in 1995, and in 2015 outperformed Australia. Lithuania scored significantly lower than Australia in 1995 and attained an equivalent level in 2015. The Russian Federation and Ireland both scored at an equivalent level to that of Australia in 1995 and outperformed Australia in 2015.

TABLE 3.4 Relative trends in Year 8 mathematics achievement, by country

Country	Position relative to Australia 2015	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Singapore	↑	↑	↑	↑	↑
Korea	↑	↑	↑	↑	↑
Chinese Taipei	↑	↑	↑	↑	–
Hong Kong	↑	↑	↑	↑	↑
Japan	↑	↑	↑	↑	↑
Russian Federation	↑	↑	↑	•	•
Kazakhstan	↑	↓	–	–	–
Canada	↑	–	–	–	–
Ireland	↑	–	–	–	•
United States	↑	•	↑	•	↓
England	↑	•	↑	•	↓
Slovenia	↑	•	•	↓	↓
Hungary	•	•	↑	↑	↑
Norway (9)	•	–	–	–	–
Lithuania	•	•	•	•	↓
Israel	•	•	–	–	–
Australia					
Sweden	•	↓	•	•	↑
Italy	↓	•	↓	↓	–
Malta	↓	–	↓	–	–
New Zealand	↓	↓	–	•	•
Malaysia	↓	↓	↓	•	–
United Arab Emirates	↓	↓	–	–	–
Turkey	↓	↓	–	–	–
Bahrain	↓	↓	↓	↓	–
Georgia	↓	↓	↓	–	–
Lebanon	↓	↓	↓	↓	–
Qatar	↓	↓	–	–	–
Iran	↓	↓	↓	↓	↓
Thailand	↓	↓	↓	–	–
Chile	↓	↓	–	↓	–
Oman	↓	↓	↓	–	–
Kuwait	↓	–	–	–	–
Egypt	↓	–	↓	↓	–
Botswana (9)	↓	↓	–	–	–
Jordan	↓	↓	↓	↓	–
Morocco	↓	↓	–	–	–
South Africa (9)	↓	↓	–	–	–
Saudi Arabia	↓	↓	–	–	–

↑ Score significantly higher than Australia's.

↓ Score significantly lower than Australia's.

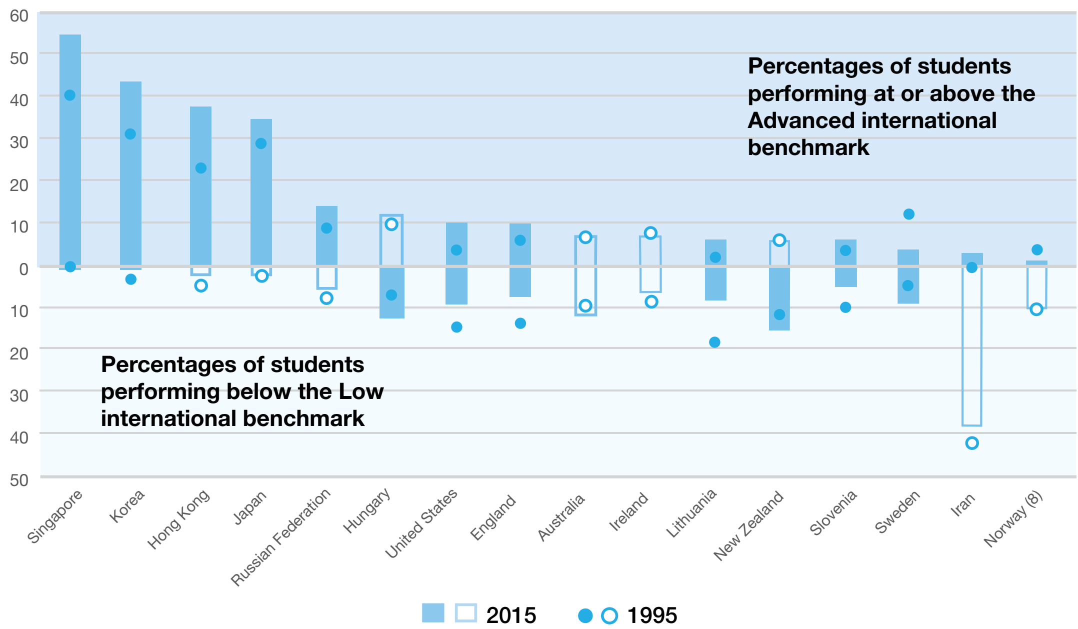
• Score not significantly different to that of Australia.

– Did not participate in this cycle.

Figure 3.7 shows the trends in the percentages of students achieving the Advanced international benchmark and those not achieving the Low international benchmark for countries that participated in both TIMSS 1995 and TIMSS 2015.

Figure 3.7 shows that for the majority of countries (10 out of 16) that participated in both TIMSS 1995 and TIMSS 2015, the percentage of Year 8 students achieving the Advanced benchmark has significantly increased over this time. Australia was one of the exceptions to this pattern, with no significant change in the percentage of Australian Year 8 students achieving the Advanced benchmark over the past 20 years.

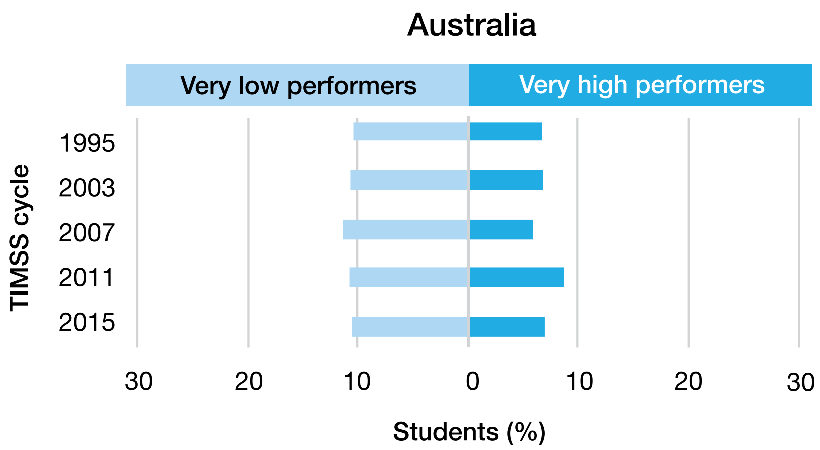
Examination of the percentage of students not achieving the Low benchmark reveals a much more mixed trend. Over the 20-year period from 1995 to 2015, seven of the 16 countries showed no significant difference; five countries showed a reduction in the percentage of students falling below the Low benchmark; and four countries showed an increase in the percentage of students falling below the Low benchmark. Australia was one of the countries for which there was no change in the percentage of Year 8 students falling below the Low benchmark.



Note: A coloured bar and a coloured circle indicate that the difference in the percentages of students between TIMSS 1995 and TIMSS 2015 was significant.

FIGURE 3.7 Percentages of very high- and very low-achieving students in Year 8 mathematics in TIMSS 1995 and TIMSS 2015, by country

Figure 3.8 shows the trends in the percentages of Australian Year 8 students achieving the Advanced international benchmark and those not achieving the Low international benchmark in mathematics in all cycles since TIMSS 1995. As would be expected, given the absence of significant change in the mean score over time, there has been no significant change in the percentage of Australian Year 8 students achieving the Advanced benchmark and of those not achieving the Low benchmark in mathematics since TIMSS 1995.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 3.8 Percentages of very high- and very low-achieving students in Year 8 mathematics in TIMSS 1995 to TIMSS 2015, Australia

Trends across year levels: Year 4 to Year 8 cohort analysis

One of the benefits of administering TIMSS on a four-year cycle is that it allows for an examination of changes over time within a cohort of students, given that the Year 4 students assessed in 2011 were assessed as the Year 8 cohort in 2015. The results are presented in Table 3.5, which shows the average mathematics achievement as a difference from the TIMSS scale centrepoint (500) for the Year 4 students in 2011 on the left and the Year 8 students in 2015 on the right. Eleven countries, including the East Asian countries, and England and the United States, performed above the scale centrepoint in Year 4 in 2011 and again above the scale centrepoint in Year 8 in 2015 (although not in the same order of average achievement).

Another 11 countries retained their position below the TIMSS centrepoint from Year 4 in 2011 to Year 8 in 2015, while Sweden was stable at the centrepoint from Year 4 in 2011 to Year 8 in 2015. Three countries, including Australia, fell from their position relative to the TIMSS scale centrepoint in Year 4 in 2011 to a lower position in Year 8 in 2015. Australia was placed above the TIMSS centrepoint in Year 4 in 2011, but fell to a position not significantly different to the centrepoint in Year 8 in 2015, while Italy fell from above to below the centrepoint and Norway, which was positioned at the centrepoint in 2011, fell below it in 2015. One country, Kazakhstan, managed to improve its performance over time, advancing from a position at the TIMSS centrepoint in Year 4 in 2011 to a position above it in Year 8 in 2011.

TABLE 3.5 Relative achievement in mathematics of 2011 Year 4 students and 2015 Year 8 students, by country

Year 4 2011		
Country	Achievement difference from TIMSS scale centrepoint	SE
Singapore	106 ↑	3.2
Korea	105 ↑	1.9
Hong Kong	102 ↑	3.4
Chinese Taipei	91 ↑	2.0
Japan	85 ↑	1.7
England	42 ↑	3.5
Russian Federation	42 ↑	3.7
United States	41 ↑	1.9
Lithuania	34 ↑	2.4
Australia	16 ↑	3.0
Hungary	15 ↑	3.4
Slovenia	13 ↑	2.1
Italy	8 ↑	2.6
Sweden	4	2.1
Kazakhstan	1	4.5
Norway (4)	-5	2.8
New Zealand	-14 ↓	2.6
Turkey	-31 ↓	4.7
Chile	-38 ↓	2.3
Georgia	-50 ↓	3.7
Bahrain	-64 ↓	3.2
United Arab Emirates	-66 ↓	2.0
Iran	-69 ↓	3.5
Qatar	-87 ↓	3.4
Saudi Arabia	-90 ↓	5.2
Oman	-115 ↓	2.9
Morocco	-165 ↓	4.0

Year 8 2015		
Country	Achievement difference from TIMSS scale centrepoint	SE
Singapore	121 ↑	3.2
Korea	106 ↑	2.6
Chinese Taipei	99 ↑	2.4
Hong Kong	94 ↑	4.6
Japan	86 ↑	2.3
Russian Federation	38 ↑	4.7
Kazakhstan	28 ↑	5.3
United States	18 ↑	3.1
England	18 ↑	4.2
Slovenia	16 ↑	2.1
Hungary	14 ↑	3.8
Lithuania	12 ↑	2.9
Australia	5	3.1
Sweden	1	2.8
Italy	-6 ↓	2.5
New Zealand	-7 ↓	3.4
Norway (8)	-13 ↓	2.0
United Arab Emirates	-35 ↓	2.0
Turkey	-42 ↓	4.7
Bahrain	-46 ↓	1.4
Georgia	-47 ↓	3.4
Qatar	-63 ↓	3.0
Iran	-64 ↓	4.6
Chile	-73 ↓	3.2
Oman	-97 ↓	2.4
Morocco	-116 ↓	2.3
Saudi Arabia	-132 ↓	4.6

↑ Country mean is significantly higher than the TIMSS scale centrepoint.

↓ Country mean is significantly lower than the TIMSS scale centrepoint.

Australia's Year 8 mathematics results at the national level

Figure 3.9 presents the distribution of Year 8 mathematics performance for each of the Australian jurisdictions for TIMSS 2015. To place the jurisdiction results in perspective, the means and distributions for Australia as a whole, and for Singapore, the highest-achieving country at Year 8 in mathematics, are also included in this figure. The jurisdictions are shown in order from highest to lowest mean scores.

Figure 3.9 should be read in conjunction with Table 3.6, which presents the multiple comparisons of average performance between the jurisdictions and indicates which jurisdiction's performance does, or does not, differ significantly from the performance of each of the other jurisdictions.

In TIMSS 2015, the Australian Capital Territory and Victoria had the highest average achievement in mathematics (516 score points). New South Wales displayed the widest distribution of scores, with a range of 282 score points between the 5th and 95th percentiles. Queensland and the Northern Territory had the narrowest range, with 249 score points separating the 5th and 95th percentiles.

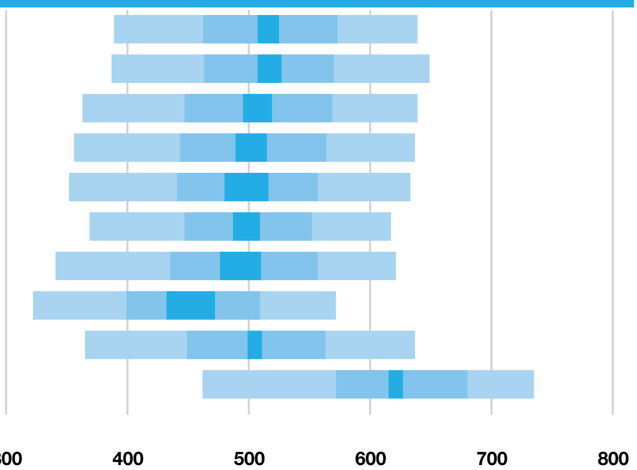
Figure 3.9 and Table 3.6 together show that the spread of average scores across the jurisdictions was 65 score points, between the highest-performing jurisdictions, Victoria and the Australian Capital Territory, and the lowest-performing jurisdiction, the Northern Territory.

Students in Victoria and the Australian Capital Territory significantly outperformed students in Queensland, Tasmania and the Northern Territory, but their results were not significantly different to those of students in Western Australia, New South Wales and South Australia.

The average scores for Western Australia, New South Wales, South Australia, Queensland and Tasmania were not significantly different to each other but were significantly higher than that of the Northern Territory.

Jurisdiction	Mean	SE	Gap 95th–5th percentiles
ACT	516	4.5	250
VIC	516	5.1	262
WA	508	6.0	277
NSW	503	6.9	282
SA	498	9.1	280
QLD	498	5.7	249
TAS	493	8.4	280
NT	452	10.0	249
Australia	505	3.1	272
Singapore	621	3.2	273

Mathematics achievement distribution



Note: See Reader's Guide for interpretation of graph.

FIGURE 3.9 Mean scores and distribution of Year 8 mathematics achievement, by jurisdiction

TABLE 3.6 Multiple comparisons of Year 8 mathematics achievement, by jurisdiction

Jurisdiction	Mean	SE	ACT	VIC	WA	NSW	SA	QLD	TAS	NT
ACT	516	4.5		•	•	•	•	↑	↑	↑
VIC	516	5.1	•		•	•	•	↑	↑	↑
WA	508	6.0	•	•		•	•	•	•	↑
NSW	503	6.9	•	•	•		•	•	•	↑
SA	498	9.1	•	•	•	•		•	•	↑
QLD	498	5.7	↓	↓	•	•	•		•	↑
TAS	493	8.4	↓	↓	•	•	•	•		↑
NT	452	10.0	↓	↓	↓	↓	↓	↓	↓	

Note: Read across the row to compare a state/territory's performance with the performance of each jurisdiction listed in the column heading.

↑ Average performance statistically significantly higher than in comparison jurisdiction.

• No statistically significant difference from comparison jurisdiction.

↓ Average performance statistically significantly lower than in comparison jurisdiction.

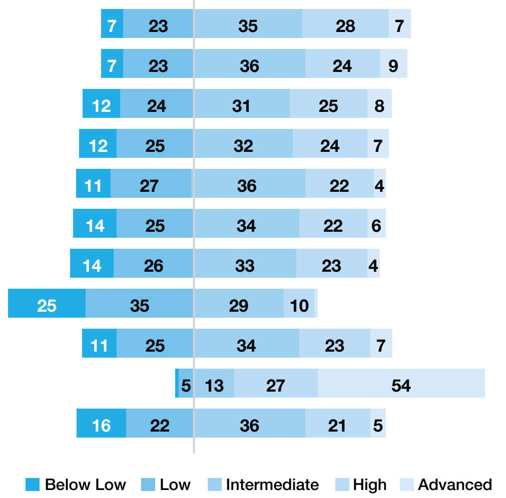
Performance at the international benchmarks by jurisdiction

Figure 3.10 shows the percentage of students in each jurisdiction at each of the international benchmarks for Year 8 mathematics, along with the percentages for Australia as a whole, Singapore (as the highest-scoring country) and the international median for comparison.

Figure 3.10 shows that all Australian jurisdictions had less than 10 per cent of Year 8 students reaching the Advanced benchmark. While this is very low compared to the 54 per cent of students in Singapore who achieved the Advanced benchmark, it was a proportion similar to those of most other countries. The jurisdiction with the highest percentage of Year 8 students achieving the Advanced benchmark was Victoria, with nine per cent, closely followed by Western Australia, which reported eight per cent of its students performing at this level. The jurisdiction with the lowest proportion of high achievers was the Northern Territory, of whose students only one per cent achieved the Advanced benchmark.

The other end of the achievement distribution shows that 60 per cent of students in the Northern Territory did not reach the Intermediate benchmark, which is the proficient standard for Australia. In the other jurisdictions this proportion ranged from 30 per cent in Victoria and the Australian Capital Territory to 39 per cent in Tasmania. The number not reaching the Low benchmark was 25 per cent in the Northern Territory and between seven and 14 per cent in all other jurisdictions.

Jurisdiction	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
ACT	70	2.1	
VIC	70	2.1	
WA	65	2.7	
NSW	63	3.5	
QLD	62	3.1	
SA	62	3.5	
TAS	61	3.7	
NT	40	5.2	
Australia	64	1.6	
Singapore	94	0.9	
International median	62		



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

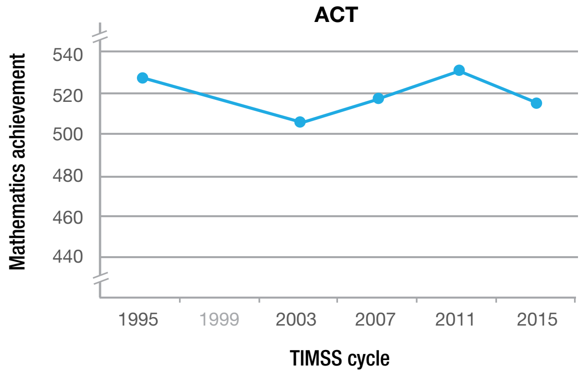
Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.10 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by jurisdiction

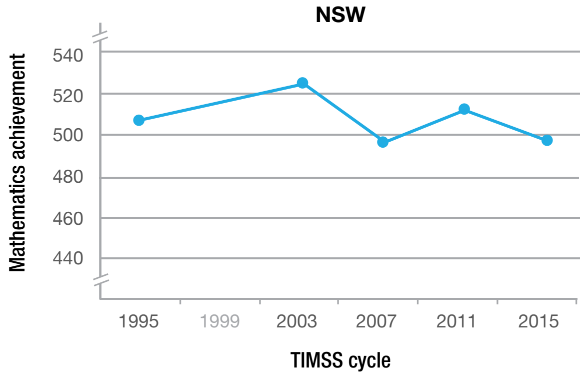
Trends in Year 8 mathematics achievement by jurisdiction

Figure 3.11 presents the trends in mathematics achievement for each of the jurisdictions for each cycle of TIMSS (1995, 2003, 2007, 2011 and 2015) and also an indication of the statistical significance of the difference between cycles (please see Appendix C for the mean scores by cycle for each jurisdiction).

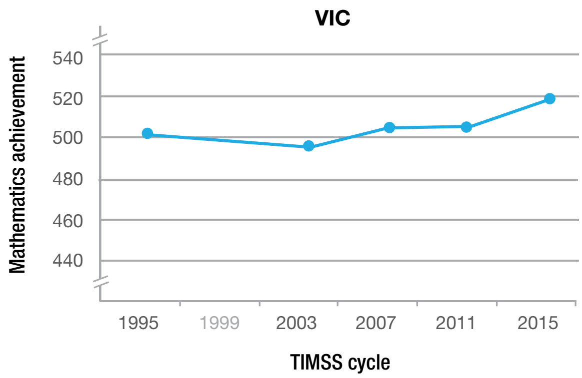
Victoria has experienced a significant improvement in Year 8 mathematics achievement since 1995 and 2003, while New South Wales has declined since 2003. Western Australia is showing improvement compared to 2003 and 2007, but is not yet back to the same level of achievement that was seen in 1995.



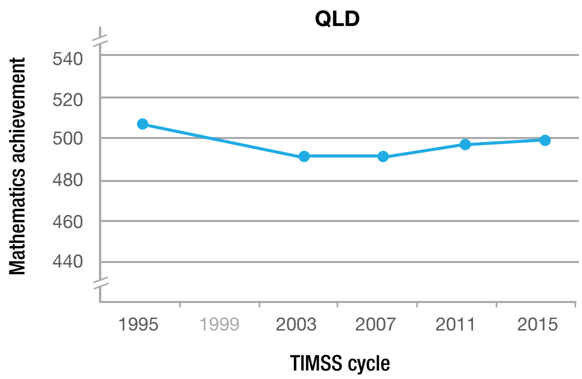
Differences between years				
	2011	2007	2003	1995
2015	-15	-2	10	-12
2011		13	25	4
2007			12	-10
2003				-21



Differences between years				
	2011	2007	2003	1995
2015	-15	3	-28 ↓	-10
2011		18	-13	6
2007			-31	-13
2003				18



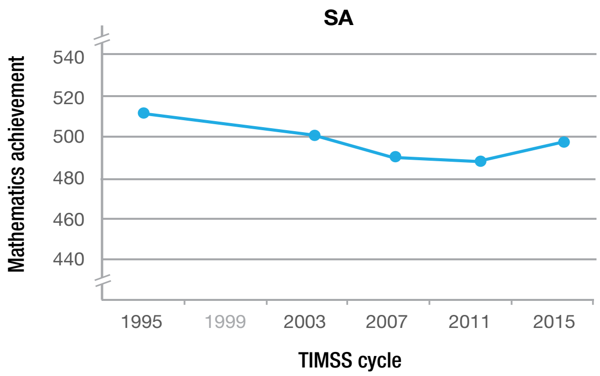
Differences between years				
	2011	2007	2003	1995
2015	12	13	22 ↑	16 ↑
2011		1	10	4
2007			9	3
2003				-5



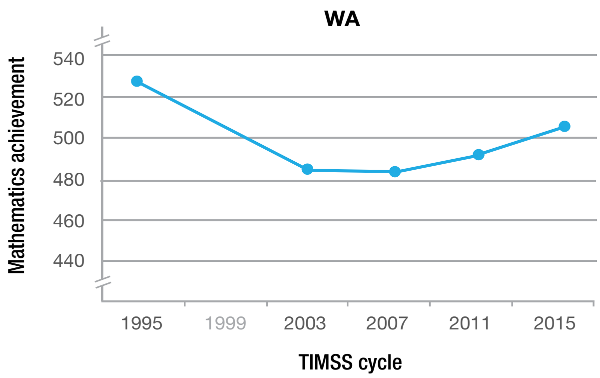
Differences between years				
	2011	2007	2003	1995
2015	1	8	8	-8
2011		6	7	-9
2007			0	-15
2003				-16

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

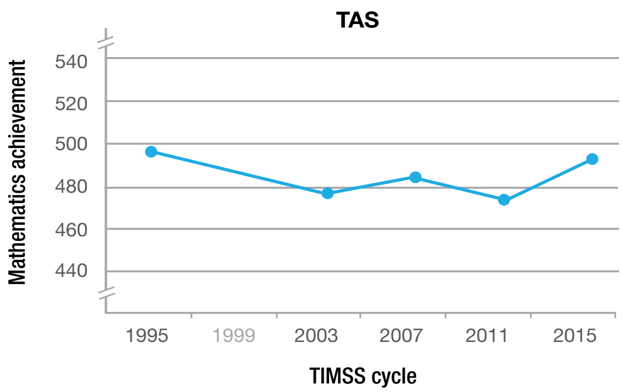
FIGURE 3.11 Trends in Year 8 mathematics achievement within Australia, 1995–2015, by jurisdiction



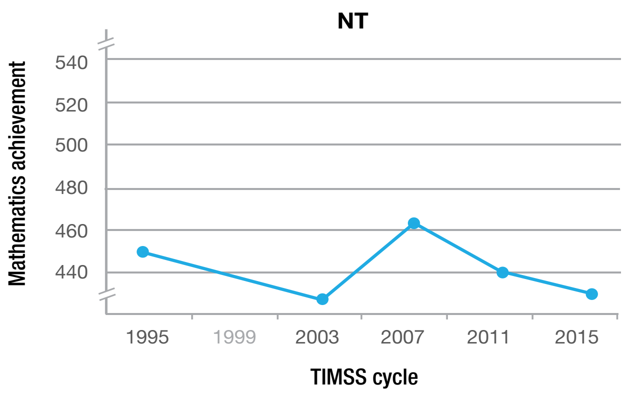
Differences between years				
	2011	2007	2003	1995
2015	10	8	-3	-14
2011		-2	-13	-24 ↓
2007			-11	-22 ↓
2003				-11



Differences between years				
	2011	2007	2003	1995
2015	14	23 ↑	20 ↑	-19 ↓
2011		8	6	-34 ↓
2007			-2	-42 ↓
2003				-40 ↓



Differences between years				
	2011	2007	2003	1995
2015	18	8	16	-3
2011		-11	-2	-21
2007			9	-11
2003				-20



Differences between years				
	2011	2007	2003	1995
2015	-10	-31	3	-18
2011		-22	13	-9
2007			34	13
2003				-21

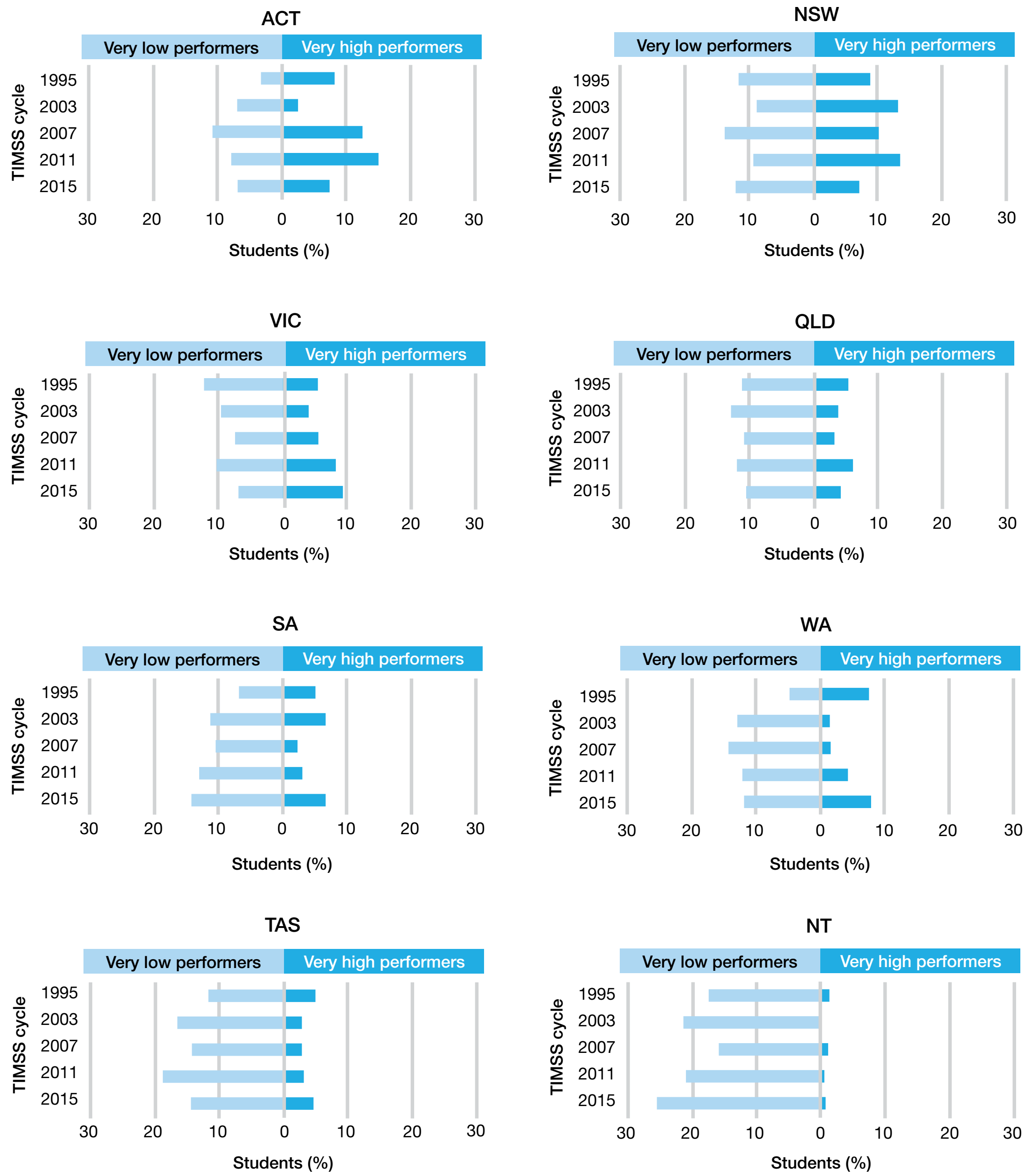
Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

FIGURE 3.11 Trends in Year 8 mathematics achievement within Australia, 1995–2015, by jurisdiction (cont.)

Figure 3.12 shows the percentage of students achieving the Advanced international benchmark in Year 8 mathematics, as well as the percentage of students not achieving the Low international benchmark, for each Australian jurisdiction for all TIMSS cycles from 1995 through to 2015.

Most jurisdictions experienced an increase in the percentage of students not achieving the Low benchmark in Year 8 mathematics. The increase (of about seven percentage points) was statistically significant in South Australia and Western Australia. Victoria was the only state to reduce the proportion of students not achieving the Low benchmark, with a statistically significant reduction from 12 per cent in 1995 to seven per cent in 2015.

There was very little change from 1995 to 2015 in the percentage of students achieving the Advanced benchmark in Year 8 mathematics for any of the Australian jurisdictions. Victoria had the largest improvement (four percentage points) but it was not statistically significant.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 3.12 Percentages of very high- and very low-achieving students in Year 8 mathematics in TIMSS 1995 to TIMSS 2015, by jurisdiction

Table 3.7 presents the cohort comparisons for the Australian jurisdictions. Two jurisdictions, Victoria and the Australian Capital Territory, performed above the TIMSS scale centrepoint in Year 4 in 2011 and again above the centrepoint in Year 8 in 2015, while South Australia, Western Australia and Queensland retained their position as not significantly different from the TIMSS scale centerpoint. In comparison, New South Wales and Tasmania experienced a decline, moving from scoring significantly higher than the TIMSS scale centrepoint in Year 4 in 2011 to recording a score not significantly different to it in Year 8 in 2015. The Northern Territory also experienced a decline, dropping from a position not significantly different to the TIMSS scale centrepoint in Year 4 in 2011 to a position below it in Year 8 in 2015.

TABLE 3.7 Relative achievement in mathematics of Australian 2011 Year 4 students and 2015 Year 8 students, by jurisdiction

Year 4 2011		
Jurisdiction	Achievement difference from TIMSS scale centrepoint	SE
ACT	45 ↑	5.7
VIC	31 ↑	5.7
NSW	25 ↑	6.0
TAS	17 ↑	8.0
SA	2	5.4
WA	-1	6.3
QLD	-1	5.6
NT	-11	12.6

Year 8 2015		
Jurisdiction	Achievement difference from TIMSS scale centrepoint	SE
ACT	16 ↑	4.5
VIC	16 ↑	5.1
WA	8	6.0
NSW	3	6.9
SA	-2	9.1
QLD	-2	5.7
TAS	-7	8.4
NT	-48 ↓	10.0

↑ Jurisdiction mean is significantly higher than the TIMSS scale centrepoint.

↓ Jurisdiction mean is significantly lower than the TIMSS scale centrepoint.

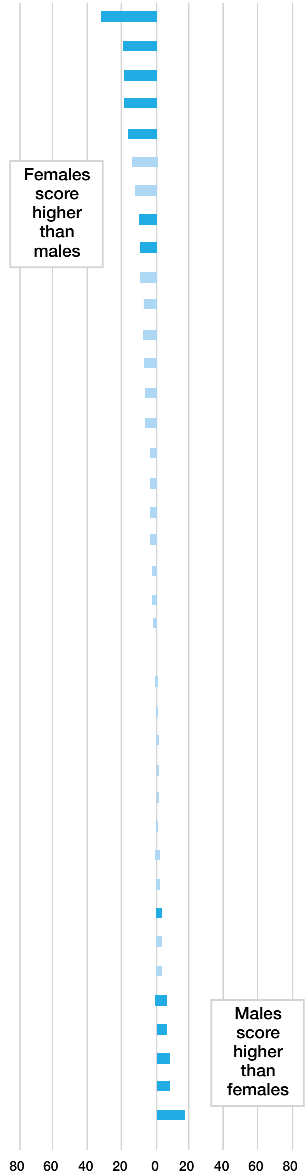
Australia's Year 8 mathematics achievement for different demographic groups

Year 8 mathematics achievement by sex

Figure 3.13 shows the performance of male and female Year 8 students in mathematics achievement across the countries participating in TIMSS 2015. This figure presents average achievement separately for females and males, as well as the differences between the averages. Sex differences are shown by a bar indicating the size and direction of each difference (in favour of males or females) and whether the difference was statistically significant (indicated by a darkened bar). Countries are presented in the figure in increasing order of the difference between females and males in average achievement.

Figure 3.13 shows that there were no statistically significant sex differences in 26 of the 39 countries that tested at Year 8, including Australia. Interestingly, there were slightly more countries in which the sex difference favoured females, and the largest differences were in favour of females. In Canada, Italy, Sweden, Hungary, the Russian Federation and Chile, males scored significantly higher (between four and 18 score points) than females. However, in Singapore, Malaysia, Bahrain, Thailand, Jordan, Botswana and Oman, the difference was significantly in favour of females, with the differences ranging from nine score points in Singapore to a large 32 score points in Oman.

Country	Female				Male				Difference (absolute value)	SE
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE		
Oman	48	1.7	420	2.9	52	1.7	388	3.5	32	4.6
Botswana (9)	51	0.6	400	2.5	49	0.6	381	2.5	19	2.9
Jordan	50	2.6	395	4.0	50	2.6	376	5.4	19	7.0
Thailand	54	1.5	440	5.2	46	1.5	422	5.7	18	5.5
Bahrain	48	0.9	462	2.4	52	0.9	446	2.2	16	3.6
Saudi Arabia	51	1.6	375	5.1	49	1.6	360	7.1	14	8.2
United Arab Emirates	50	2.5	471	3.5	50	2.5	459	4.0	12	6.4
Malaysia	50	1.8	470	3.8	50	1.8	461	3.8	9	2.8
Singapore	49	0.6	626	3.4	51	0.6	616	3.8	9	3.5
Egypt	53	2.3	397	5.5	47	2.3	387	5.1	9	6.7
South Africa (9)	51	1.1	376	5.3	49	1.1	369	4.6	7	4.1
Kuwait	50	2.5	396	4.6	50	2.5	389	7.1	7	7.5
Qatar	50	3.0	440	3.2	50	3.0	434	4.5	7	4.9
Turkey	48	0.8	461	4.8	52	0.8	455	5.3	6	3.6
Kazakhstan	49	0.9	531	5.8	51	0.9	525	5.3	6	3.7
Iran	48	0.9	438	5.0	52	0.9	435	7.5	3	8.9
England	51	1.6	520	5.2	49	1.6	517	4.8	3	5.6
Malta	49	0.3	495	1.8	51	0.3	492	1.6	3	2.8
New Zealand	51	2.0	494	3.2	49	2.0	491	4.6	3	4.2
Japan	51	1.0	588	3.1	49	1.0	585	3.0	2	4.2
Morocco	46	0.7	385	2.3	54	0.7	384	2.6	2	2.0
Georgia	47	0.9	454	3.9	53	0.9	453	4.0	1	4.0
Chinese Taipei	49	0.8	599	2.6	51	0.8	599	3.0	0	2.8
Korea	47	0.5	605	2.6	53	0.5	606	3.1	1	2.7
Norway (9)	50	0.7	511	2.5	50	0.7	512	2.7	1	2.6
United States	50	0.6	517	3.3	50	0.6	519	3.2	2	2.0
Australia	51	1.6	504	3.8	49	1.6	506	3.5	2	4.0
Israel	49	1.2	510	4.3	51	1.2	512	4.8	2	3.9
Slovenia	48	0.7	515	2.4	52	0.7	518	2.5	2	2.4
Lebanon	53	1.6	441	3.7	47	1.6	444	4.5	3	3.9
Lithuania	50	0.8	510	3.4	50	0.8	513	3.1	3	3.4
Canada	51	1.0	525	2.0	49	1.0	530	2.7	4	2.0
Ireland	50	1.1	521	2.6	50	1.1	526	4.0	5	3.9
Hong Kong	47	2.1	591	4.7	53	2.1	597	6.0	5	5.7
Italy	49	0.8	491	3.0	51	0.8	498	2.8	7	2.8
Sweden	48	1.0	497	3.3	52	1.0	504	3.1	7	3.2
Hungary	50	0.9	510	4.3	50	0.9	519	4.0	9	3.4
Russian Federation	49	0.9	533	5.1	51	0.9	543	4.6	9	2.9
Chile	48	1.8	418	3.7	52	1.8	436	4.2	18	4.9
International average	50	0.2	483	0.6	50	0.2	480	0.7		



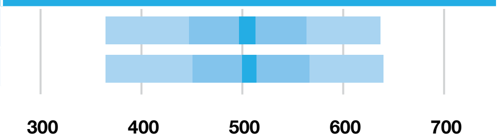
Difference is statistically significant

Difference is not statistically significant

FIGURE 3.13 Sex differences in Year 8 mathematics achievement, by country

Figure 3.14 confirms the lack of significant sex differences in Australia in that the range of scores was very similar for Year 8 male students (273 score points) and for Year 8 female students (269 score points), with each of the percentiles falling in similar positions on the scale.

Sex	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Female	51	504	3.8	269	
Male	49	506	3.5	273	



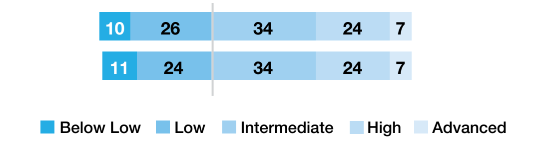
Note: See Reader's Guide for interpretation of graph.

FIGURE 3.14 Mean scores and distribution of Year 8 mathematics achievement within Australia, by sex

Performance at the international benchmarks by sex

In Australia, there was not much difference between males and females in terms of performance at the international benchmarks, with differences of less than two per cent across the benchmarks. This near equivalence in performance is illustrated in Figure 3.15.

Sex	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Female	64	1.8	
Male	65	1.9	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.15 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by sex

Trends in mathematics achievement by sex

Figure 3.16 provides a graphic representation of trends from 1995 to 2015 in the mathematics achievement of male and female Year 8 students in Australia. The average score for males has changed little over time, and the decline in the average score for females seen between 1995 and 2007 has virtually recovered — the 16-point gap found in 2007 for females has closed to a mere two score points.

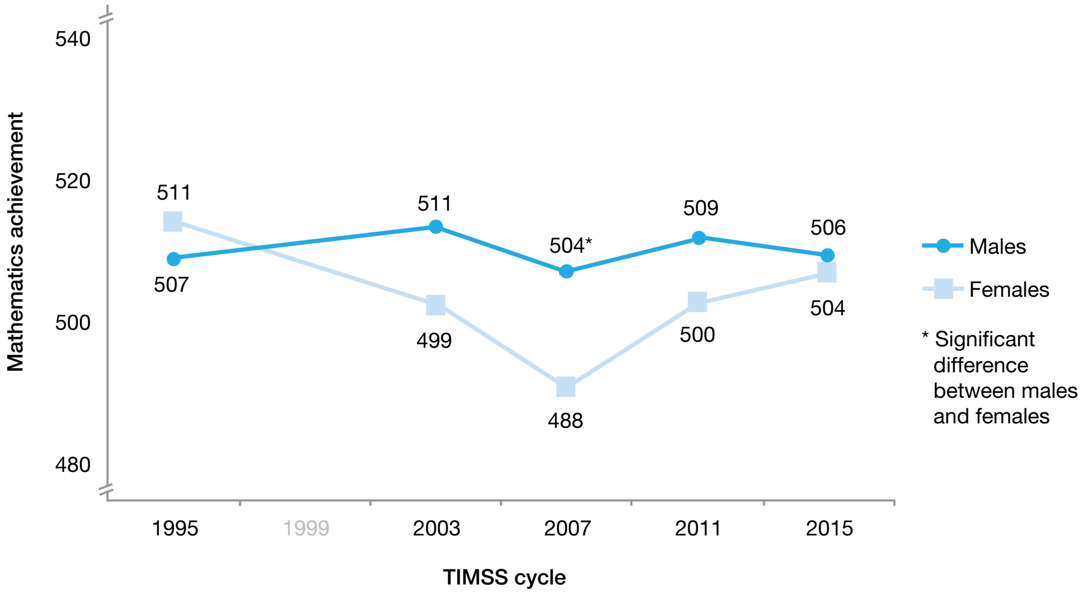


FIGURE 3.16 Trends in Year 8 mathematics achievement within Australia, 1995–2015, by sex

Sex difference in mathematics achievement by jurisdiction

Figure 3.17 shows the sex differences in Year 8 mathematics by jurisdiction. Given that there is no sex difference in mathematics for Australia as a whole, it would be expected that this would be reflected in the scores for the jurisdictions. This appears to be the case, as none of the differences that appear in the figure are statistically significant.

Jurisdiction	Female		Male		Difference (absolute value)	SE
	Mean	SE	Mean	SE		
VIC	519	7.4	514	5.7	5	8.7
NT	455	11.2	450	10.3	5	10.4
SA	500	11.0	497	9.6	3	9.6
WA	508	6.7	507	8.5	1	9.5
TAS	492	13.1	494	8.8	2	14.9
QLD	495	6.3	501	8.3	6	9.2
NSW	499	9.0	506	7.2	8	9.0
ACT	512	6.6	521	8.0	9	11.8

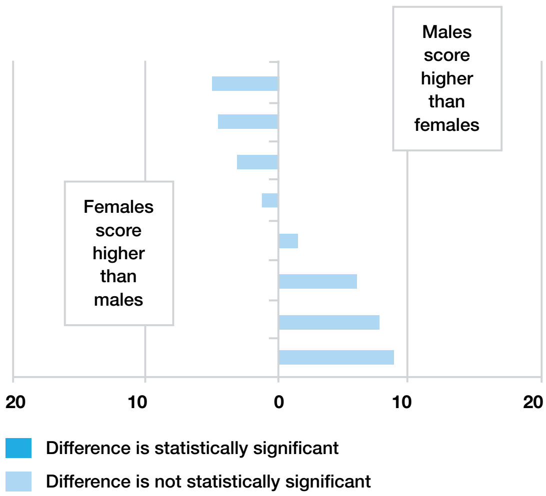
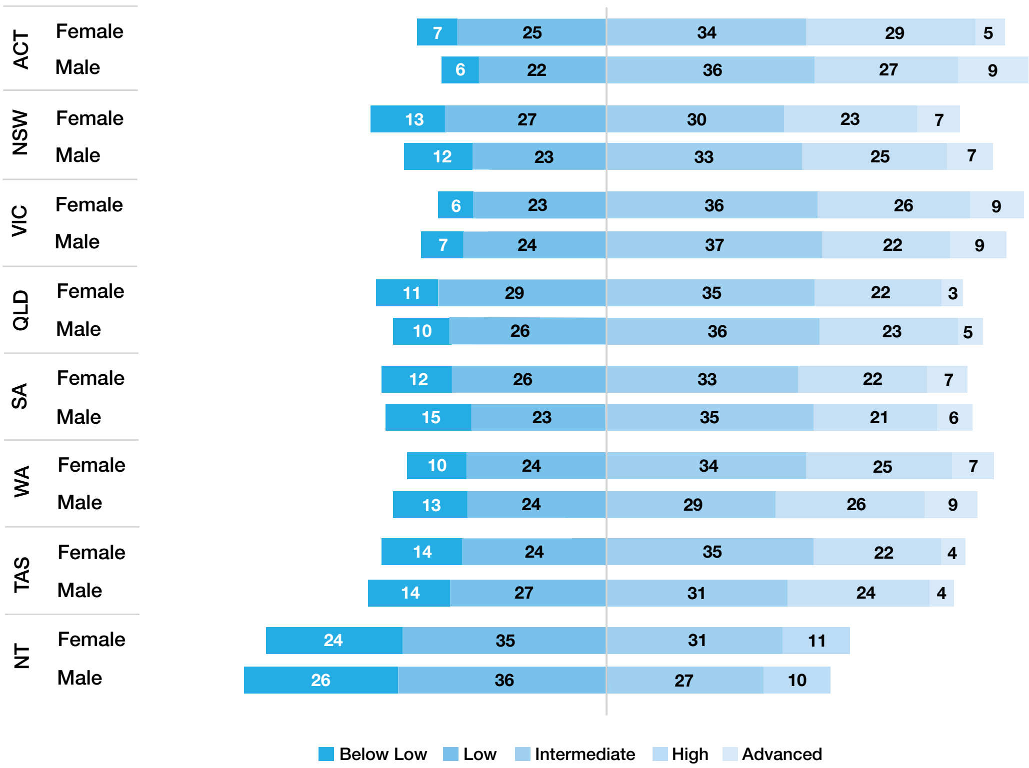


FIGURE 3.17 Sex differences in Year 8 mathematics achievement within Australia, by jurisdiction

Figure 3.18 shows the percentages of students at each of the international benchmarks in Year 8 mathematics in each jurisdiction, by sex. There was no significant difference in the percentages of males and females achieving the Intermediate benchmark (the proficient standard for Australia) in any jurisdiction.



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.18 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by sex within jurisdiction

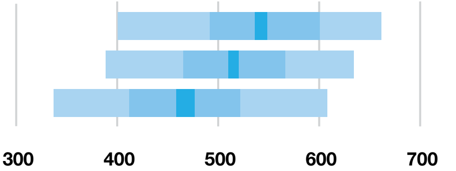
Year 8 mathematics achievement by books in the home

Socioeconomic status has been found (in TIMSS and other studies) to be related to achievement. In TIMSS, the number of books in the home is used as a proxy for socioeconomic status. This section presents Australian students' mathematics achievement according to the number of books in the home. For more information about this variable, please refer to the Reader's Guide.

Figure 3.19 provides the percentage of students in each category, and the average achievement score for students in each group. At this year level, the 21 per cent of students who reported having *many books* in the home gained a substantial advantage, scoring on average 26 score points higher than the next category of students and around three-quarters of a standard deviation, 73 score points, higher than students with a *few books* in the home. Possession even of an *average number*, between 26 and 200 books in the home, indicates a substantial relationship with achievement, with students in this category scoring, on average, half a standard deviation, 47 score points, higher than the students with just a *few books* in the home.

Figure 3.19 also shows the substantial spread of scores in mathematics for students by their reports of books in the home. The largest range between the 5th and 95th percentiles was for students in the group who reported having a *few books* in the home (270 score points) and the smallest range was for those students with an *average number of books* (243 score points). Interestingly, the greatest spread for students with *many books* in the home was at the tail end of the distribution, whereas the greatest spread for students with a *few books* in the home was at the upper end of the distribution.

Number of books in the home	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Many books	21	541	3.0	257	
Average number of books	48	515	2.8	243	
A few books	31	468	4.8	270	



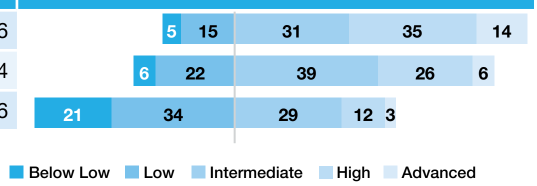
Note: See Reader's Guide for interpretation of graph.

FIGURE 3.19 Mean scores and distribution of Year 8 mathematics achievement within Australia, by number of books in the home

Figure 3.20 shows the percentages of students at each of the benchmarks. Of those students who reported having *many books* in the home, 14 per cent achieved the Advanced benchmark. The proportion in this highest benchmark falls away quickly, though, with six per cent of students in the *average number of books* category and just three per cent of those with a *few books* in the home attaining this level of achievement.

The relationship between books in the home and achievement is not definitive – there is a great deal of variation in the scores of students in each category. However, around 20 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark (the proficient standard for Australia), with 15 per cent achieving the Low benchmark and five per cent not achieving even this very basic level. Of students in the middle category – those with between 26 and 200 books in the home – around 22 per cent achieved the Low benchmark, and around six per cent failed to achieve this level. In comparison, 34 per cent of students who reported having a *few books* in the home achieved the Low benchmark, and a further 21 per cent did not achieve this basic level.

Number of books in the home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Many books	80	1.6	
Average number of books	71	1.4	
A few books	45	2.6	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.20 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by number of books in the home

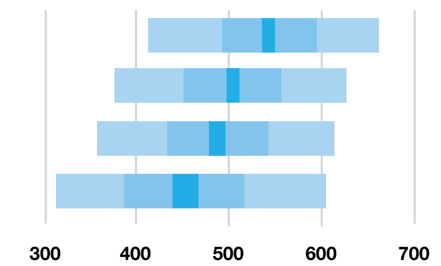
Year 8 mathematics achievement by level of parental education

Parental education has also been found to be strongly related to student achievement. This section presents Australian students' mathematics achievement according to the level of parental education. For more information about this variable, please refer to the Reader's Guide.

Figure 3.21 shows the mean scores and associated standard errors in mathematics for Year 8 Australian students according to the highest level of education attained by either parent. As can be seen in this figure, the mean score increases as the level of parental education increases, with students who have at least one parent with a university degree achieving an average mathematics score a substantial 88 score points higher than that of students whose parents did not complete secondary school, 54 score points higher than the average score for students for whom the highest level of parental education was completion of secondary school and 37 score points higher than that of students whose parents completed a Technical and Further Education qualification. All differences are statistically significant.

Figure 3.21 also shows the spread of scores in mathematics achievement for Year 8 students for the different parental education groups. The largest range between the 5th and 95th percentiles was for students whose parents did not complete secondary school (291 score points) and the smallest range was for students whose parents completed university (247 score points). Interestingly, while the spread of scores at the tail end of the distribution was similar across the groups, the spread at the upper end was larger for the students whose parents did not complete secondary school than for the other groups.

Parental education	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Completed university degree	41	542	3.5	247	
Completed post-secondary but not university	30	505	3.3	248	
Completed upper secondary education	21	488	4.6	255	
Did not complete upper secondary education	8	454	7.3	291	

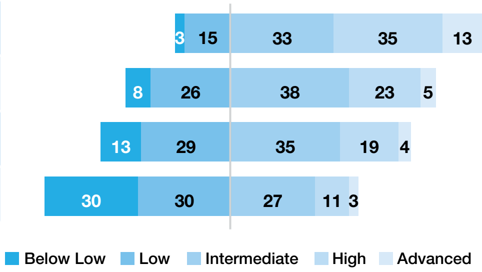


Note: See Reader's Guide for interpretation of graph.

FIGURE 3.21 Mean scores and distribution of Year 8 mathematics achievement within Australia, by parental education

Figure 3.22 shows the percentages of students at each of the benchmarks according to level of parental education. Around 13 per cent of students who had at least one parent complete a university degree reached the Advanced benchmark, compared to five per cent or less for all other groups. Almost two-thirds (59%) of students whose parents did not complete secondary school did not reach the Intermediate benchmark (the proficient standard for Australia), compared to 18 per cent of students with parents holding university degrees.

Parental education	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Completed university degree	82	1.5	
Completed post-secondary but not university	66	2.0	
Completed upper secondary education	58	2.8	
Did not complete upper secondary education	41	3.8	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.22 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by parental education

Year 8 mathematics achievement by educational resources in the home

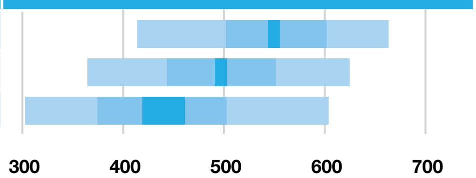
The presence or absence of educational resources in the home expresses potential advantage or disadvantage for students that may reflect the ability of parents to provide materially for their children or indicate differences in practical and psychological support for academic achievement. This section presents Australian students' mathematics achievement according to the number of educational resources in the home. For more information about this variable, please refer to the Reader's Guide.

Australia recorded one of the highest proportions of students who had *many resources* at home, with 23 per cent of students in this category, similar to Sweden (also 23%), the United States (22%), Canada (21%), and England and New Zealand (both 19%). Only Korea and Norway had higher percentages of students in this category (37 and 29%, respectively). Australia's percentage of students with only a *few resources* at home (4%) was quite low by international standards. The majority of Australian students (73%) fell into the middle category of *some resources*.

Figure 3.23 shows that, in Australia, Year 8 students who had *many resources* in the home performed at a significantly higher level than those who had *some resources*, who again performed at a significantly higher level than those who had *few resources*. This pattern was found, on average, to hold across participating countries. Australian Year 8 students who had *many resources* scored, on average, 51 score points higher than those who had *some resources*, whose average achievement was 57 score points higher than those with *few resources* at home. Therefore, the average achievement of those with *many resources* was 109 score points more than those with *few resources*, a difference that is greater than one standard deviation on the TIMSS Year 8 mathematics scale.

Figure 3.23 also shows the distribution in mathematics achievement for Australian students for each of the categories of the Home Educational Resources scale. Interestingly, while it is clear that students who have *many resources* at home are achieving at higher levels than those in the other two categories, the gap between the categories narrows at the 95th percentile, which shows a difference only of 60 score points (compared to 109 at the mean) between students with *many resources* and those with *few resources*.

Number of resources in the home	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Many resources	23	548	3.1	247	
Some resources	73	497	3.1	259	
Few resources	4	439	10.6	298	



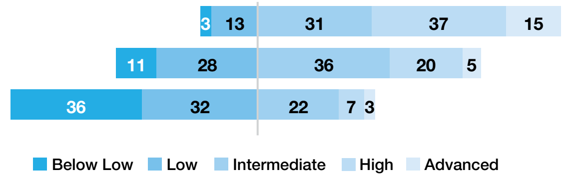
Note: See Reader's Guide for interpretation of graph.

FIGURE 3.23 Mean scores and distribution of Year 8 mathematics achievement within Australia, by educational resources in the home

Figure 3.24 presents the percentage of Year 8 students at each of the international benchmarks for each of the categories of the Home Educational Resources scale. About two-thirds (68%) of students with *few resources* at home are not reaching the Intermediate benchmark (the proficient standard for Australia), compared to slightly more than a third (39%) of those with *some resources* and about a sixth (16%) with *many resources.*

At the other end of the scale, 15 per cent of students with *many resources*, five per cent with *some resources* and three per cent with *few resources* achieved the Advanced benchmark.

Number of resources in the home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Many resources	84	1.5	
Some resources	61	1.7	
Few resources	32	5.2	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.24 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by educational resources in the home

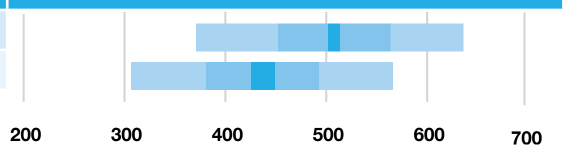
Year 8 mathematics achievement by Indigenous background

The educational attainment of Australia's Indigenous students in core subject areas such as mathematics is an important issue, and previous TIMSS studies have provided a picture of Indigenous achievement in mathematics and science. This section presents Australian students' mathematics achievement according to Indigenous status. For more information about this variable, please refer to the Reader's Guide.

The mean scores for overall mathematics achievement for Indigenous and non-Indigenous students in Year 8 are shown in Figure 3.25. The results clearly show that Indigenous students at the Year 8 level did not perform as well as their non-Indigenous counterparts. At Year 8, Indigenous students achieved an average score of 438, which was 70 score points less than the average score of non-Indigenous students of 508 score points (a statistically significant difference).

Figure 3.25 also shows that the spread of scores (between the 5th and 95th percentiles) is similar for both groups, although the distribution of scores for Indigenous students sits lower on the scale than that for non-Indigenous students.

Indigenous background	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
Non-Indigenous	95	508	3.0	268	
Indigenous	5	438	6.0	261	



Note: See Reader's Guide for interpretation of graph.

FIGURE 3.25 Mean scores and distribution of Year 8 mathematics achievement within Australia, by Indigenous background

Figure 3.26 adds to the picture of performance by presenting the percentages of Indigenous and non-Indigenous students in Year 8 at each of the international benchmarks for mathematics.

One per cent of Indigenous students achieved the Advanced benchmark, compared to seven per cent of non-Indigenous students. At the other end of the achievement spectrum, 32 per cent of Year 8 Indigenous students did not reach the Low benchmark, compared to 10 per cent of non-Indigenous students, and a total of 68 per cent of Indigenous students and 34 per cent of non-Indigenous students did not achieve the Intermediate benchmark (the proficient standard for Australia).

Indigenous background	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Non-Indigenous	66	1.5	10 24 34 24 7
Indigenous	32	3.2	32 36 24 8

Below Low   Low   Intermediate   High   Advanced

Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.26 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by Indigenous background

Figure 3.27 shows trends in achievement for Indigenous and non-Indigenous students over the period from 1995 to 2015. None of the differences between years are significant; that is, the 2015 score for Indigenous students, as for non-Indigenous students, is not significantly different to the score in any of the other years of testing. The difference in 2015 between Indigenous and non-Indigenous students was significant, as it has been in each year of testing, and has not decreased measurably over 20 years.

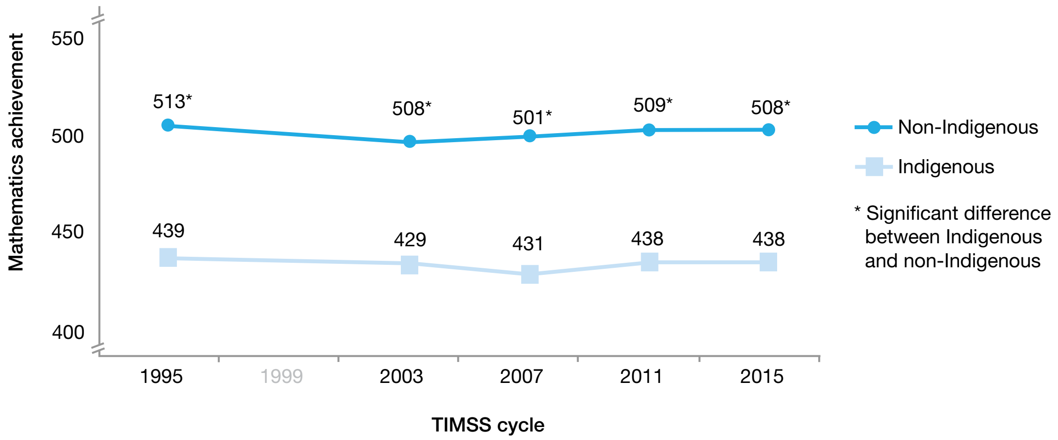


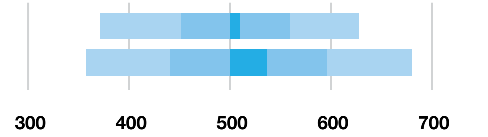
FIGURE 3.27 Trends in Year 8 mathematics achievement within Australia, 1995–2015, by Indigenous background

Year 8 mathematics achievement by language spoken at home

How often English is spoken at home is a factor that has been associated with achievement, both in past cycles of TIMSS and in other similar studies. Students that come from homes where English is not spoken frequently have less exposure to the language of instruction and test, which could disadvantage them. This section presents Australian students' mathematics achievement according to whether a language other than English is spoken as the main language at home. For more information about this variable, please refer to the Reader's Guide.

Figure 3.28 shows that while the majority of students tested in Year 8 spoke English 'always' or 'almost always' at home, there was a group of around seven per cent of students for whom this was not true. While there was no significant difference between the means for the two groups in mathematics, the gap from the 5th to the 95th percentile was much higher for those students who spoke a language other than English at home. The range of scores was 330 score points for students who spoke a language other than English at home, and 264 score points for those who spoke English at home. At the 5th percentile, the scores for the two groups were similar (a difference of 15 score points); however, at the 95th percentile, students who spoke a language other than English at home were scoring about half a standard deviation higher than students who spoke English at home. Clearly, this makes it difficult to categorise students who spoke a language other than English at home as either high or low achievers.

Language spoken at home	% of students	Mean	SE	Gap 95th–5th percentiles	Mathematics achievement distribution
English	93	505	2.7	264	
Other	7	518	9.9	330	

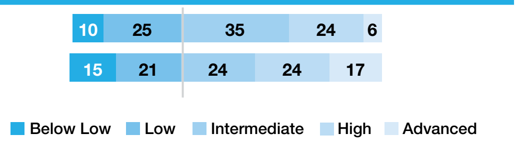


Note: See Reader's Guide for interpretation of graph.

FIGURE 3.28 Mean scores and distribution of Year 8 mathematics achievement within Australia, by language spoken at home

Figure 3.29 further exemplifies this pattern, showing that while a higher proportion of students who spoke a language other than English at home achieved the Advanced benchmark (17% compared to 6% of English-speaking students), larger percentages of English-speaking students performed at the Intermediate benchmark. While more students who spoke a language other than English at home did not reach the Low benchmark (15% compared to 10 per cent of English-speaking students), more English-speaking students (25% compared to 21%) achieved at the Low benchmark, resulting in 35 per cent of both groups not achieving the Intermediate benchmark (the proficient standard for Australia).

Language spoken at home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
English	65	1.5	
Other	64	3.8	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.29 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by language spoken at home

Year 8 mathematics achievement by geographic location of the school

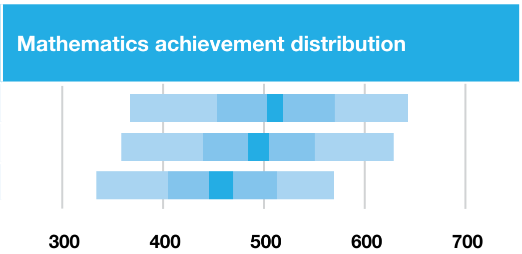
Past cycles of TIMSS have found that students attending schools in remote or regional areas of Australia are often at an educational disadvantage compared to students attending metropolitan schools. This section presents Australian students' mathematics achievement according to the geographic location of the school. For more information about this variable, please refer to the Reader's Guide.

The average performance of students attending schools in the three location categories are presented in Figure 3.30. It should be noted that the students in remote schools make up less than one per cent of the Year 8 student sample; therefore, the level of uncertainty around statistics may be large.

Students in metropolitan schools significantly outperformed those in provincial schools and those in remote schools. There was a 52 score-point difference between the scores of Year 8 students in remote schools and those in metropolitan schools.

As can be seen in Figure 3.30, the spread of achievement of students in metropolitan schools is the widest of the three groups.

Geographic location	% of students	Mean	SE	Gap 95th–5th percentiles
Metropolitan	71	510	4.0	272
Provincial	29	494	4.9	267
Remote	0	457	6.4	233

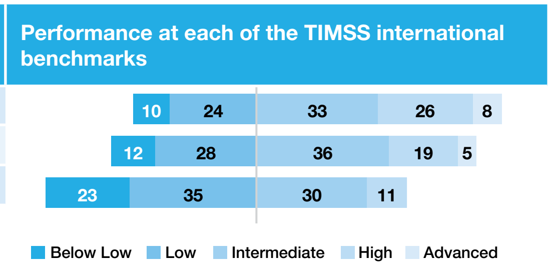


Note: See Reader's Guide for interpretation of graph.

FIGURE 3.30 Mean scores and distribution of Year 8 mathematics achievement within Australia, by geographic location

Figure 3.31 presents the percentage of students in each geographic location at each of the benchmarks. More than one-third (34%) of students in metropolitan areas did not achieve the Intermediate benchmark (the proficient standard for Australia), compared to 40 per cent in provincial areas and almost two-thirds (59%) in remote areas. Eight per cent of students in metropolitan areas achieved the Advanced benchmark, compared to just five per cent in provincial areas and less than one per cent in remote areas.

Geographic location	% of students at or above the proficient standard for Australia	SE
Metropolitan	66	1.8
Provincial	60	3.2
Remote	41	5.0



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 3.31 Percentages of Australian students at the international benchmarks for Year 8 mathematics, by geographic location

This chapter so far has reported on achievement on the TIMSS Year 8 mathematics scale, examining achievement in terms of jurisdiction, sex, number of books in the home, parental education, educational resources in the home, Indigenous background, language spoken at home and geographic location of the school. The next section of this chapter examines achievement in the Year 8 mathematics content and cognitive domains.

Achievement in the TIMSS mathematics content and cognitive domains

As noted earlier in the chapter, the TIMSS mathematics assessment can be described in terms of content and cognitive domains. The content domains outline the subject matter to be assessed and include *number*, *algebra*, *geometry* and *data and chance* at Year 8. The cognitive domains detail the thinking processes that students will need to use. The cognitive domains are *knowing*, *applying* and *reasoning*. Each item is associated with a single content domain and a single cognitive domain. This allows student performance to be described in terms of achievement in each of the domains.

To allow comparisons of student achievement across the domains, the content and cognitive achievement scales at each year level were constructed to have the same average level of difficulty. The following tables present the average achievement in each of the Year 8 mathematics content and cognitive domains for Australia as a whole, for each of the Australian jurisdictions, for males and females and for Indigenous and non-Indigenous students, as well as showing trends for Australia in the content and cognitive domains since 2007.

Mathematics content domains

Table 3.8 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 8 achievement in the mathematics content domains.

Across Australia, Year 8 students performed better in *data and chance* and *number* than in *algebra* and *geometry*. Of these, *data and chance* is the area in which Australian students clearly excel, with the average score for Australia and all of the jurisdictions significantly higher than the overall average for mathematics. The reverse was true for *algebra*, with the average score for Australia and all of the jurisdictions significantly lower than the overall average for mathematics.

The relative performance for *number* and *geometry* fell between *data and chance* and *algebra*, with the difference from the overall mathematics score significant for Australia as a whole and most of the jurisdictions. There was no significant difference between *number* and mathematics overall for the Northern Territory; and no significant difference between *geometry* and mathematics overall for South Australia, Western Australia and Tasmania.

There were no sex differences in three of the content domains. However, males performed significantly better than females in *number*.

The difference between non-Indigenous and Indigenous students remained fairly stable across the domains (ranging from 68 score points for *geometry* and 74 score points for *number*). However, the results recorded by Indigenous students across the domains indicate that Indigenous students – unlike their non-Indigenous peers – do not show a significant (or substantial) difference in performance between mathematics overall and *geometry* and *number*.

TABLE 3.8 Relative mean achievement in the Year 8 mathematics content domains, for Australia and by jurisdiction, sex and Indigenous background

	Mathematics overall		*Number*		Differences between mathematics overall and *number*		*Algebra*		Differences between mathematics overall and *algebra*		*Geometry*		Differences between mathematics overall and *geometry*		*Data and Chance*		Differences between mathematics overall and *data and chance*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	505	3.1	511	3.1	**6**	**0.7**	491	3.4	**-14**	**1.3**	500	3.1	**-5**	**1.1**	519	3.1	**14**	**1.2**
ACT	516	4.5	523	4.5	**7**	**1.7**	499	4.2	**-17**	**1.8**	510	5.0	**-6**	**1.8**	531	4.9	**14**	**2.1**
NSW	503	6.9	508	7.3	**6**	**1.4**	487	7.2	**-16**	**1.6**	498	6.8	**-5**	**1.4**	516	6.9	**13**	**1.6**
VIC	516	5.1	525	5.2	**8**	**1.7**	503	5.6	**-13**	**2.2**	509	5.6	**-7**	**2.7**	530	5.3	**14**	**2.2**
QLD	498	5.7	503	5.8	**5**	**2.4**	485	5.7	**-13**	**2.4**	494	5.4	**-4**	**1.5**	513	5.8	**15**	**2.2**
SA	498	9.1	507	9.7	**8**	**2.1**	483	9.4	**-15**	**2.4**	494	9.7	-5	2.7	513	9.5	**15**	**2.7**
WA	508	6.0	513	6.4	**5**	**1.9**	494	6.5	**-14**	**2.4**	504	5.9	-3	2.0	522	6.1	**14**	**1.7**
TAS	493	8.4	499	8.7	**6**	**2.7**	475	8.7	**-18**	**2.7**	496	8.8	3	2.7	507	8.5	**14**	**2.8**
NT	452	10.0	452	10.3	0	2.4	435	9.3	**-17**	**2.5**	442	9.0	**-10**	**3.5**	460	11.2	**8**	**3.8**
Female	504	3.8	506	4.1	2	0.9	492	4.3	**-12**	**1.8**	500	4.0	**-4**	**1.1**	518	4.1	**14**	**1.5**
Male	506	3.5	517	3.5	**11**	**1.2**	489	3.7	**-17**	**1.3**	500	3.6	**-6**	**1.5**	520	3.6	**14**	**1.7**
Non-Indigenous	508	3.0	515	3.1	**7**	**0.7**	494	3.3	**-14**	**1.3**	503	3.0	**-5**	**1.1**	522	3.0	**14**	**1.2**
Indigenous	438	6.0	440	5.9	2	3.1	420	6.2	**-17**	**3.3**	435	5.9	-2	3.7	450	6.8	**12**	3.8

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 3.9 shows the trends in achievement for the content domains for Australia as a whole. Despite the relatively strong performance in *data and chance* in 2015, compared to mathematics overall, the average score for *data and chance* in 2015 dropped a significant 16 score points since 2011. In contrast, the average scores for *algebra* and *geometry* were significantly higher than in 2007.

TABLE 3.9 Trends in mean achievement in the Year 8 mathematics content domains, for Australia

	Number				*Algebra*				*Geometry*				*Data and chance*			
			Differences between years				Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	511	3.2	-1	8	491	3.4	2	16 ↑	500	3.1	1	12 ↑	519	3.1	-16 ↓	-7
2011	513	5.5		9	489	5.3		15 ↑	499	5.3		11	534	6.0		8
2007	504	4.0			474	4.2			488	4.0			526	4.4		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Mathematics cognitive domains

Table 3.10 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 8 achievement in the mathematics cognitive domains.

Australian Year 8 students performed at a level that was statistically similar to the overall mathematics score in *knowing*, but were weaker in *applying* and stronger in *reasoning*.

Table 3.10 shows that, for the Australian jurisdictions, this pattern was replicated only in New South Wales. In the Australian Capital Territory and the Northern Territory there was no significant difference from mathematics overall for *knowing* and *reasoning*, but a slightly weaker performance in *applying*. In contrast, Queensland, South Australia, Western Australia, Tasmania and Victoria all had relatively stronger performance in *reasoning* compared to mathematics overall, but no significant difference in performance for *knowing* or *applying*.

There were no sex differences across the domains, and the pattern of relative performance was the same for males and females and mirrored that of Australia overall.

The difference between non-Indigenous and Indigenous students remained fairly stable across the domains (ranging from 67 score points for *knowing* and 71 score points for *applying*). However, the results recorded by Indigenous students across the domains indicate that Indigenous students – unlike their non-Indigenous peers – do not show a significant (or substantial) difference in performance between mathematics overall and *applying*. This is due to a larger standard error.

TABLE 3.10 Relative mean achievement in the Year 8 mathematics cognitive domains, for Australia and by jurisdiction, sex and Indigenous background

	Mathematics overall		*Knowing*		Differences between mathematics overall and *knowing*		*Applying*		Differences between mathematics overall and *applying*		*Reasoning*		Differences between mathematics overall and *reasoning*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	505	3.1	504	3.1	-1	1.5	502	3.0	**-3**	**1.0**	512	3.1	**7**	**1.2**
ACT	516	4.5	514	4.7	-3	2.0	512	4.7	**-4**	**2.0**	521	5.0	5	2.5
NSW	503	6.9	502	6.7	0	2.1	498	6.8	**-4**	**1.5**	508	6.5	**5**	**1.6**
VIC	516	5.1	516	5.1	0	1.8	515	5.4	-2	1.4	524	5.3	**8**	**1.9**
QLD	498	5.7	498	5.2	0	2.3	496	5.5	-2	2.1	506	5.4	**8**	**1.9**
SA	498	9.1	497	8.7	-1	1.8	495	9.3	-3	1.9	506	9.0	**8**	**1.9**
WA	508	6.0	505	5.8	-2	1.5	505	6.1	-2	1.5	515	6.0	**7**	**2.5**
TAS	493	8.4	491	7.3	-2	2.4	490	8.1	-3	1.7	503	8.2	**10**	**2.0**
NT	452	10.0	450	8.9	-2	4.2	445	9.3	**-7**	**3.3**	457	9.1	5	3.8
Female	504	3.8	505	3.8	1	1.8	500	3.9	**-4**	**1.4**	511	3.8	**7**	**1.6**
Male	506	3.5	504	3.4	-2	1.6	504	3.6	**-2**	**1.0**	513	3.7	**7**	**1.6**
Non-Indigenous	508	3.0	507	3.0	-1	1.5	505	2.9	**-3**	**1.0**	515	3.0	**7**	**1.2**
Indigenous	438	6.0	440	5.8	3	1.8	434	5.6	-3	2.0	446	5.9	**8**	**2.3**

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 3.11 shows the trends in achievement for the cognitive domains for Australia as a whole. The only significant change over time was an increase in the performance in *knowing*, of 15 score points, since 2007.

TABLE 3.11 Trends in mean achievement in the Year 8 mathematics cognitive domains, for Australia

	Knowing				*Applying*				*Reasoning*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	504	3.1	0	15 ↑	502	3.0	-4	4	512	3.1	6	9
2011	504	5.2		14 ↑	506	4.9		8	506	5.2		3
2007	490	3.9			498	3.8			503	4.0		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Chapter 4

Year 4 science

Key findings

- With an average score of 524 score points on the TIMSS Year 4 science scale, Australian students significantly outperformed students in 17 other countries, such as Portugal, New Zealand and France.
- However, Australian Year 4 students were outperformed by students in 17 other countries, including the United States and England, as well as the participating East Asian countries Singapore, Korea, Japan, Hong Kong and Chinese Taipei.
- Notwithstanding a 2015 recovery following the dip in TIMSS 2011, Australia's TIMSS 2015 Year 4 science score is not significantly different to that of TIMSS 1995.
- Eight per cent of Australian Year 4 students achieved the Advanced international benchmark in science – compared to 37 per cent of students in Singapore.
- Seventy-five per cent of Australian Year 4 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 4 students scored significantly higher than the overall science score in *life science*, but were weaker in *physical science* and, to a lesser degree, *Earth science*.
- Australian Year 4 students performed at a level that was statistically similar to the overall science score in *knowing* and *applying*, while scoring significantly higher in *reasoning*.
- The performance of students in the Australian Capital Territory was significantly higher than that of students in all other jurisdictions. Students in the Northern Territory performed significantly below students in all other jurisdictions.
- The difference between Australian male and female students in Year 4 science was not statistically significant.
- Students who have *many books* in the home were found to score 19 score points higher than students with an *average number of books* in the home, and 70 score points higher than those who reported having a *few books* in the home.
- Fifty-three per cent of Indigenous students compared to 23 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.

- Students who spoke English ‘always’ or ‘almost always’ at home scored significantly higher than students whose main language at home was not English.
- Fifty-five per cent of students in remote schools, compared to 70 per cent of provincial students and 78 per cent of metropolitan students, performed at or above the Intermediate international benchmark – the proficient standard for Australia.

This chapter presents the TIMSS 2015 international and national results for science at Year 4 level. The first section provides a summary of the TIMSS 2015 science framework at Year 4, along with a description of the international benchmarks for Year 4 science. The second section examines the performance of Australian Year 4 students in science in the international context. Turning the focus to domestic outcomes, the third section looks at Year 4 science performance across the Australian educational jurisdictions and the fourth provides the results for demographic groups within Australia. The final section looks at the results for the content and cognitive domains for Year 4 science.

The TIMSS 2015 science framework

Mullis and Martin (2013) contend that for young people in today’s world, some level of understanding of science is imperative to enable them to make decisions about themselves (e.g. regarding nutrition, medication, hygiene) and the world in which they live (e.g. regarding climate change, food production, natural resources). In TIMSS, students’ scientific understanding is assessed by having participating students read selected questions and stimulus materials and respond to a variety of questions.

The TIMSS 2015 science framework is organised around two dimensions – a content dimension, which specifies the subject matter to be assessed within science (e.g. *life science* and *physical science*) and the cognitive dimension, which specifies the thinking processes and sets of behaviours expected of students as they engage with the science content.

In 2015, TIMSS science also assessed science practices. These are the scientific practices involved in scientific inquiry and include:

- asking questions based on observations
- generating evidence
- working with data
- answering the research question
- making an argument from evidence.

Within the TIMSS assessment framework the scientific practices are considered to be best assessed in the context of the content domains and by drawing upon the thinking processes from the cognitive domains. Thus, a number of items within the TIMSS 2015 science assessment, at both Year 4 and Year 8, assess one or more of the scientific practices, along with content and thinking processes from the content and cognitive items.

Science content and cognitive domains

In the TIMSS 2015 science framework for Year 4 students, three content domains are defined:

- *life science*
- *physical science*
- *Earth science*.

Each of these content domains has several topic areas. For example, the domain *life science* includes characteristics and life processes of organisms; life cycles, reproduction and heredity; organisms, environment and their interactions; ecosystems; and human health. These topic areas are shown in Table 4.1.

For a detailed description of each of the content domains in science, please refer to Mullis and Martin (2013).

TABLE 4.1 TIMSS Year 4 science content domains and percentage of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Life science	▸ Characteristics and life processes of organisms ▸ Life cycles, reproduction and heredity ▸ Organisms, environment and their interactions ▸ Ecosystems ▸ Human health	45
Physical science	▸ Classification and properties of matter and changes in matter ▸ Forms of energy and energy transfer ▸ Forces and motion	35
Earth science	▸ Earth's structure, physical characteristics and resources ▸ Earth's processes and history ▸ Earth in the solar system	20

To respond correctly to TIMSS test items, students need to be familiar with the science content of the items. Just as importantly, however, items were designed to elicit the use of particular cognitive skills. The TIMSS 2015 assessment framework presents detailed descriptions of the skills and abilities that make up the cognitive domains and that are assessed in conjunction with the content. The student behaviours encompassed by the cognitive dimension have been classified into three domains within the assessment framework.

The three domains can be described as follows:

- *knowing* – which covers the facts, procedures and concepts students need to know
- *applying* – which focuses on the ability of students to apply knowledge to generate explanations and to solve practical problems
- *reasoning* – which includes using evidence and science understanding to analyse, synthesise and generalise, often in unfamiliar situations and complex contexts.

Table 4.2 shows the percentage of assessment devoted to each cognitive domain at Year 4. These three cognitive domains are used for both Year 4 and Year 8, but the balance of testing time differs in these two year levels, reflecting the difference in age and experience of the students tested. In TIMSS 2015, each content domain included items developed to address each of the three cognitive domains; for example, the *life science* domain included *knowing*, *applying* and *reasoning* items, as did the other content domains.

TABLE 4.2 TIMSS Year 4 science cognitive domains and percentage of assessment for each domain

Cognitive domains	Target % of TIMSS assessment
Knowing	40
Applying	40
Reasoning	20

The TIMSS international benchmarks

The TIMSS science achievement scale summarises Year 4 students' performance when interacting with a variety of scientific tasks and questions (please see the Reader's Guide for more information about the achievement scales). Students' achievement is based on their responses to test questions designed to assess a range of content areas. When comparing groups of students across and within countries, summary statistics such as the average, or mean, scale score are often used. This score, however, does not provide detailed information as to what types of scientific tasks the students were able to undertake successfully. Instead, TIMSS uses international benchmarks to provide descriptions of achievement on the scale in relation to performance on the questions asked.

Internationally, it was decided that performance should be measured at four levels. These four levels summarise the achievement reached by:

- the 'Advanced international benchmark', which was set at 625 score points
- the 'High international benchmark', which was set at 550 score points
- the 'Intermediate international benchmark', which was set at 475 score points
- the 'Low international benchmark', which was set at 400 score points.

The descriptions of the levels are cumulative, so that a student who reached the High benchmark can typically demonstrate the knowledge and skills for both the Intermediate and the Low benchmarks. Table 4.3 provides a summary of the TIMSS 2015 Year 4 science benchmarks.

TABLE 4.3 The TIMSS 2015 international benchmarks for Year 4 science

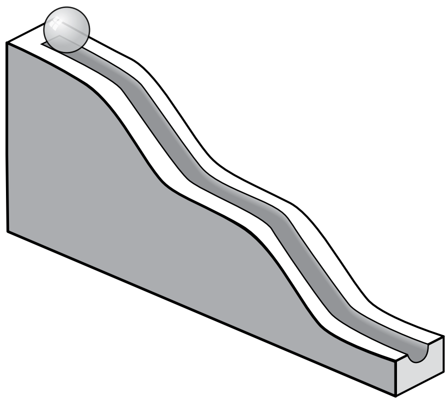
625	**Advanced international benchmark** *Students communicate understanding of life, physical, and Earth sciences and demonstrate some knowledge of the process of scientific inquiry.* Students demonstrate knowledge of characteristics and life processes of a variety of organisms, communicate understanding of relationships in ecosystems and interactions between organisms and their environment, and communicate and apply knowledge of factors related to human health. They communicate understanding of properties and states of matter and physical and chemical changes, apply some knowledge of forms of energy and energy transfer, and show some knowledge of forces and an understanding of their effect on motion. Students communicate understanding of Earth's structure, physical characteristics, processes and history, and show knowledge of Earth's revolution and rotation. Students demonstrate basic knowledge and skills related to scientific inquiry, recognising how a simple experiment should be set up, interpreting the results of an investigation, reasoning and drawing conclusions from descriptions and diagrams, and evaluating and supporting an argument.
550	**High international benchmark** *Students communicate and apply knowledge of the life, physical and Earth sciences in everyday and abstract contexts.* Students communicate knowledge of characteristics of plants, animals and their life cycles, and apply knowledge of ecosystems and of humans' and organisms' interactions with their environment. Students communicate and apply knowledge of states and properties of matter, and of energy transfer in practical contexts, as well as showing some understanding of forces and motion. Students apply knowledge of Earth's structure, physical characteristics, processes and history, and show basic understanding of the Earth–Moon–Sun system. Students compare, contrast and make simple inferences using models, diagrams and descriptions of investigations, and provide brief descriptive responses using science concepts, both in everyday and abstract contexts.
475	**Intermediate international benchmark** *Students show basic knowledge and understanding of life, physical and Earth sciences.* Students demonstrate some knowledge of life processes of plants and humans, communicate and apply knowledge of the interaction of living things with their environments as well as impacts humans can have on their environment, and communicate knowledge of basic facts related to human health. They apply knowledge about some properties of matter and about some facts related to electricity and to energy transfer, and apply elementary knowledge of forces and motion. They show some understanding of Earth's physical characteristics and demonstrate some basic knowledge of Earth in the solar system. Students interpret information in diagrams, apply factual knowledge to everyday situations, and provide simple explanations for biological and physical phenomena.

400	**Low international benchmark** *Students show basic knowledge of life and physical sciences.* Students demonstrate some basic knowledge of behavioural and physical characteristics of plants and animals as well as of the interaction of living things with their environments, and apply knowledge of some facts related to human health. Students show basic knowledge of states of matter and physical properties of matter. They interpret simple diagrams, complete simple tables and provide short, fact-based written responses.

At Year 4, students at the Advanced benchmark in science demonstrated the ability to communicate their understanding of life, physical and Earth sciences and demonstrate basic knowledge and skills related to scientific inquiry, including how a simple experiment should be set up.

As an example, Figure 4.1 shows an item from the *physical science* domain that Year 4 students performing at the Advanced benchmark could answer correctly. This constructed-response item required students to identify the force that moves the object down the track. This item was relatively difficult for students in most countries and was answered correctly by only 26 per cent of students across countries, on average. In Australia, 25 per cent of students answered this item correctly, which was not significantly different to the international average.

Marcus puts a marble at the top of a sloping track as shown below.



The marble rolls down the track.

Name the force that moves the marble. Gravity

FIGURE 4.1 Advanced international benchmark, Year 4 science – example item

At Year 4, students achieving the Low benchmark demonstrated basic knowledge of the life and physical sciences. This included simple facts related to human health and the behavioural and physical characteristics of animals and plants.

The item in Figure 4.2 shows four pairs of animals from which students identified the pair (the duck and the frog) that both lay eggs. This elementary knowledge of *life science* exemplifies the Low benchmark. With an international average of 69 per cent correct across the Year 4 countries, this item was relatively easy for students in most countries. In Australia, 80 per cent of Year 4 students answered this question correctly, which is significantly above the international average.

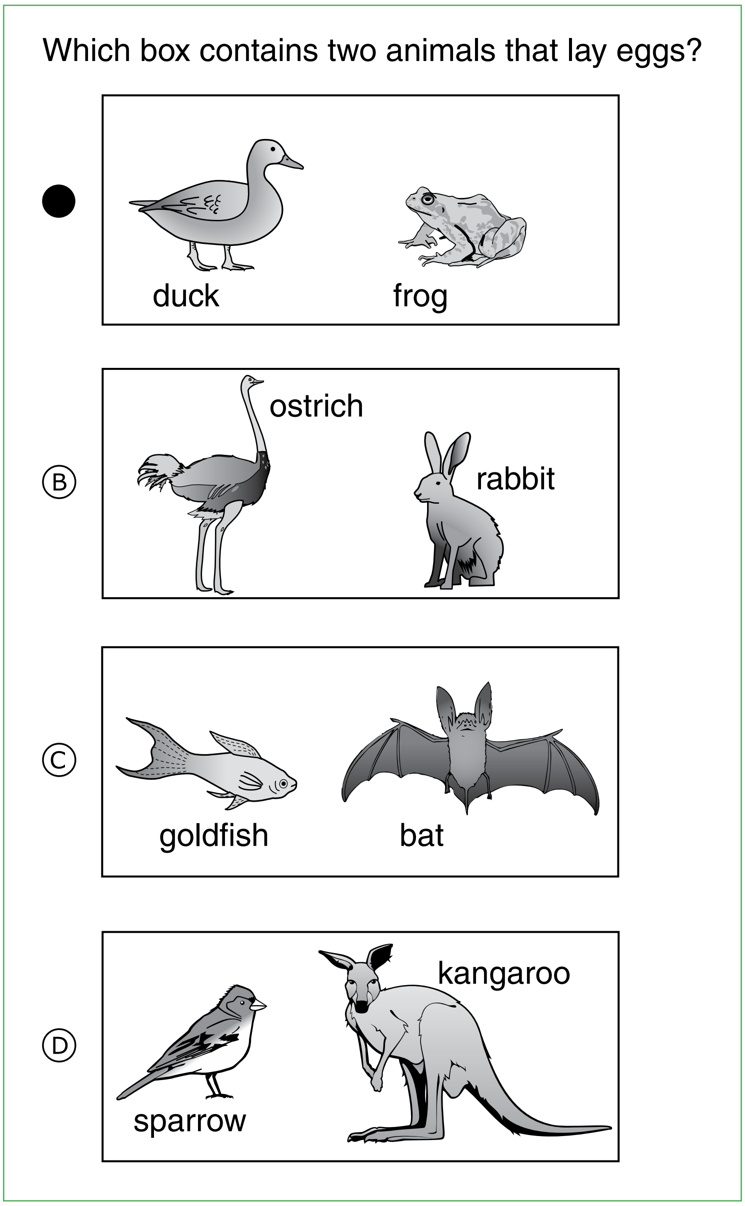


FIGURE 4.2 Low international benchmark, Year 4 science – example item

Further information about the types of science skills and strategies demonstrated by Year 4 students who performed at each of the international benchmarks, along with examples of the types of responses provided by students at each of the benchmarks, is provided in the *TIMSS 2015 International Results in Science* (http://timss2015.org/timss-2015/science/performance-at-international-benchmarks/).

Australia's Year 4 science results within the international context

This section reports the TIMSS 2015 science results as average scores and distributions on the TIMSS Year 4 science scale (please see the Reader's Guide for more information about the achievement scales).

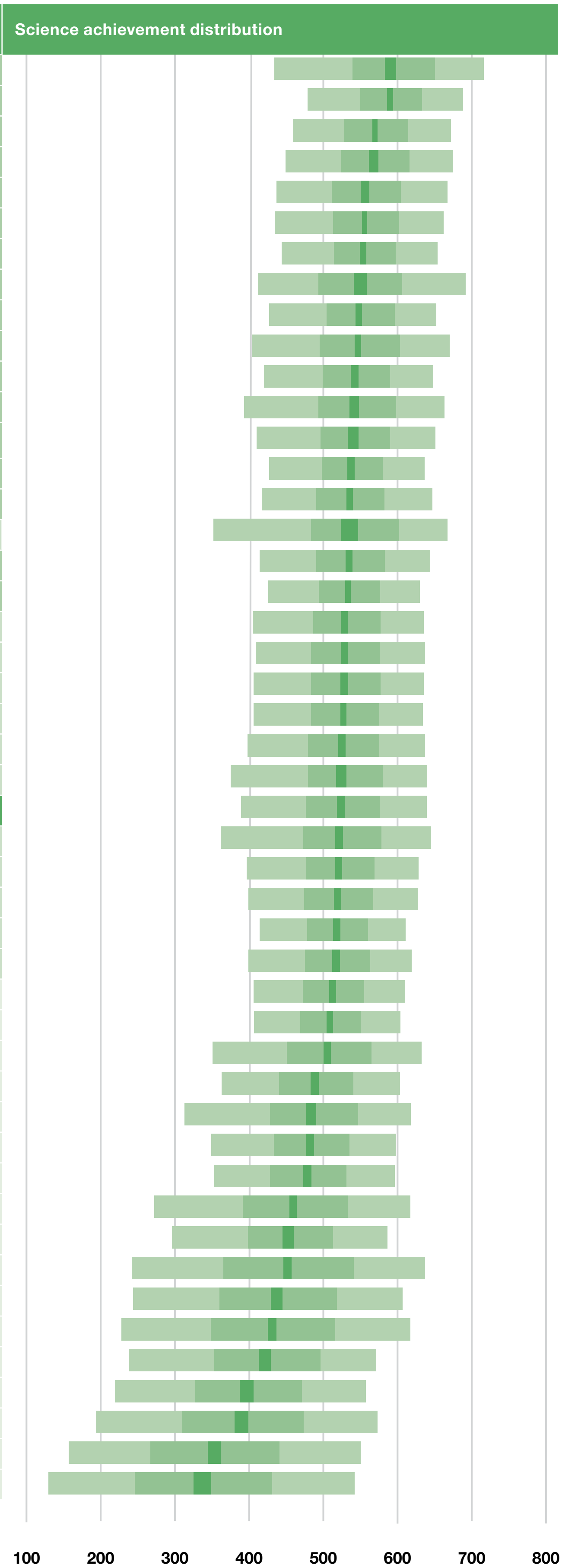
Figure 4.3 provides a summary of the overall performance of students in Year 4 across different countries on the TIMSS 2015 science achievement scale, in terms of the mean scores achieved by students in each country, the standard error of each mean, and the range of scores achieved between the 5th and 95th percentiles.

Countries are positioned in Figure 4.3 according to decreasing level of achievement; however, this should not be interpreted as a simple ranking, as the differences between countries may not be statistically significant. The shading in this figure indicates whether the score for a given country is significantly different to that of Australia. To determine whether or not differences between other countries are statistically significant, please refer to the multiple-comparisons tables available in the *TIMSS 2015 International Results in Science* (http://timss2015.org/timss-2015/science/student-achievement/multiple-comparisons-of-science-achievement/).

Singapore and Korea were the top-performing countries of TIMSS 2015, scoring well in excess of the High benchmark of 550. The scores for these countries were not significantly different to each other but were significantly higher than those for all other countries. The next-highest-performing country was Japan, closely followed by the Russian Federation. Australia's average score of 524 score points was significantly higher than that of 17 other countries, including New Zealand, Portugal and France. It was, however, significantly lower than the average score for 17 other countries, including the United States and England, as well as the participating Asian countries Singapore, Korea, Japan, Hong Kong and Chinese Taipei. Australia's score was not significantly different to the scores of 12 other countries, including Ireland, Northern Ireland and Canada.

Figure 4.3 also shows the range of achievement within countries, with 282 score points separating the 5th and 95th percentiles for Singapore, but more than 400 score points separating the highest and lowest achievers in Kuwait (412 score points). Australia's gap between high and low achievers, of 251 score points, was low to mid-range, similar to that of Canada (240 score points) and the United States (265 score points). The country with the narrowest range was the Netherlands, with only 196 score points separating the highest and lowest achievers.

Group	Country	Mean	SE	Gap 95th–5th percentiles
Achievement significantly higher than Australia's	Singapore	590	3.7	282
	Korea	589	2.0	208
	Japan	569	1.8	212
	Russian Federation	567	3.2	225
	Hong Kong	557	2.9	231
	Chinese Taipei	555	1.8	226
	Finland	554	2.3	210
	Kazakhstan	550	4.4	280
	Poland	547	2.4	224
	United States	546	2.2	265
	Slovenia	543	2.4	228
	Hungary	542	3.3	270
	Sweden	540	3.6	242
	Norway (5)	538	2.6	209
	England	536	2.4	231
	Bulgaria	536	5.9	316
	Czech Republic	534	2.4	230
	Croatia	533	2.1	204
Achievement not different to Australia's	Ireland	529	2.4	230
	Germany	528	2.4	229
	Lithuania	528	2.5	228
	Denmark	527	2.1	227
	Canada	525	2.6	240
	Serbia	525	3.7	266
	Australia	524	2.9	251
	Slovak Republic	520	2.6	283
	Northern Ireland	520	2.2	230
	Spain	518	2.6	227
	Netherlands	517	2.7	196
	Italy	516	2.6	219
Achievement significantly lower than Australia's	Belgium (Flemish)	512	2.3	203
	Portugal	508	2.2	197
	New Zealand	506	2.7	282
	France	487	2.7	239
	Turkey	483	3.3	305
	Cyprus	481	2.6	248
	Chile	478	2.7	242
	Bahrain	459	2.6	345
	Georgia	451	3.7	288
	United Arab Emirates	451	2.8	394
	Qatar	436	4.1	362
	Oman	431	3.1	389
	Iran	421	4.0	333
	Indonesia	397	4.8	338
	Saudi Arabia	390	4.9	379
	Morocco	352	4.7	393
	Kuwait	337	6.2	412



Note: See Reader's Guide for interpretation of graph.

Bulgaria recorded a mean score that, though not significantly different to Australia's, was higher than scores of other countries that significantly exceeded Australia's. Bulgaria's larger standard error accounts for the discrepancy.

FIGURE 4.3 Mean scores and distribution of Year 4 science achievement, by country

Performance at the international benchmarks

In addition to analysing performance according to mean scores, it is beneficial to use the international benchmarks described previously to gain further insight into student achievement. Figure 4.4 shows the percentage of students in each country at each of the international benchmarks.

The countries are ordered by the percentages of students reaching the Intermediate international benchmark, which is the proficient standard set for TIMSS science in Australia (please see the Reader's Guide for more information about the proficient standard).

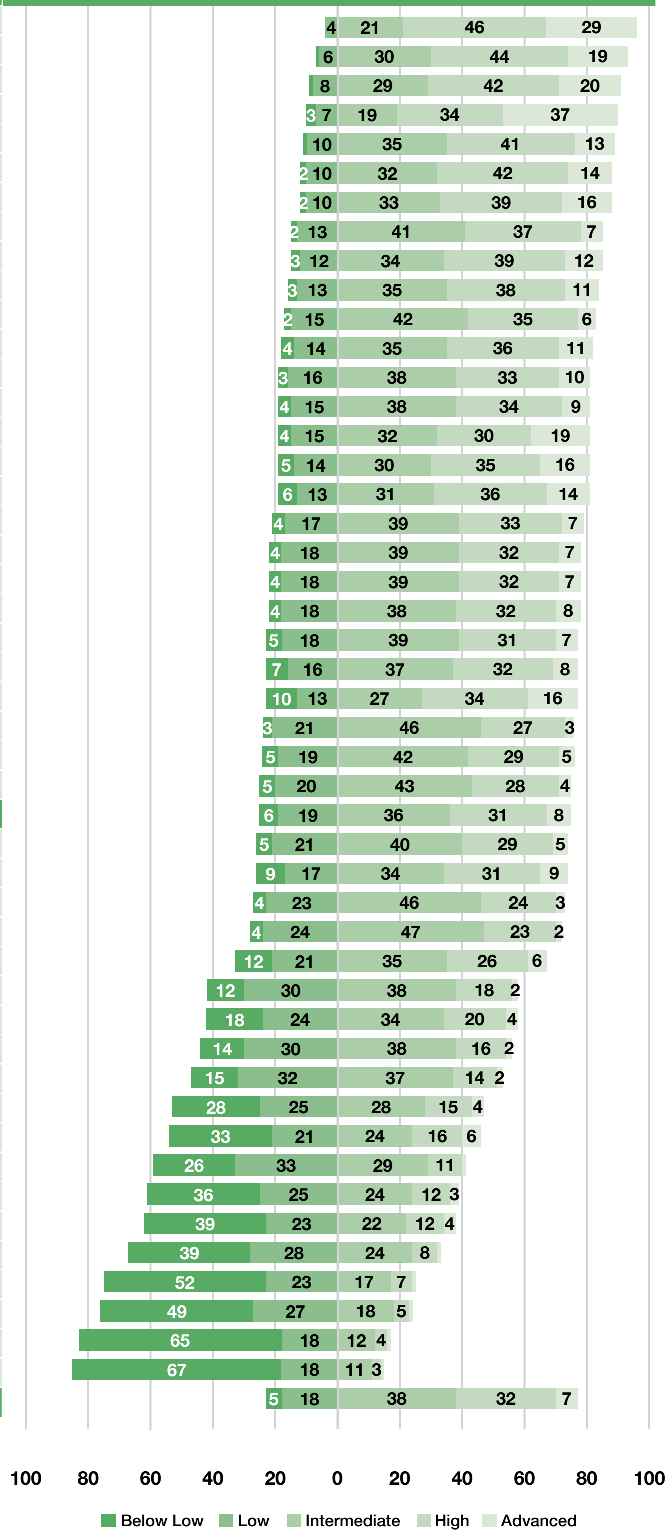
The countries with the largest percentages of students reaching the Advanced benchmark were also countries with the highest average science achievement. Singapore, Korea, the Russian Federation and Japan head the participants represented in Figure 4.4, with between 19 and 37 per cent of their Year 4 students achieving the Advanced benchmark, and between four and 10 per cent of their students reaching only the Low benchmark or not achieving this level at all. Kazakhstan also had 19 per cent of their Year 4 students achieve the Advanced benchmark, but also had a significant proportion (19%) who achieved at or below the Low benchmark.

Only eight per cent of Australian students achieved the Advanced benchmark, with a further 31 per cent performing at the High benchmark and 36 per cent at the Intermediate benchmark, which is the proficient standard for Australia. Of concern are the 25 per cent of Australian Year 4 students that did not achieve the Intermediate benchmark. This group is made up of 19 per cent achieving at the Low benchmark and six per cent achieving below this level.

The percentage of Australian Year 4 students achieving at each of the international benchmarks is similar to that of the international median.

Country	% of students at or above the proficient standard for Australia	SE
Korea	96	0.5
Japan	93	0.5
Russian Federation	91	1.0
Singapore	90	1.1
Finland	89	0.9
Chinese Taipei	88	0.8
Hong Kong	88	1.1
Norway (5)	85	1.1
Poland	85	1.3
Slovenia	84	1.0
Croatia	83	1.1
Sweden	82	1.5
England	81	1.2
Czech Republic	81	1.1
Kazakhstan	81	1.4
United States	81	0.9
Hungary	81	1.6
Ireland	79	1.2
Denmark	78	1.3
Lithuania	78	1.2
Germany	78	1.3
Canada	77	1.4
Serbia	77	1.7
Bulgaria	77	2.2
Netherlands	76	1.4
Northern Ireland	76	1.3
Italy	75	1.7
Australia	75	1.4
Spain	74	1.6
Slovak Republic	74	1.2
Belgium (Flemish)	73	1.4
Portugal	72	1.5
New Zealand	67	1.4
France	58	1.6
Turkey	58	1.4
Cyprus	56	1.4
Chile	53	1.5
Bahrain	47	1.2
United Arab Emirates	46	1.0
Georgia	41	1.7
Qatar	39	1.7
Oman	38	1.2
Iran	33	1.5
Saudi Arabia	25	1.4
Indonesia	24	1.8
Morocco	17	1.3
Kuwait	15	1.4
International median	77	

Performance at each of the TIMSS international benchmarks



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.4 Percentages of students at the international benchmarks for Year 4 science, by country

Trends in Year 4 science achievement

Looking at the overall trends in Year 4 science achievement during the 1995–2015 period, there have been more countries with increases in their average science achievement than with decreases. Among the countries with the greatest increases from 1995 to 2015 were Slovenia, Singapore, Portugal, Hong Kong and Iran, with achievement increases of between 41 and 78 score points over the 20-year period. Slovenia and Hong Kong also managed improvements of over 20 score points since 2011, while a number of other countries also had impressive increases since 2011, such as Kazakhstan (55 score points), Oman (54 score points), Qatar (42 score points) and Morocco (89 score points).

Figure 4.5 shows trends in Year 4 science achievement for some selected countries that have comparable data from previous TIMSS assessments. Rather than include graphs showing changes for all countries, we have provided just a few, for interest and comparison. The countries that have been included are those with which we usually make comparisons: the United States, England and New Zealand, along with one of the higher-achieving countries, Singapore, and Slovenia, which showed a large change over this time. The figure provides a graphical depiction of change in Year 4 average achievement in science across the TIMSS assessment years (1995–2015).

In TIMSS 2015, Australia's average scale score for science achievement (524) was eight score points higher than that of the previous cycle, and this difference was significant. The average scale score for TIMSS 2015 was slightly lower than the 2007 score, and very similar to those for 2003 and 1995. However, none of these difference were statistically significant.

As shown in Figure 4.5, the patterns of achievement through the five cycles of TIMSS vary considerably across countries. Of the countries chosen for comparison, Singapore and Slovenia recorded quite considerable improvement since 1995 (in the order of 67 and 78 score points, respectively). England, while having a statistically significant improvement of eight score points since 1995, has improved and declined, and then improved again. Likewise, New Zealand has had a pattern of improvement and decline, followed by improvement, although New Zealand's average scale score in 2015 was not significantly different to that in 1995. The pattern for the United States was for some variation over the years but no significant difference from 1995.

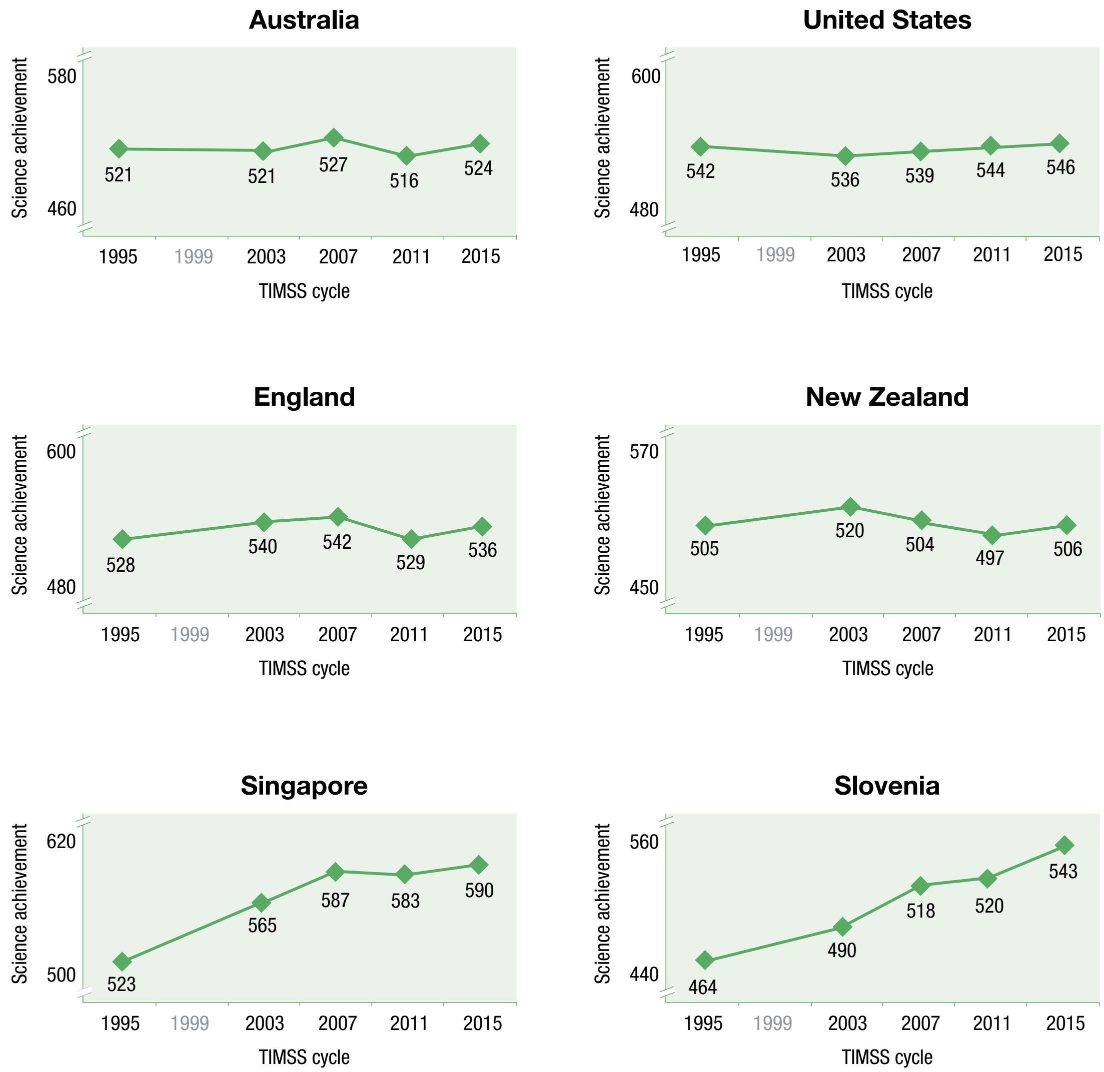
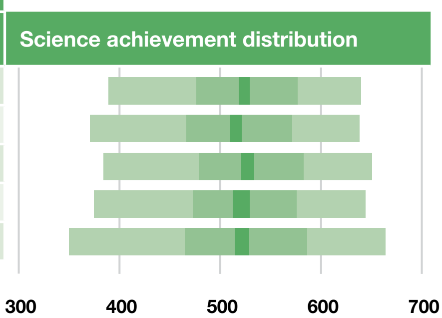


FIGURE 4.5 Trends in Year 4 science achievement scores, 1995–2015, selected countries

Interestingly, the spread of science achievement scores for Australian Year 4 students has decreased since 1995. Figure 4.6 shows the distribution of science achievement for Australian Year 4 students across the cycles and shows quite clearly that the 5th percentile (or lowest-performing 5% of students) performed at a higher level in 2015 than in 1995. In comparison, the top five per cent (or 95th percentile) were performing at a lower level in 2015 than in 1995.

			Differences between years			
	Mean	SE	2011	2007	2003	1995
2015	524	2.9	8 ↑	-4	3	2
2011	516	2.9		-12 ↓	-5	-6
2007	527	3.3			7	6
2003	521	4.3				-1
1995	521	3.7				



Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

See Reader's Guide for interpretation of graph.

FIGURE 4.6 Trends in Year 4 science achievement score and distribution, 1995–2015, Australia

Table 4.4 displays each country's position relative to that of Australia in each TIMSS cycle (please see Appendix B for the mean scores by cycle for each country). Australia's relative position in TIMSS 2015 was about the same as that of TIMSS 2011, although there had been some movement of other countries around Australia.

Slovenia and Croatia, which had the same score as Australia's in 2011, outperformed Australia in 2015. Spain, whose position was significantly lower than Australia's in 2011, achieved a score in TIMSS 2015 that is not significantly different to that of Australia. Kazakhstan, which scored significantly lower than Australia in 2011, scored significantly higher than Australia in 2015. Australia's score has improved relative to Germany, Denmark, the Slovak Republic, Netherlands and Italy, all of which outperformed Australia in 2011.

In terms of trends since 1995, Singapore and England had scores in TIMSS 1995 that were not statistically different to that of Australia, but both have improved their scores over the past 20 years to achieve at a significantly higher level than Australia's. Hong Kong, Slovenia and Hungary all scored at a significantly lower level than that of Australia in TIMSS 1995 but now significantly outperform Australia.

TABLE 4.4 Relative trends in Year 4 science achievement, by country

Country	Position relative to Australia 2015	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Singapore	↑	↑	↑	↑	•
Korea	↑	↑	–	–	↑
Japan	↑	↑	↑	↑	↑
Russian Federation	↑	↑	↑	•	–
Hong Kong	↑	↑	↑	↑	↓
Chinese Taipei	↑	↑	↑	↑	–
Finland	↑	↑	–	–	–
Kazakhstan	↑	↓	–	–	–
Poland	↑	–	–	–	–
United States	↑	↑	↑	↑	↑
Slovenia	↑	•	↓	↓	↓
Hungary	↑	↑	•	•	↓
Sweden	↑	↑	•	–	–
Norway (5)	↑	–	–	–	–
England	↑	↑	↑	↑	•
Bulgaria	•	–	–	–	–
Czech Republic	↑	↑	↓	–	↑
Croatia	↑	•	–	–	–
Ireland	•	•	–	–	•
Germany	•	↑	•	–	–
Lithuania	•	•	↓	•	–
Denmark	•	↑	↓	–	–
Canada	•	–	–	–	–
Serbia	•	•	–	–	–
Australia					
Slovak Republic	•	↑	•	–	–
Northern Ireland	•	•	–	–	–
Spain	•	↓	–	–	–
Netherlands	•	↑	•	•	•
Italy	•	↑	•	•	–
Belgium (Flemish)	↓	↓	•	–	–
Portugal	↓	•	–	–	↓
New Zealand	↓	↓	↓	•	↓
France	↓	–	–	–	–
Turkey	↓	↓	–	–	–
Cyprus	↓	–	–	↓	↓
Chile	↓	↓	–	–	–
Bahrain	↓	↓	–	–	–
United Arab Emirates	↓	↓	–	–	–
Georgia	↓	↓	↓	–	–
Qatar	↓	↓	–	–	–
Oman	↓	↓	–	–	–
Iran	↓	↓	↓	↓	↓
Indonesia	↓	–	–	–	–
Saudi Arabia	↓	↓	–	–	–
Morocco	↓	↓	–	–	–
Kuwait	↓	↓	–	–	–

↑ Score significantly higher than Australia's.

↓ Score significantly lower than Australia's.

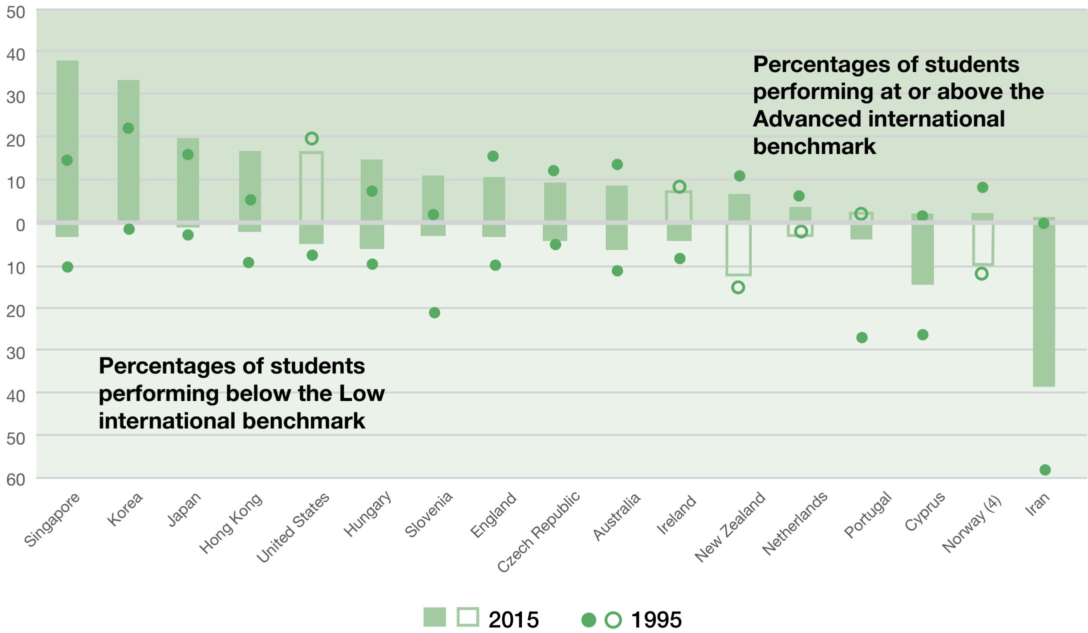
• Score not significantly different to that of Australia.

– Did not participate in this cycle.

Figure 4.7 shows the trends in the percentages of students achieving the Advanced international benchmark and those not achieving the Low international benchmark for countries that participated in both TIMSS 1995 and TIMSS 2015.

In the majority of countries (14 out of 17) that participated in both TIMSS 1995 and TIMSS 2015, the percentages of students achieving the Low benchmark in Year 4 science significantly increased between 1995 and 2015.

However, between the 1995 and 2015 cycles, only eight of the 17 countries managed significantly to increase the percentages of students who achieved the Advanced benchmark. In six of the countries, including Australia, the percentages of students achieving the Advanced benchmark significantly decreased from 1995 to 2015.



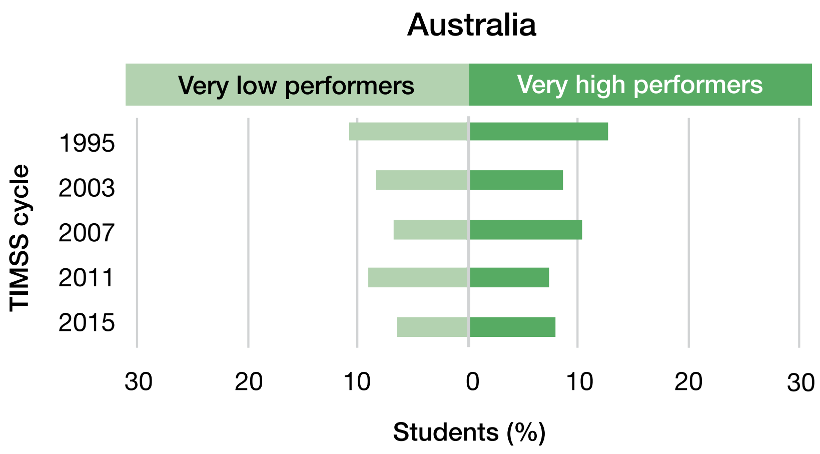
Note: A coloured bar and a coloured circle indicate that the difference in the percentages of students between TIMSS 1995 and TIMSS 2015 was significant.

FIGURE 4.7 Percentages of very high- and very low-achieving students in Year 4 science in TIMSS 1995 and TIMSS 2015, by country

Chapter 4

Figure 4.8 shows the trends in the percentages of Australian Year 4 students achieving the Advanced international benchmark and those not achieving the Low international benchmark in science in all cycles since TIMSS 1995.

This figure shows that the percentage of Australian Year 4 students achieving the Advanced benchmark has decreased significantly since 1995, while the percentage of students not achieving the Low benchmark in science has also decreased significantly since 1995.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 4.8 Percentages of very high- and very low-achieving students in Year 4 science in TIMSS 1995 to TIMSS 2015, Australia

Australia's Year 4 science results at the national level

Figure 4.9 presents the distribution of Year 4 science performance for each of the Australian jurisdictions for TIMSS 2015. To place the jurisdiction results in perspective, the means and distributions for Australia as a whole, and for Singapore, the highest-achieving country in the TIMSS science assessment, are also included in this figure. The jurisdictions are shown in order from highest to lowest mean scores.

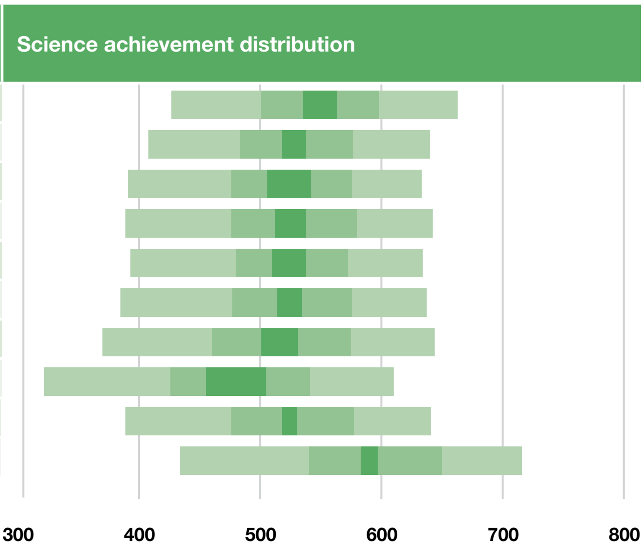
Figure 4.9 should be read in conjunction with Table 4.5, which presents the multiple comparisons of mean science performance between jurisdictions and indicates which jurisdiction's performance does, or does not, differ significantly from the performance of each of the other jurisdictions.

Figure 4.9 and Table 4.5 show that the variation of average scores across jurisdictions was moderately large, being 69 score points (almost three-quarters of a standard deviation) between the highest-achieving jurisdiction, the Australian Capital Territory, and the lowest-achieving jurisdiction, the Northern Territory.

The average science score of students in the Australian Capital Territory was significantly higher than that of students in all other jurisdictions. All jurisdictions performed significantly higher than the Northern Territory. There was no significant difference in mean achievement between Victoria, Tasmania, New South Wales, South Australia, Queensland and Western Australia.

The largest range of student performance was seen in the lowest-scoring jurisdiction, the Northern Territory, with a gap of 288 score points between the 5th and 95th percentiles. In contrast, the highest-performing jurisdiction, the Australian Capital Territory, had one of the smallest ranges of performance, along with Victoria, of around 230 score points. By way of comparison, Singapore's range from the 5th to the 95th percentile was 282 score points.

Jurisdiction	Mean	SE	Gap 95th–5th percentiles
ACT	549	7.0	235
VIC	527	4.9	231
TAS	525	9.4	243
NSW	524	6.4	252
SA	524	7.1	241
QLD	523	5.2	252
WA	516	7.5	274
NT	480	12.7	288
Australia	524	2.9	250
Singapore	590	3.7	282



Note: See Reader's Guide for interpretation of graph.

FIGURE 4.9 Mean scores and distribution of Year 4 science achievement, by jurisdiction

TABLE 4.5 Multiple comparisons of Year 4 science achievement, by jurisdiction

Jurisdiction	Mean	SE	ACT	VIC	TAS	NSW	SA	QLD	WA	NT
ACT	549	7.0		↑	↑	↑	↑	↑	↑	↑
VIC	527	4.9	↓		•	•	•	•	•	↑
TAS	525	9.4	↓	•		•	•	•	•	↑
NSW	524	6.4	↓	•	•		•	•	•	↑
SA	524	7.1	↓	•	•	•		•	•	↑
QLD	523	5.2	↓	•	•	•	•		•	↑
WA	516	7.5	↓	•	•	•	•	•		↑
NT	480	12.7	↓	↓	↓	↓	↓	↓	↓	

Note: Read across the row to compare a state/territory's performance with the performance of each jurisdiction listed in the column heading.

↑ Average performance statistically significantly higher than in comparison jurisdiction.

• No statistically significant difference from comparison jurisdiction.

↓ Average performance statistically significantly lower than in comparison jurisdiction.

Performance at the international benchmarks by jurisdiction

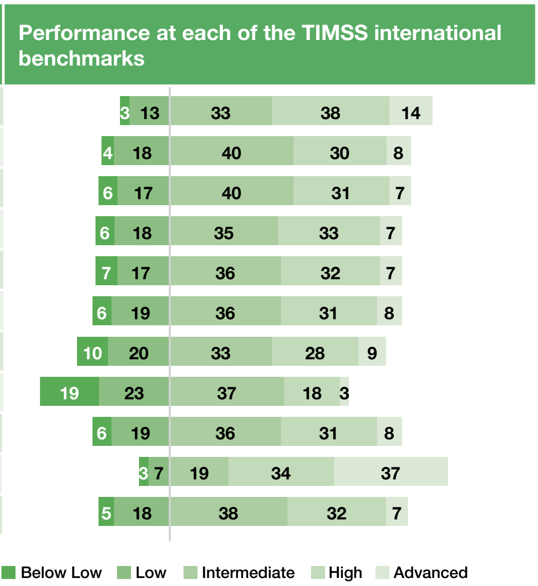
Figure 4.10 shows the percentage of students in each jurisdiction at each of the international benchmarks for Year 4 science, along with the percentages for Australia as a whole, Singapore (as the highest-scoring country) and the international median for comparison.

The Australian Capital Territory was the highest-performing jurisdiction, with 14 per cent of students reaching the Advanced benchmark and 85 per cent achieving at least the Intermediate benchmark, which is the proficient standard for Australia. In Singapore, however, 37 per cent of students achieved the Advanced benchmark and 90 per cent achieved at least the Intermediate benchmark.

Across Victoria, Tasmania, New South Wales, South Australia and Queensland, seven to eight per cent achieved the Advanced benchmark and about 40 per cent reached at least the High benchmark. More than three-quarters of students in each of these five jurisdictions achieved at least the Intermediate benchmark.

In Western Australia, 30 per cent of students failed to achieve the proficient standard, while nine per cent attained the Advanced benchmark. In the Northern Territory, 42 per cent of students did not achieve the Intermediate benchmark, while three per cent of students achieved the Advanced benchmark.

Jurisdiction	% of students at or above the proficient standard for Australia	SE
ACT	85	2.9
VIC	78	2.4
SA	77	3.7
TAS	76	4.9
QLD	76	2.5
NSW	75	2.8
WA	70	3.7
NT	58	7.3
Australia	75	1.4
Singapore	90	1.1
International median	77	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

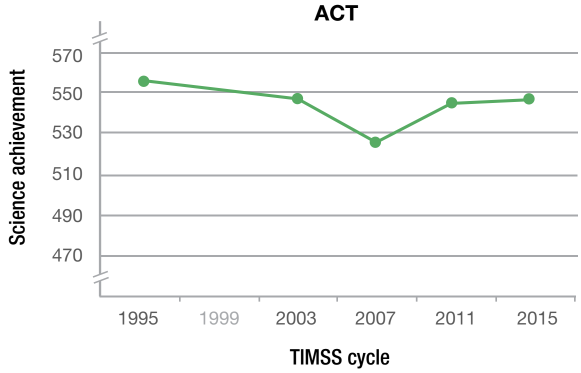
Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.10 Percentages of Australian students at the international benchmarks for Year 4 science, by jurisdiction

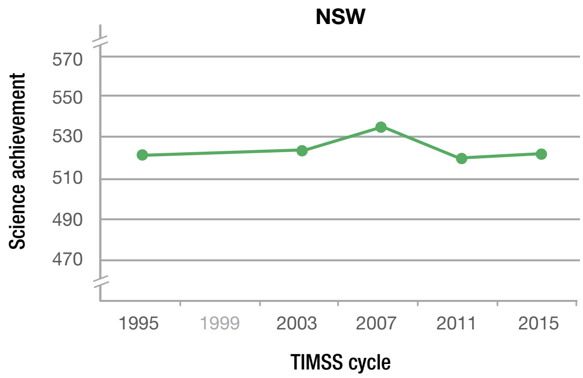
Trends in Year 4 science achievement by jurisdiction

Figure 4.11 presents the trends in science achievement for each of the jurisdictions for each cycle of TIMSS (1995, 2003, 2007, 2011 and 2015) and also an indication of the statistical significance of the difference between cycles (please see Appendix C for the mean scores by cycle for each jurisdiction).

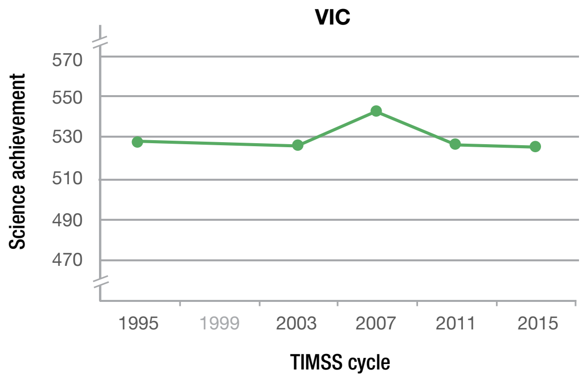
The results show that there has been little change in scores for most of the jurisdictions in science achievement at Year 4 since 1995. South Australia and Queensland showed a significant improvement between 2011 and 2015, and Queensland's average science score also increased in 2015 as compared to the 2007 and 1995 cycles.



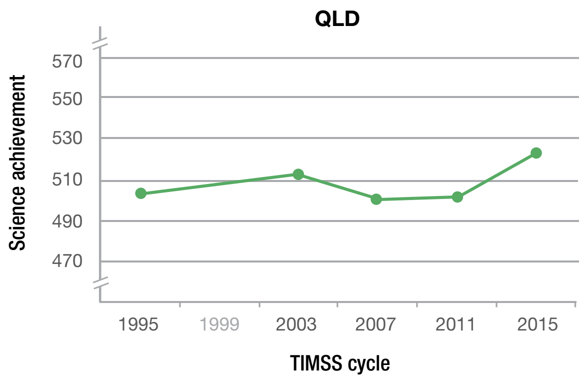
Differences between years				
	2011	2007	2003	1995
2015	2	22	2	-8
2011		19	-1	-10
2007			-20	-30 ↓
2003				-10



Differences between years				
	2011	2007	2003	1995
2015	2	-14	-2	1
2011		-16 ↓	-4	-1
2007			12	15
2003				3



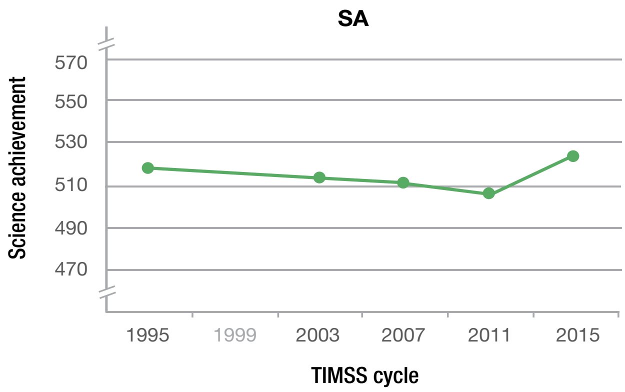
Differences between years				
	2011	2007	2003	1995
2015	-2	-17	-1	-2
2011		-16	1	-1
2007			16	15
2003				-1



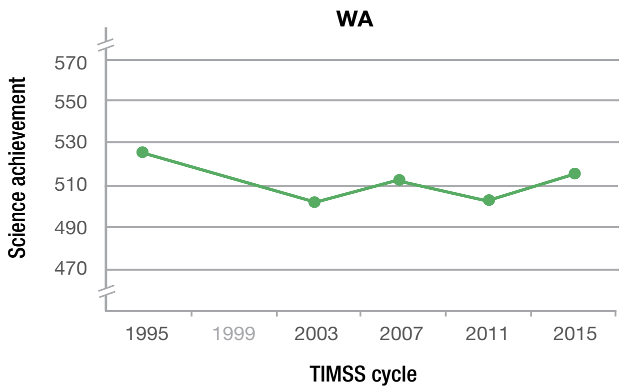
Differences between years				
	2011	2007	2003	1995
2015	23 ↑	23 ↑	10	20 ↑
2011		0	-12	-3
2007			-12	-3
2003				10

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

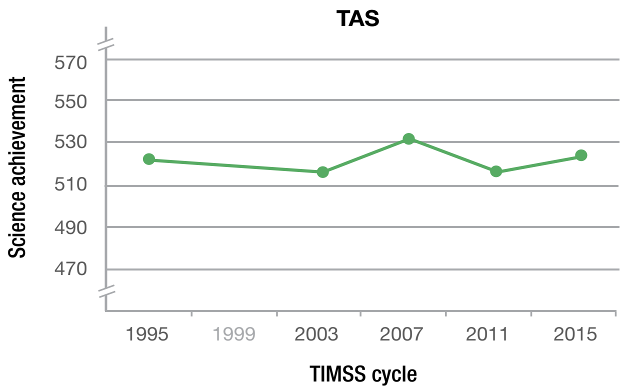
FIGURE 4.11 Trends in Year 4 science achievement within Australia, 1995–2015, by jurisdiction



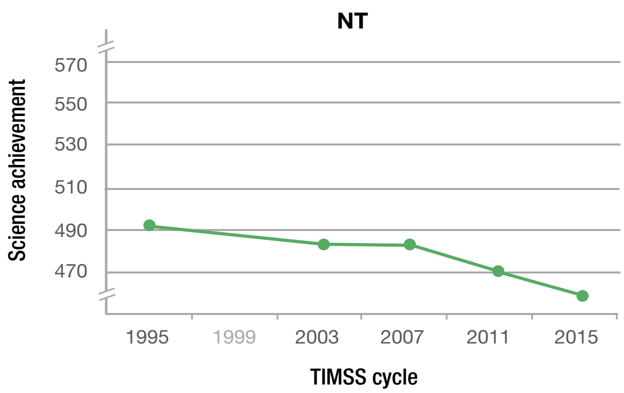
Differences between years				
	2011	2007	2003	1995
2015	18 ↑	12	9	5
2011		-6	-9	-13
2007			-3	-7
2003				-4



Differences between years				
	2011	2007	2003	1995
2015	14	4	14	-11
2011		-10	0	-25 ↓
2007			10	-15
2003				-25 ↓



Differences between years				
	2011	2007	2003	1995
2015	7	-8	7	2
2011		-15	0	-5
2007			16	10
2003				-5



Differences between years				
	2011	2007	2003	1995
2015	-11	-23	-23	-32
2011		-12	-12	-21
2007			0	-9
2003				-9

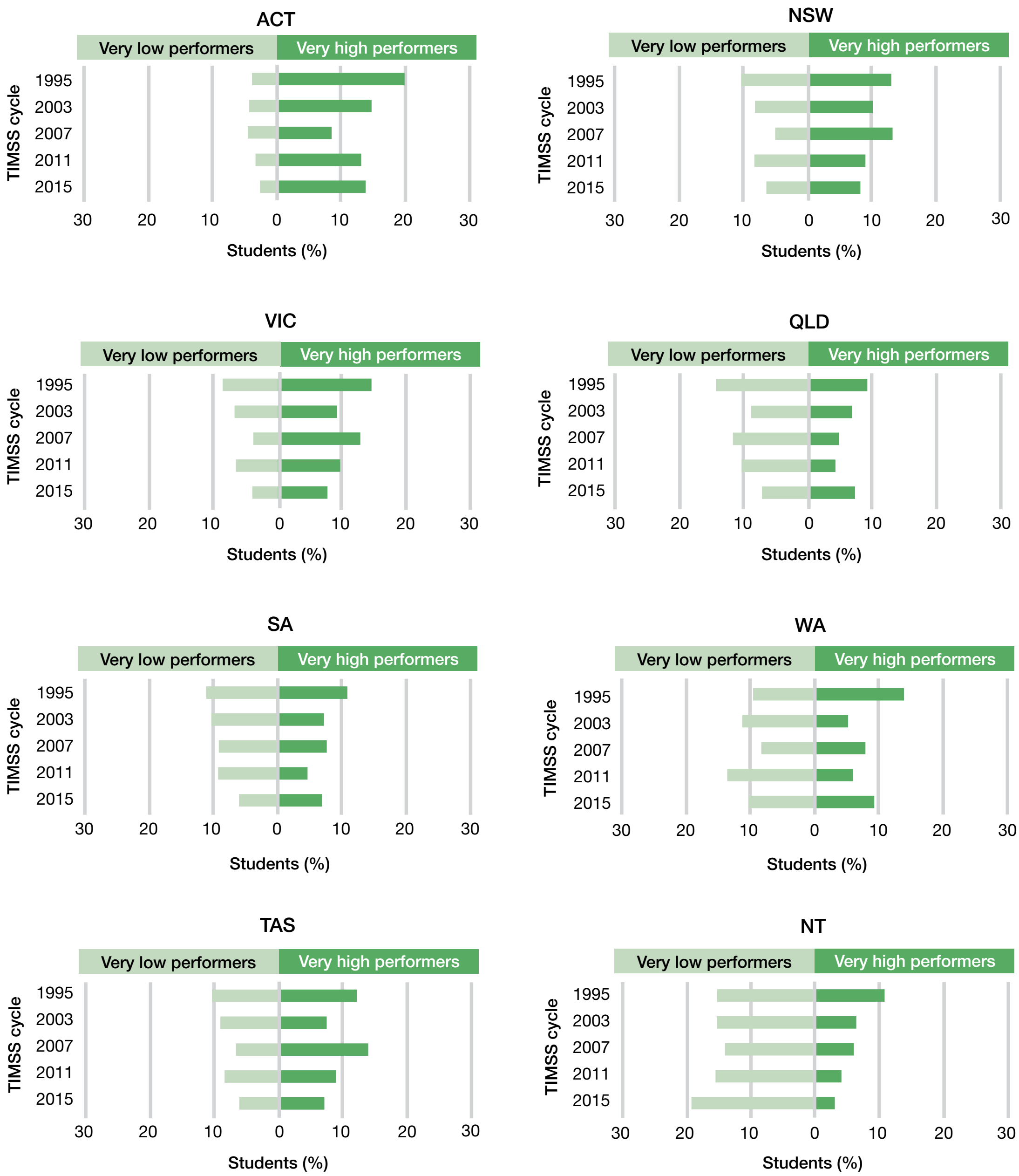
Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

FIGURE 4.11 Trends in Year 4 science achievement within Australia, 1995–2015, by jurisdiction (cont.)

Figure 4.12 shows the percentage of students achieving the Advanced international benchmark in Year 4 science, as well as the percentage of students not achieving the Low international benchmark, for each Australian jurisdiction for all TIMSS cycles from 1995 through to 2015.

The percentages of students not achieving the Low benchmark decreased in most of the Australian jurisdictions over the 20-year period from 1995 to 2015. The decrease (of about seven percentage points) was statistically significant in Queensland.

Each jurisdiction experienced a decrease in the percentage of students achieving the Advanced benchmark from 1995 to 2015. The decrease was statistically significant in New South Wales and the Northern Territory.



Note: The terms ‘very low performers’ and ‘very high performers’ refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 4.12 Percentages of very high- and very low-achieving students in Year 4 science in TIMSS 1995 to TIMSS 2015, by jurisdiction

Australia's Year 4 science achievement for different demographic groups

Year 4 science achievement by sex

Figure 4.13 shows the performance of male and female Year 4 students in science achievement across the countries participating in TIMSS 2015. This figure presents average achievement separately for females and males, as well as the differences between the averages. Sex differences are shown by a bar indicating the size and direction of each difference (in favour of males or females) and whether the difference was statistically significant (indicated by a darkened bar). Countries are presented in the figure in increasing order of the difference between females and males in average achievement.

Overall, there was little achievement difference between females and males (the international average scores were 508 and 504, respectively). Of the countries participating at Year 4 in science, 25 – including Australia – recorded no significant sex differences in achievement. Of the remaining countries, 11 had relatively small but significant differences favouring male students, and six had relatively small differences favouring females. Five countries had relatively larger differences (greater than 20 score points) favouring female students (Saudi Arabia, Bahrain, Oman, Kuwait and Qatar).

In Australia, along with England, New Zealand and Ireland, there were no significant sex differences in science achievement at Year 4.

Country	Female				Male				Difference (absolute value)	SE
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE		
Saudi Arabia	49	1.0	431	5.3	51	1.0	352	7.6	79	9.0
Bahrain	50	0.8	478	3.0	50	0.8	439	3.5	39	4.0
Oman	50	0.7	447	3.4	50	0.7	415	3.6	32	3.1
Kuwait	51	2.1	352	7.6	49	2.1	322	7.6	30	9.1
Qatar	51	2.5	448	4.7	49	2.5	424	6.0	24	7.2
United Arab Emirates	48	2.2	459	4.4	52	2.2	444	4.0	14	6.4
Finland	48	0.8	560	2.3	52	0.8	548	2.9	12	2.5
Iran	49	1.1	427	5.2	51	1.1	415	5.6	11	7.4
Morocco	48	0.8	358	4.7	52	0.8	347	5.7	10	4.9
Bulgaria	49	0.8	540	6.3	51	0.8	532	5.9	8	2.9
Sweden	49	1.0	544	4.1	51	1.0	536	3.5	8	2.7
Indonesia	48	0.7	401	5.2	52	0.7	393	5.3	8	4.2
Kazakhstan	49	0.8	552	4.5	51	0.8	547	4.7	5	2.7
Georgia	49	0.9	453	3.9	51	0.9	449	4.6	4	4.1
New Zealand	49	0.7	507	3.2	51	0.7	504	3.0	3	3.1
Lithuania	50	0.9	529	2.9	50	0.9	526	3.1	3	3.4
Serbia	48	0.8	526	3.6	52	0.8	523	4.9	3	4.6
Canada	49	0.5	526	2.8	51	0.5	524	3.0	2	2.2
Belgium (Flemish)	50	0.9	512	2.6	50	0.9	511	2.6	2	2.4
Poland	50	0.8	548	2.5	50	0.8	546	3.0	1	2.8
Turkey	49	0.6	484	3.3	51	0.6	483	4.0	1	3.1
Netherlands	50	0.9	517	2.8	50	0.9	517	3.0	1	2.4
Australia	49	1.0	524	3.3	51	1.0	523	3.4	1	3.4
England	51	0.7	536	3.0	49	0.7	536	2.6	1	2.8
Norway (5)	49	0.9	538	3.1	51	0.9	537	3.1	1	3.2
Singapore	48	0.5	591	3.7	52	0.5	590	4.2	0	2.8
Russian Federation	49	0.9	567	3.1	51	0.9	567	3.7	0	2.7
France	49	0.7	487	3.1	51	0.7	487	2.9	0	2.4
Northern Ireland	50	1.1	520	3.0	50	1.1	520	2.8	0	3.7
Cyprus	49	0.7	481	2.8	51	0.7	481	2.9	0	2.6
Chile	49	1.7	477	3.0	51	1.7	478	3.4	1	3.3
Germany	48	0.7	527	2.7	52	0.7	529	2.6	2	2.3
Croatia	49	0.8	532	2.7	51	0.8	534	2.2	2	2.8
United States	51	0.6	544	2.4	49	0.6	548	2.5	4	2.0
Denmark	49	0.8	525	2.5	51	0.8	529	2.6	4	2.8
Japan	50	0.5	567	2.0	50	0.5	571	2.3	4	2.4
Ireland	47	1.5	526	2.9	53	1.5	531	2.9	5	3.4
Spain	49	0.9	515	2.9	51	0.9	521	2.9	6	2.7
Slovenia	49	0.8	539	2.4	51	0.8	546	3.1	7	2.7
Portugal	49	0.8	504	2.5	51	0.8	512	2.4	7	2.2
Hungary	49	0.9	538	3.5	51	0.9	546	3.9	8	3.1
Czech Republic	49	0.9	530	2.8	51	0.9	538	2.7	8	2.6
Slovak Republic	48	0.9	516	3.2	52	0.9	524	2.7	8	2.7
Chinese Taipei	49	0.6	551	2.2	51	0.6	560	2.4	9	2.9
Italy	49	0.7	512	3.1	51	0.7	521	2.8	9	2.5
Hong Kong	46	1.5	551	3.9	54	1.5	561	3.3	10	3.9
Korea	48	0.5	584	2.3	52	0.5	595	2.3	11	2.4
International average	49	0.1	508	0.5	51	0.1	504	0.6		

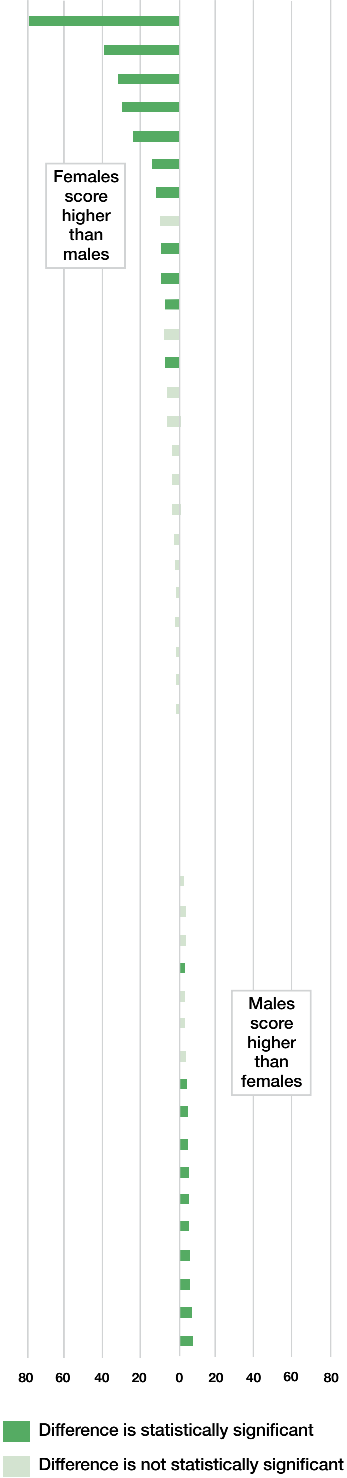
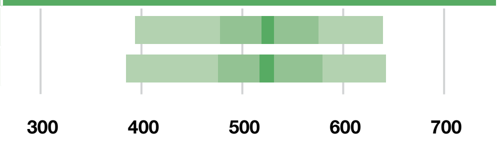


FIGURE 4.13 Sex differences in Year 4 science achievement, by country

Chapter 4

While there were no sex differences in science achievement at Year 4 in Australia, the range of scores was slightly greater for Year 4 males (255) than for Year 4 females (245), with the lowest-performing male students falling slightly lower on the scale than the lowest-performing female students, but with very little difference at the higher end of the scale (see Figure 4.14).

Sex	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Female	49	524	3.3	245	
Male	51	523	3.4	255	



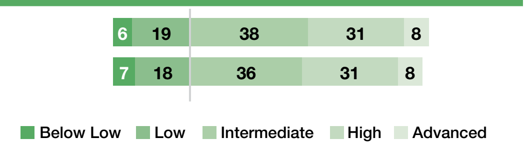
Note: See Reader's Guide for interpretation of graph.

FIGURE 4.14 Mean scores and distribution of Year 4 science achievement within Australia, by sex

Performance at the international benchmarks by sex

Figure 4.15 illustrates a high degree of similarity in science achievement for males and females at Year 4 in Australia in terms of performance at the international benchmarks. Eight per cent of both female and male students achieved the Advanced benchmark in TIMSS 2015, while around 25 per cent of female and male students did not reach the Intermediate benchmark (the proficient standard for Australia).

Sex	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Female	76	1.8	
Male	75	1.6	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.15 Percentages of Australian students at the international benchmarks for Year 4 science, by sex

Trends in science achievement by sex

Figure 4.16 provides a graphic representation of trends from 1995 to 2015 in the science achievement of male and female Year 4 students in Australia. Although there is some variation across the cycles in Australia, there were no significant differences in the average science scores of Australian male and female students from 1995 through to 2015.

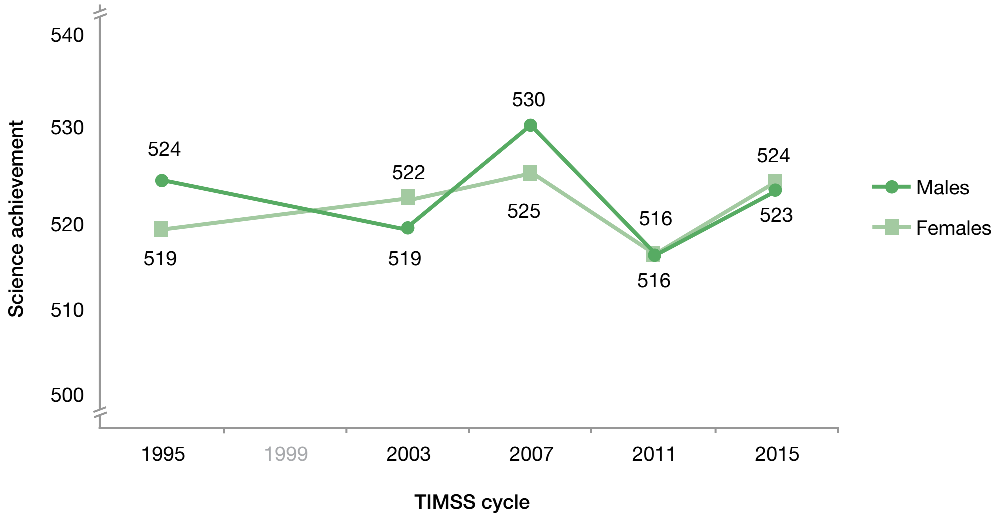


FIGURE 4.16 Trends in Year 4 science achievement within Australia, 1995–2015, by sex

Sex differences in science achievement by jurisdiction

Figure 4.17 shows the sex differences in Year 4 science by jurisdiction. As may be expected, given the lack of sex difference in science for Australia overall, there were no significant differences between the average science scores of male and female students in any of the jurisdictions.

Jurisdiction	Female		Male		Difference (absolute value)	SE
	Mean	SE	Mean	SE		
NT	489	13.5	471	15.3	18	13.6
NSW	528	6.8	519	7.8	9	7.2
TAS	525	10.5	524	10.7	1	9.9
WA	517	7.4	516	9.4	1	7.7
QLD	523	5.9	524	5.8	2	5.6
ACT	548	8.2	550	7.9	3	8.1
SA	521	8.3	526	7.8	4	7.3
VIC	523	6.7	531	4.9	8	6.4

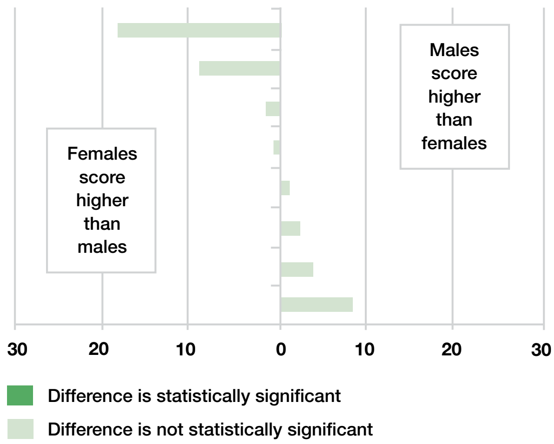
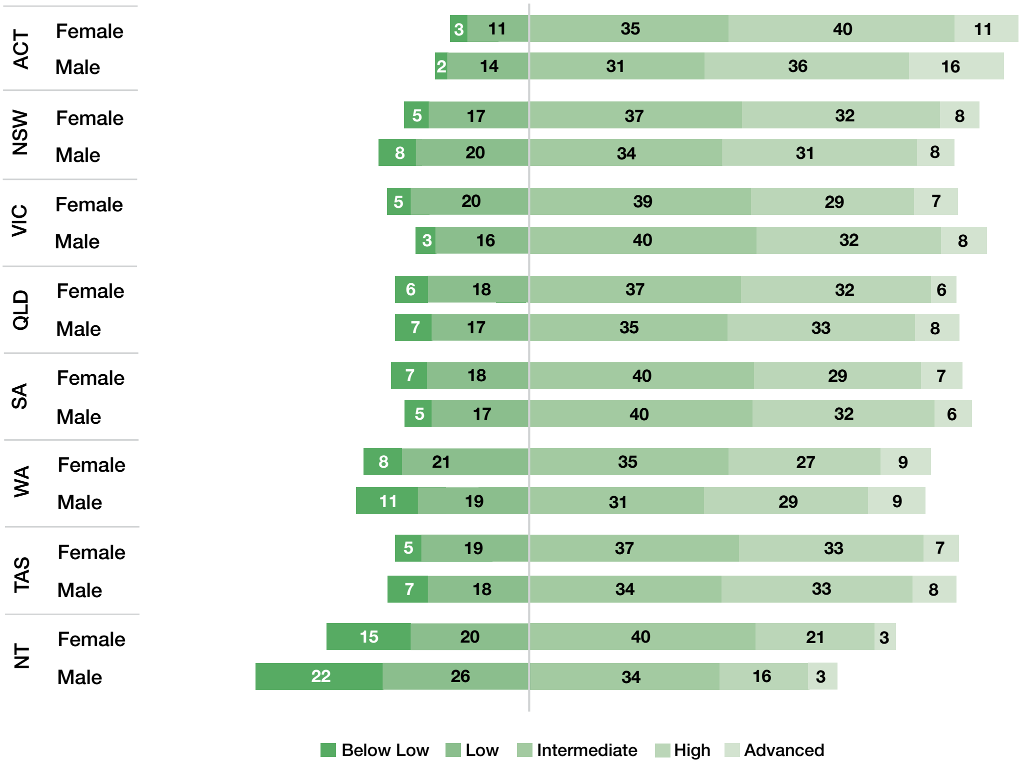


FIGURE 4.17 Sex differences in Year 4 science achievement, by jurisdiction

Figure 4.18 shows the percentages of students at each of the international benchmarks in Year 4 science in each jurisdiction, by sex. There are no significant sex differences in the average science scores in any jurisdictions, and this is reflected in the fact that most of the percentages at each of the benchmarks are very similar. There was no significant difference in the percentages of male and female students achieving the Advanced benchmark in any jurisdiction. Likewise, there was no significant difference in the percentages of male and female students achieving at or above the Intermediate benchmark (the proficient standard for Australia) in any jurisdiction.



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.18 Percentages of Australian students at the international benchmarks for Year 4 science, by sex within jurisdiction

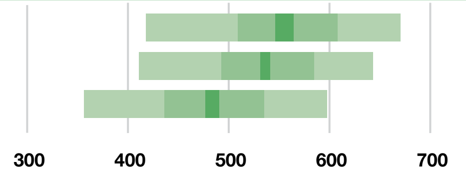
Year 4 science achievement by books in the home

Socioeconomic status has been found (in TIMSS and other studies) to be related to achievement. In TIMSS, the number of books in the home is used as a proxy for socioeconomic status. This section presents Australian students' science achievement according to the number of books in the home. For more information about this variable, please refer to the Reader's Guide.

Figure 4.19 provides the percentage of students in each category and the average achievement score for students in each group. The majority of the Australian students (57%) reported having an *average number of books* and only 16 per cent reported having *many books* at home. The students who had the most books in the home also had the highest levels of achievement, scoring 19 score points, on average, higher than students with an *average number of books* in the home, and 70 score points higher than those with a *few books* in the home. All differences in scales scores were significant.

Figure 4.19 shows the distribution of scores in science achievement of Year 4 students for each category of books at home. The spread of scores between the 5th and 95th percentiles did not vary greatly across the groups, ranging from 229 to 249 score points. Those students who reported having *many books* in the home had the widest range of scores, while the spread of scores was narrowest for the group that reported an *average number of books* at home.

Number of books in the home	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Many books	16	554	4.4	249	
Average number of books	57	535	2.4	229	
A few books	26	484	3.8	241	



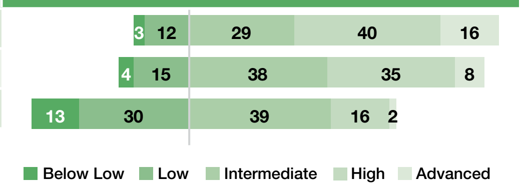
Note: See Reader's Guide for interpretation of graph.

FIGURE 4.19 Mean scores and distribution of Year 4 science achievement within Australia, by number of books in the home

The percentages of students at each of the benchmarks (Figure 4.20) serve to indicate educational capacities. Of those students who reported having *many books* in the home, 16 per cent achieved the Advanced benchmark. The proportion at this highest benchmark falls away quickly, though, with eight per cent of students in the *average number of books* category and just two per cent of those with a *few books* in the home attaining this level of achievement.

Clearly, while living in a home with *many books* (or by implication, in a home environment that values literacy, the acquisition of knowledge and general academic support) influences academic achievement, the relationship is not definitive. Around 15 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark (the proficient standard for Australia), with 12 per cent achieving the Low benchmark and three per cent not achieving even this very basic level. However, this group of students performed better than students in the middle category, those with between 26 and 200 books in the home. Of this group, around 15 per cent achieved the Low benchmark, and around four per cent failed to achieve this level. Of the students who reported having a *few books* in the home, 30 per cent achieved the Low benchmark, and a further 13 per cent did not achieve even this basic level.

Number of books in the home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Many books	85	1.8	
Average number of books	82	1.3	
A few books	57	2.3	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.20 Percentages of Australian students at the international benchmarks for Year 4 science, by number of books in the home

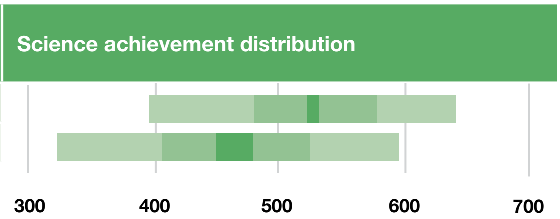
Year 4 science achievement by Indigenous background

The education attainment of Australian Indigenous students in core subject areas such as science is an important issue, and previous TIMSS studies have provided a picture of Indigenous achievement in this area. This section presents Australian students' science achievement according to Indigenous status. For more information about this variable, please refer to the Reader's Guide.

As shown in Figure 4.21, four per cent of the TIMSS sample at Year 4 are Indigenous. These students attained an average score in science of 463 score points, 63 score points (about two-thirds of a standard deviation) lower than the average score for non-Indigenous Australian students and below the Intermediate benchmark (set at 475 score points), which is the proficient standard for Australia.

Figure 4.21 presents the distribution of Year 4 achievement scores for Indigenous and non-Indigenous students. The spread of scores between the 5th and 95th percentiles was slightly wider for Indigenous students, at 273 score points, compared to 245 for non-Indigenous students.

Indigenous background	% of students	Mean	SE	Gap 95th–5th percentiles
Non-Indigenous	96	526	2.8	245
Indigenous	4	463	7.6	273

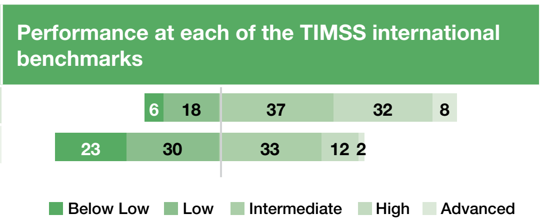


Note: See Reader's Guide for interpretation of graph.

FIGURE 4.21 Mean scores and distribution of Year 4 science achievement within Australia, by Indigenous background

Figure 4.22 presents the percentages of Indigenous and non-Indigenous students at each of the international benchmarks for science. The differences are apparent at both ends of the distribution: eight per cent of non-Indigenous students reached the Advanced benchmark compared to two per cent of Indigenous students, while the percentage of Indigenous students who did not achieve the Intermediate benchmark was more than twice that of non-Indigenous students – 53 per cent compared to 23 per cent, respectively.

Indigenous background	% of students at or above the proficient standard for Australia	SE
Non-Indigenous	77	1.3
Indigenous	47	4.8



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.22 Percentages of Australian students at the international benchmarks for Year 4 science, by Indigenous background

Figure 4.23 shows the trends in achievement of Indigenous students from 1995 to 2015. The average science scores of Indigenous students have remained fairly stable over these cycles, with no significant differences in the performance of Indigenous students between TIMSS 2015 and previous cycles.

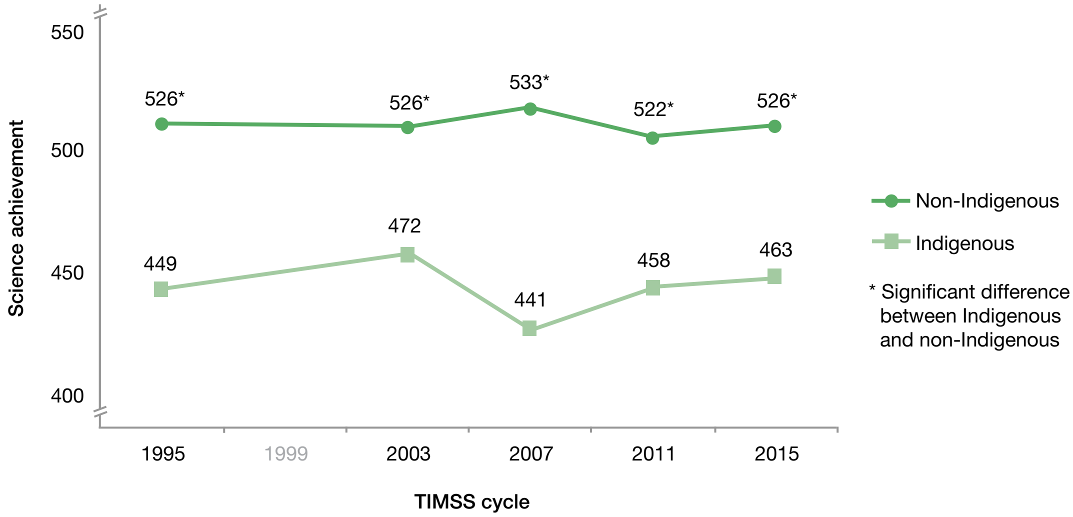


FIGURE 4.23 Trends in Year 4 science achievement within Australia, 1995–2015, by Indigenous background

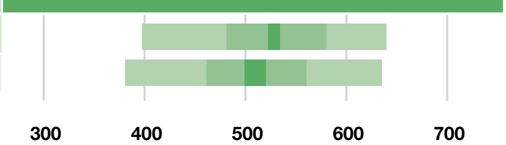
Year 4 science achievement by language spoken at home

How often English is spoken at home is a factor that has been associated with Year 4 science achievement in past cycles of TIMSS. Students who come from homes in which English is not spoken frequently have less exposure to the language of instruction and test, which could place them at a disadvantage. This section presents Australian students' science achievement according to whether a language other than English is spoken as the main language at home. For more information about this variable, please refer to the Reader's Guide.

Figure 4.24 shows that 15 per cent of students in the TIMSS Year 4 sample indicated that they did not speak English at home 'always' or 'almost always'. At the Year 4 level, students who spoke mainly English at home achieved 19 score points higher, on average, than students who spoke a language other than English at home. This was a statistically significant difference.

Figure 4.24 also shows the distribution of scores for students by their language background. The spread of scores between the 5th and 95th percentiles was quite similar for the two groups of students: 246 score points for students with an English-speaking background and 258 score points for those students who spoke a language other than English at home.

Language spoken at home	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
English	85	527	2.8	246	
Other	15	509	5.7	258	

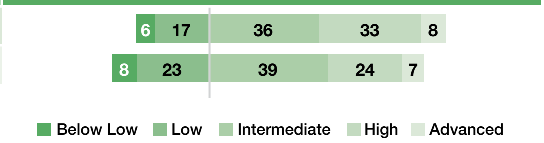


Note: See Reader's Guide for interpretation of graph.

FIGURE 4.24 Mean scores and distribution of Year 4 science achievement within Australia, by language spoken at home

The distribution of scores for Year 4 students who spoke a language other than English at home in science is reflected in the percentages of students achieving at each of the benchmarks. Figure 4.25 shows that at the top end of achievement, eight per cent of English-background students and seven per cent of students who spoke a language other than English at home reached the Advanced benchmark. At the lower levels of achievement, 31 per cent of students who spoke a language other than English at home compared to 23 per cent of students who spoke English at home did not achieve the Intermediate benchmark, which is the proficient standard for Australia.

Language spoken at home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
English	77	1.3	
Other	69	3.3	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.25 Percentages of Australian students at the international benchmarks for Year 4 science, by language spoken at home

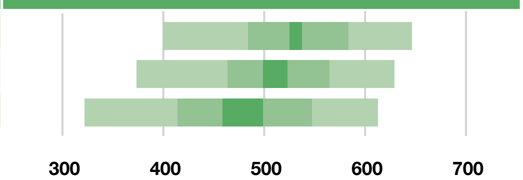
Year 4 science achievement by geographic location of the school

Past cycles of TIMSS have found that students attending schools in remote or regional areas of Australia are often at an educational disadvantage compared to students attending metropolitan schools. This section presents Australian students' science achievement according to the geographic location of the school. For more information about this variable, please refer to the Reader's Guide.

As shown in Figure 4.26, students attending school in remote areas make up only one per cent of the Year 4 TIMSS sample, while those attending school in metropolitan areas make up 69 per cent of the sample. Students attending schools in metropolitan areas scored, on average, 19 score points higher than students attending schools in provincial areas, and 52 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 33 score points higher than students attending schools in remote areas. All these differences are statistically significant.

Figure 4.26 also provides the spread of scores for science achievement by the geographic location of the school. The range of scores from the 5th to the 95th percentile was not dissimilar between students attending schools in provincial areas (254 score points) and metropolitan areas (243 score points). However, the spread of scores for science achievement for students attending schools in remote areas was greater than that of the other two groups, at 289 score points.

Geographic location	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Metropolitan	69	530	2.9	243	
Provincial	30	511	6.3	254	
Remote	1	478	10.4	289	

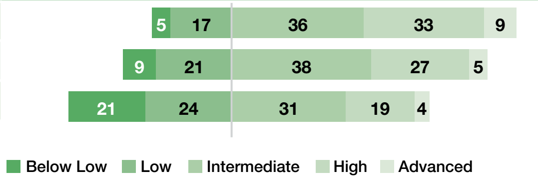


Note: See Reader's Guide for interpretation of graph.

FIGURE 4.26 Mean scores and distribution of Year 4 science achievement within Australia, by geographic location

Figure 4.27 shows the percentages of students at each of the international benchmarks for science, by geographic location. Nine per cent of students in metropolitan schools achieved the Advanced benchmark, and 42 per cent achieved at least the High benchmark, with 78 per cent achieving at least the Intermediate benchmark (the proficient standard for Australia). In contrast, just four per cent of students attending schools in remote areas achieved the Advanced benchmark, 23 per cent achieved at least the High benchmark and 55 per cent achieved the Intermediate benchmark.

Geographic location	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Metropolitan	78	1.4	
Provincial	70	3.3	
Remote	55	5.5	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 4.27 Percentages of Australian students at the international benchmarks for Year 4 science, by geographic location

This chapter so far has reported on achievement on the TIMSS Year 4 science scale, examining achievement in terms of jurisdiction, sex, number of books in the home, Indigenous background, language spoken at home and geographic location of the school. The next section of this chapter examines achievement in the Year 4 science content and cognitive domains.

Achievement in the TIMSS science content and cognitive domains

As noted earlier in the chapter, the TIMSS science assessment can be described in terms of content and cognitive domains. The content domains outline the subject matter to be assessed and include *life science*, *physical science* and *Earth science* at Year 4. The cognitive domains detail the thinking processes that students will need to use. The cognitive domains are *knowing*, *applying* and *reasoning*. Each item is associated with a single content domain and a single cognitive domain. This allows student performance to be described in terms of achievement in each of the domains.

To allow comparisons of student achievement across the domains, the content and cognitive achievement scales at each year level were constructed to have the same average level of difficulty. The following tables present the average achievement in each of the Year 4 science content and cognitive domains for Australia as a whole, for each of the Australian jurisdictions, for males and females and for Indigenous and non-Indigenous students, as well as showing trends for Australia in the content and cognitive domains since 2007.

Science content domains

Table 4.6 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 4 achievement in the science content domains.

Australian Year 4 students performed relatively better in *life science* and relatively less well in *physical science* and, to a lesser degree, *Earth science*. These differences were statistically significant for Australia as a whole.

However, at the jurisdiction level the relative performance across the domains was not statistically significant in all jurisdictions – due to large standard errors – despite fairly similar patterns of relative performance across the domains.

Interestingly, despite no statistically significant sex differences within the domains, female students showed a stronger pattern of relative differences across the domains (that is, the difference between the domain score and the overall score was greater) than that shown by male students.

Due to large standard errors, none of the differences between the content domains and the overall science score were significantly different for Indigenous students.

TABLE 4.6 Relative mean achievement in the Year 4 science content domains, for Australia and by jurisdiction, sex and Indigenous background

	Science overall		*Life science*		Differences between science overall and *life science*		*Physical science*		Differences between science overall and *physical science*		*Earth science*		Differences between science overall and *Earth science*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	524	2.9	531	3.0	**8**	**1.4**	516	2.7	**-8**	**1.1**	520	3.3	**-4**	**1.9**
ACT	549	7.0	558	7.3	**9**	**4.1**	541	7.7	-8	4.1	549	8.8	0	4.5
NSW	524	6.4	531	7.0	**7**	**2.3**	516	6.0	**-8**	**2.3**	520	6.7	**-4**	**2.1**
VIC	527	4.9	535	5.2	**8**	**3.0**	518	5.2	**-9**	**3.0**	523	5.9	-4	3.7
QLD	523	5.2	531	5.3	**8**	**2.2**	517	4.9	**-6**	**2.0**	520	6.3	-3	3.0
SA	524	7.1	532	7.8	**8**	**3.4**	516	6.9	**-7**	**2.3**	521	8.9	-3	4.6
WA	516	7.5	524	8.4	**7**	**3.1**	508	7.3	**-8**	**2.9**	510	8.5	-6	4.1
TAS	525	9.4	534	9.1	**9**	**4.1**	520	8.7	-5	3.8	526	11.4	1	6.4
NT	480	12.7	486	12.7	**6**	**4.2**	473	13.2	-7	5.0	471	14.3	-8	5.7
Female	524	3.3	535	3.1	**11**	**1.7**	513	2.9	**-11**	**2.2**	516	4.1	**-8**	**2.1**
Male	523	3.4	527	3.8	**4**	**1.9**	519	3.6	**-4**	**1.3**	524	4.0	0	2.7
Non-Indigenous	526	2.8	534	2.9	**8**	**1.5**	518	2.6	**-8**	**1.2**	523	3.2	-4	1.9
Indigenous	463	7.6	469	9.1	5	3.8	460	8.1	-3	3.1	454	10.2	-9	6.3

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 4.7 shows the trends in achievement for the content domains for Australia as a whole. Australian Year 4 performance in *Earth science* has dropped 17 score points since 2007, whereas performance in *life science* decreased between 2007 and 2011 and improved again in 2015. There have been no significant changes in performance in *physical science*.

TABLE 4.7 Trends in mean achievement in the Year 4 science content domains, for Australia

	Life science				*Physical science*				*Earth science*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	531	3.0	15 ↑	2	516	2.7	2	-5	520	3.3	0	-16 ↓
2011	516	3.1		-14 ↓	514	3.1		-7	520	3.6		-17 ↓
2007	529	3.6			521	3.8			536	4.2		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Science cognitive domains

Table 4.8 presents the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 4 achievement in the science cognitive domains.

Performance in each of the *knowing* and *applying* cognitive domains was similar to performance in science overall for all Australian Year 4 students, and for all sub-groups. However, performance in *reasoning* was slightly (but still statistically significantly) higher than in science overall for Australia as a whole, Queensland and Tasmania, female students and non-Indigenous students.

There were no statistically significant sex differences within the domains.

TABLE 4.8 Relative mean achievement in the Year 4 science cognitive domains, for Australia and by jurisdiction, sex and Indigenous background

	Science overall		*Knowing*		Differences between science overall and *knowing*		*Applying*		Differences between science overall and *applying*		*Reasoning*		Differences between science overall and *reasoning*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	524	2.9	523	3.3	-1	1.7	522	2.7	-1	1.3	527	3.0	**4**	**1.6**
ACT	549	7.0	550	8.2	1	3.4	548	6.8	-1	2.9	555	7.1	6	4.0
NSW	524	6.4	521	6.7	-2	2.4	523	6.1	-1	2.1	526	6.6	2	2.3
VIC	527	4.9	528	6.3	1	3.2	525	4.9	-2	2.5	529	5.4	2	3.4
QLD	523	5.2	522	5.3	-1	2.3	522	5.2	-1	2.6	530	5.3	**7**	**3.3**
SA	524	7.1	523	8.1	-1	3.4	522	7.5	-1	2.5	531	7.9	7	3.7
WA	516	7.5	517	8.1	0	3.8	515	7.4	-1	3.7	520	8.5	4	3.6
TAS	525	9.4	527	9.7	2	3.0	522	8.6	-2	3.3	534	9.0	**10**	**3.8**
NT	480	12.7	479	13.4	-1	5.5	479	13.6	-1	3.7	481	13.7	2	5.0
Female	524	3.3	522	3.6	-2	2.5	523	3.5	-1	2.8	532	3.8	**8**	**3.3**
Male	523	3.4	524	4.2	1	2.5	522	3.6	-1	2.5	523	3.9	0	2.0
Non-Indigenous	526	2.8	526	3.2	-1	1.7	525	2.6	-1	1.2	530	2.9	**4**	**1.6**
Indigenous	463	7.6	461	8.2	-3	4.0	462	7.2	-2	5.4	466	8.2	3	5.9

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 4.9 shows the trends in achievement for the cognitive domains for Australia as a whole. The table indicates significant improvement in *applying* and *reasoning* since 2011 but a significant decline in the scores for *knowing* and *reasoning* between 2007 and 2011.

TABLE 4.9 Trends in mean achievement in the Year 4 science cognitive domains, for Australia

	Knowing				*Applying*				*Reasoning*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	523	3.3	5	-9	522	2.7	9 ↑	0	527	3.0	10 ↑	-1
2011	517	2.8		-14 ↓	513	3.0		-9	518	3.4		-11 ↓
2007	532	3.5			522	3.8			528	4.2		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Chapter 5

Year 8 science

Key findings

- With an average score of 512 score points on the TIMSS Year 8 science scale, Australian students significantly outperformed students in 20 other countries, such as Italy, Turkey and Malaysia.
- However, Australian Year 8 students were outperformed by students in 14 other countries, including Canada, the United States, England and Ireland, as well as the top five Asian countries – Singapore, Japan, Chinese Taipei, Korea and Hong Kong.
- Australia recorded an improved score in TIMSS 2003, which was followed by a weaker result in TIMSS 2007. Australia's 2015 Year 8 science score is not significantly different to that of TIMSS 1995.
- Seven per cent of Australian Year 8 students achieved the Advanced international benchmark in science – compared to more than one-fifth of students in Chinese Taipei and Japan, and 42 per cent of students in Singapore.
- Sixty-nine per cent of Australian Year 8 students achieved the Intermediate international benchmark – the proficient standard for Australia.
- Australian Year 8 students performed significantly higher than the overall science score in the content domains of *biology* and *Earth science* and lower in *chemistry* and *physics*.
- Australian Year 8 students performed at a similar level to the overall science score in all three of the cognitive domains.
- The Australian Capital Territory was the highest-performing jurisdiction. Its students performed significantly higher, on average, than students in all jurisdictions except Victoria and Western Australia. Students in the Northern Territory performed significantly below students in all other jurisdictions.
- There was no significant difference between Australian male and female students in Year 8 science achievement. The 2015 cycle of TIMSS is the first in which there are no sex differences in science achievement at the Year 8 level.
- Students who have *many books* in the home were found to score 33 score points higher than students with an *average number of books* in the home, and 88 score points higher than those who reported having a *few books* in the home.

- Fifty-seven per cent of students whose parents did not complete secondary school did not reach the Intermediate international benchmark, compared to 15 per cent of students with at least one parent holding a university degree.
- Eighteen per cent of students with *many educational resources* at home achieved the Advanced international benchmark, compared to five per cent of those with *some resources* and less than one per cent of students with only a *few educational resources*.
- Fifty-eight per cent of Indigenous students compared to 30 per cent of non-Indigenous students did not achieve the Intermediate international benchmark – the proficient standard for Australia.
- Students who spoke mainly English at home achieved an average scale score that was a statistically significant 16 points higher than that for students who did not speak English at home 'always' or 'almost always'.
- Fifty-three per cent of students in remote schools, compared to 35 per cent of provincial students and 30 per cent of metropolitan students, did not reach the Intermediate international benchmark – the proficient standard for Australia.

This chapter presents the TIMSS 2015 international and national results for science at Year 8 level. The first section provides a summary of the TIMSS 2015 science framework at Year 8, along with a description of the international benchmarks for Year 8 science. The second section examines the performance of Australian Year 8 students in science in the international context. Turning the focus to domestic outcomes, the third section looks at Year 8 science performance across the Australian educational jurisdictions and the fourth provides the results for demographic groups within Australia. The final section looks at the results for the content and cognitive domains for Year 8 science.

The TIMSS 2015 science framework

Mullis and Martin (2013) contend that for young people in today's world, some level of understanding of science is imperative to enable them to make decisions about themselves (e.g. regarding nutrition, medication, hygiene) and the world in which they live (e.g. regarding climate change, food production, natural resources). In TIMSS, students' scientific understanding is assessed by having participating students read selected questions and stimulus materials and respond to a variety of questions.

The TIMSS 2015 science framework is organised around two dimensions – a content dimension, which specifies the subject matter to be assessed within science (e.g. *physics* and *chemistry*) and the cognitive dimension, which specifies the thinking processes and sets of behaviours expected of students as they engage with the science content.

In 2015, TIMSS science also assessed science practices. These are the scientific practices involved in scientific inquiry and include:

- asking questions based on observations
- generating evidence
- working with data
- answering the research question
- making an argument from evidence.

Within the TIMSS assessment framework the scientific practices are considered to be best assessed in the context of the content domains and by drawing upon the thinking processes from the cognitive domains. Thus, a number of items within the TIMSS 2015 science assessment, at both Year 4 and Year 8, assess one or more of the scientific practices, along with content and thinking processes from the content and cognitive items.

Science content and cognitive domains

In the TIMSS 2015 science framework for Year 8 students, four content domains are defined:

- *biology*
- *chemistry*
- *physics*
- *Earth science*.

Each of these content domains has several topic areas: for example, the domain *chemistry* includes composition of matter; properties of matter; and chemical change. These topic areas are shown in Table 5.1.

For a detailed description of each of the content domains in science, please refer to Mullis and Martin (2013).

TABLE 5.1 TIMSS Year 8 science content domains and percentage of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Biology	‣ Characteristics and life processes of organisms ‣ Cells and their functions ‣ Life cycles, reproduction and heredity ‣ Diversity, adaptation and natural selection ‣ Ecosystems ‣ Human health	35
Chemistry	‣ Composition of matter ‣ Properties of matter ‣ Chemical change	20
Physics	‣ Physical states and changes in matter ‣ Energy transformation and transfer ‣ Light and sound ‣ Electricity and magnetism ‣ Forces and motion	25
Earth science	‣ Earth's structure and physical features ‣ Earth's processes, cycles and history ‣ Earth's resources, their use and conservation ‣ Earth in the solar system and the universe	20

To respond correctly to TIMSS test items, students need to be familiar with the science content of the items. Just as importantly, however, items were designed to elicit the use of particular cognitive skills. The TIMSS 2015 assessment framework presents detailed descriptions of the skills and abilities that make up the cognitive domains and that are assessed in conjunction with the content. The student behaviours encompassed by the cognitive dimension have been classified into three domains within the assessment framework.

The three domains can be described as follows:

- *knowing* – which covers the facts, procedures and concepts students need to know
- *applying* – which focuses on the ability of students to apply knowledge to generate explanations and to solve practical problems
- *reasoning* – which includes using evidence and science understanding to analyse, synthesise and generalise, often in unfamiliar situations and complex contexts.

Table 5.2 shows the percentage of assessment devoted to cognitive domains at Year 8. These three cognitive domains are used for both Year 4 and Year 8, but the balance of testing time differs in these two year levels, reflecting the difference in age and experience of the students tested. In TIMSS 2015, each content domain included items developed to address each of the three cognitive domains, for example, the *chemistry* domain included *knowing*, *applying* and *reasoning* items, as did the other content domains.

TABLE 5.2 TIMSS Year 8 science cognitive domains and percentage of assessment for each domain

Cognitive domains	Target % of TIMSS assessment
Knowing	35
Applying	35
Reasoning	30

The TIMSS international benchmarks

The TIMSS science achievement scale summarises Year 8 students' performance when interacting with a variety of scientific tasks and questions (please see the Reader's Guide for more information about the achievement scales). Students' achievement is based on their responses to test questions designed to assess a range of content areas. When comparing groups of students, across and within countries, summary statistics such as the average, or mean, scale score are often used. This score, however, does not provide detailed information as to what types of scientific tasks the students were able to undertake successfully. Instead, TIMSS uses international benchmarks to provide descriptions of achievement on the scale in relation to performance on the questions asked.

Internationally, it was decided that performance should be measured at four levels. These four levels summarise the achievement reached by:

- the 'Advanced international benchmark', which was set at 625 score points
- the 'High international benchmark', which was set at 550 score points
- the 'Intermediate international benchmark', which was set at 475 score points
- the 'Low international benchmark', which was set at 400 score points.

The descriptions of the levels are cumulative, so that a student who reached the High benchmark can typically demonstrate the knowledge and skills for both the Intermediate and the Low benchmarks. Table 5.3 provides a summary of the TIMSS 2015 Year 8 science benchmarks.

TABLE 5.3 The TIMSS 2015 international benchmarks for Year 8 science

625	**Advanced international benchmark** *Students communicate understanding of complex concepts related to biology, chemistry, physics and Earth science in practical, abstract and experimental contexts.* Students apply knowledge of cells and their functions as well as characteristics and life processes of organisms. They demonstrate understanding of diversity, adaptation and natural selection among organisms, and of ecosystems and the interaction of organisms with their environment. Students apply knowledge of life cycles, and heredity in plants and animals. Students demonstrate knowledge of the composition and physical properties of matter and apply knowledge of chemical and physical change in practical and experimental contexts. Students communicate understanding of physical states and changes in matter in practical and experimental contexts, apply knowledge of energy transfer, and demonstrate knowledge of electricity and magnetism. Students communicate understanding of forces and pressure, and demonstrate knowledge of light and sound in practical and abstract situations. Students communicate understanding of Earth's structure, physical features and resources as well as of Earth in the solar system. Students show understanding of basic aspects of scientific investigation. They identify which variables to control in an experimental situation, compare information from several sources, combine information to predict and draw conclusions, and interpret information in diagrams, maps, graphs and tables to solve problems. They provide written explanations to communicate scientific knowledge.
550	**High international benchmark** *Students apply and communicate understanding of concepts from biology, chemistry, physics and Earth science in everyday and abstract situations.* Students apply knowledge of cells and their functions and of the characteristics and life processes of organisms. They communicate understanding of ecosystems and the interaction of organisms with their environment and apply some knowledge of human health related to nutrition and infectious disease. Students show some knowledge and understanding of the composition and properties of matter and chemical change. They apply basic knowledge of energy transformation and transfer and of light and sound in practical situations, and demonstrate understanding of simple electrical circuits and properties of magnets. Students apply their knowledge of forces and motion to everyday and abstract situations. They apply knowledge of Earth's physical features, processes, cycles and history, and show some understanding of Earth's resources, their use and conservation as well as some knowledge of the interaction between the Earth and the Moon. Students demonstrate some scientific inquiry skills, including selecting and justifying an appropriate experimental method. They combine and interpret information from various types of diagrams, graphs and tables; select relevant information to analyse and draw conclusions; and provide short explanations conveying scientific knowledge.
475	**Intermediate international benchmark** *Students demonstrate and apply their knowledge of biology, chemistry, physics and Earth science in various contexts.* Students demonstrate some knowledge of characteristics and life processes of animals and human health. They apply knowledge of ecosystems, the interaction of living things and the adaptation of animals to their environments. Students apply some knowledge of the properties of matter. They also show knowledge of some aspects of force, motion and energy. Students apply knowledge of Earth's processes, resources and physical features. They interpret information from tables, graphs and pictorial diagrams to draw conclusions, apply knowledge to practical situations and communicate their understanding through brief descriptive responses.
400	**Low international benchmark** *Students show some basic knowledge of biology, chemistry, physics and Earth science.* Students apply basic knowledge of ecosystems and adaptation of animals to their environment, show knowledge of basic facts related to thermal and electrical conductivity and electromagnetism, and show knowledge of some basic Earth science facts. Students interpret simple pictorial diagrams and apply basic knowledge to practical situations.

At Year 8, students at the Advanced benchmark are expected to be able to communicate their understanding of complex concepts in science in practical, abstract and experimental contexts. For the example shown in Figure 5.1, from the content domain *chemistry*, students would have to know whether the named characteristics are physical or chemical properties in order to get the question correct. Internationally, 36 per cent of students on average across all countries answered this correctly. The percentage of Australian students who obtained full credit for this item was 35 per cent, which was not significantly different to the international average.

For each characteristic in the list below, fill in a circle to tell whether the characteristic is a physical property or a chemical property.

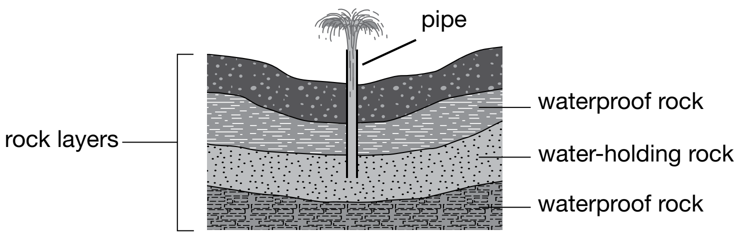
(Fill in one circle in each row.)

	Physical property	**Chemical property**
reactivity with water	Ⓐ	●
boiling point	●	Ⓑ
acidity	Ⓐ	●
density	●	Ⓑ

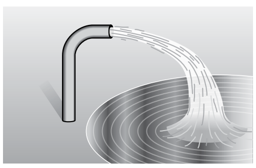
FIGURE 5.1 Advanced international benchmark, Year 8 science – example item

In contrast, Year 8 students at the Low benchmark would be expected to show basic scientific knowledge and be able to interpret simple pictorial diagrams and apply basic knowledge to practical situations. In the example shown in Figure 5.2, students' basic understanding of *Earth science* is probed in a multiple-choice item in which they should recognise that pressure causes water to rise up an underground pipe. This item was relatively easy for students in most countries, with 80 per cent of students internationally answering correctly. In Australia, 88 per cent of students answered this question correctly, which is significantly above the international average.

An artesian basin holds water underground in a layer of rock. Part of an artesian basin is shown in the diagram.



A. When people put pipes down into the rock layer, water rises up the pipe and runs onto the ground.



What moves the water up the pipe?

Ⓐ electricity

Ⓑ magnetism

● pressure

Ⓓ gravity

FIGURE 5.2 Low international benchmark, Year 8 science – example item

Further information about the types of science skills and strategies demonstrated by Year 8 students who performed at each of the international benchmarks, along with examples of the types of responses provided by students at each of the benchmarks, is provided in the *TIMSS 2015 International Results in Science* (http://timss2015.org/timss-2015/science/performance-at-international-benchmarks/).

Australia's Year 8 science results within the international context

This section reports the TIMSS 2015 science results as average scores and distributions on the TIMSS Year 8 science scale (please see the Reader's Guide for more information about the achievement scales).

Figure 5.3 provides a summary of the overall performance of students in Year 8 across different countries on the TIMSS 2015 science achievement scale, in terms of the mean scores achieved by students in each country, the standard error of each mean, and the range of scores achieved between the 5th and 95th percentiles.

Countries are positioned in Figure 5.3 according to decreasing level of achievement; however, this should not be interpreted as a simple ranking, as the differences between countries may not be statistically significant. The shading in this figure indicates whether the score for a given country is significantly different to that of Australia. To determine whether or not differences between other countries are statistically significant, please refer to the multiple-comparisons tables available in the *TIMSS 2015 International Results in Science* (http://timss2015.org/timss-2015/science/student-achievement/multiple-comparisons-of-science-achievement/).

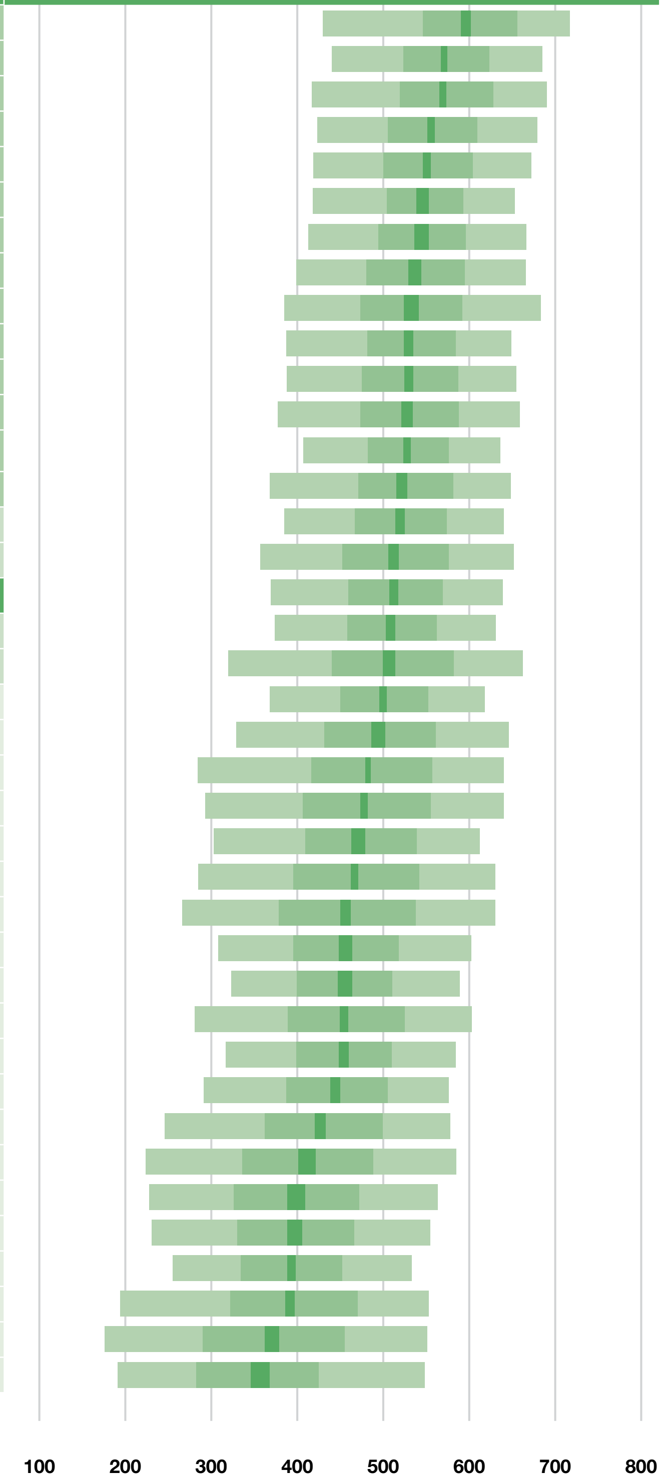
Figure 5.3 shows that Singapore recorded the highest achievement in Year 8 science. Singapore's score of 597 was significantly higher than those of all other countries, and it was followed by those for Japan (571) and Chinese Taipei (569), which were not significantly different to each other but were significantly higher than scores recorded by all other countries. In addition to these three high-performing countries, Korea (556) and Slovenia (551) also scored, on average, above the High international benchmark.

Australian Year 8 students' average score of 512 score points in science was significantly higher than the scores for 20 other countries, such as Italy, Turkey and Malaysia, and places average achievement about halfway between the Intermediate and High benchmarks. Australia was significantly outperformed by 14 countries, including Canada, the United States, Ireland and England, as well as the top five countries mentioned above, along with Hong Kong, the Russian Federation, Kazakhstan, Hungary and Sweden.

Canada, one of the higher-achieving countries, had the smallest gap between high and low achievers (228 score points), while Egypt had the largest gap (375 score points). Australia's gap was about mid-range at 270 score points, similar to that of the United States and smaller than the gap in Singapore.

	Country	Mean	SE	Gap 95th–5th percentiles
Achievement significantly higher than Australia's	Singapore	597	3.2	288
	Japan	571	1.8	246
	Chinese Taipei	569	2.1	273
	Korea	556	2.2	256
	Slovenia	551	2.4	253
	Hong Kong	546	3.9	235
	Russian Federation	544	4.2	253
	England	537	3.8	266
	Kazakhstan	533	4.4	298
	Ireland	530	2.8	263
	United States	530	2.8	268
	Hungary	527	3.4	281
	Canada	526	2.2	228
	Sweden	522	3.4	281
Achievement not different to Australia's	Lithuania	519	2.8	255
	New Zealand	513	3.1	295
	Australia	512	2.7	270
	Norway (9)	509	2.8	257
	Israel	507	3.9	342
Achievement significantly lower than Australia's	Italy	499	2.4	250
	Turkey	493	4.0	316
	Malta	481	1.6	356
	United Arab Emirates	477	2.3	346
	Malaysia	471	4.1	309
	Bahrain	466	2.2	345
	Qatar	457	3.0	364
	Iran	456	4.0	294
	Thailand	456	4.2	267
	Oman	455	2.7	323
	Chile	454	3.1	267
	Georgia	443	3.1	285
	Jordan	426	3.4	331
	Kuwait	411	5.2	361
	Lebanon	398	5.3	334
	Saudi Arabia	396	4.5	324
	Morocco	393	2.5	278
	Botswana (9)	392	2.7	359
	Egypt	371	4.3	375
	South Africa (9)	358	5.6	358

Science achievement distribution



Note: See Reader's Guide for interpretation of graph.

FIGURE 5.3 Mean scores and distribution of Year 8 science achievement, by country

Performance at the international benchmarks

In addition to analysing performance according to mean scores, it is beneficial to use the international benchmarks described previously to gain further insight into student achievement. Figure 5.4 shows the percentage of students in each country at each of the international benchmarks.

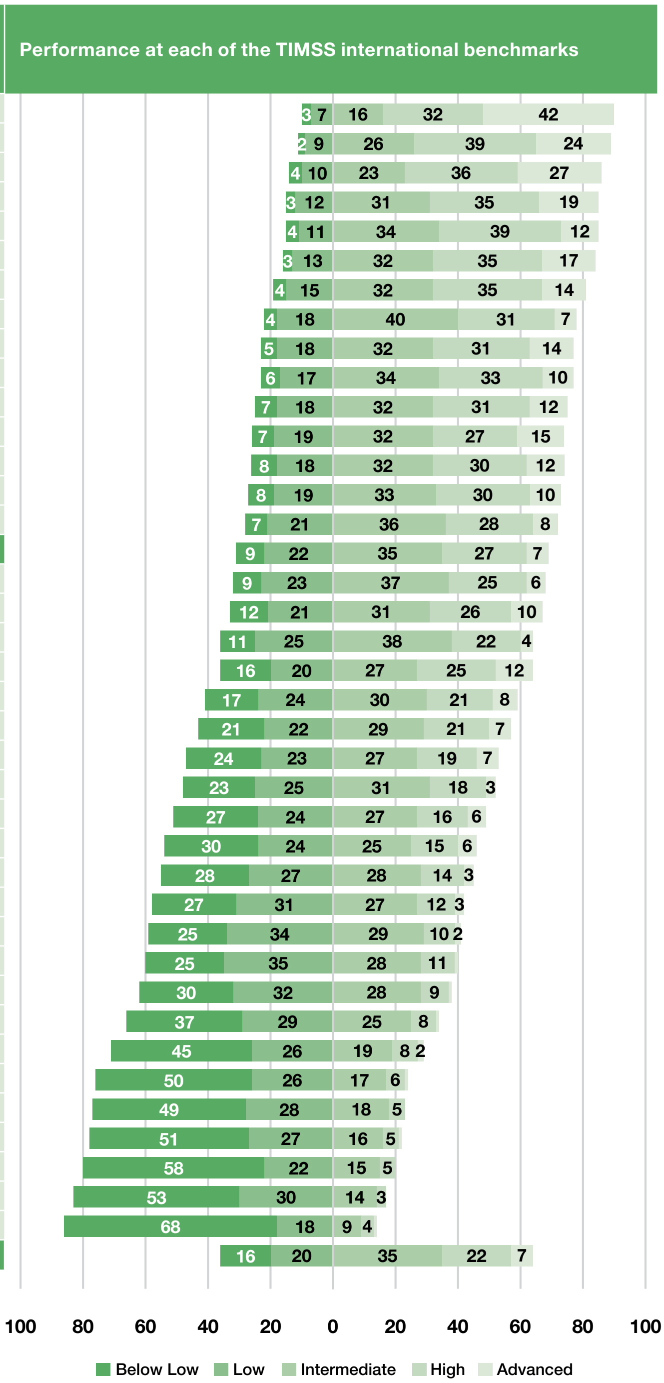
The countries are ordered by the percentages of students reaching the Intermediate international benchmark, which is the proficient standard set for TIMSS science in Australia (please see the Reader's Guide for more information about the proficient standard).

Singapore, in particular, had an impressive percentage of Year 8 students reaching the Advanced benchmark in science. Forty-two per cent of Year 8 Singaporean students achieved this standard. In Chinese Taipei more than one-quarter of students (27%), in Japan just under one-quarter of students (24%) and in Korea 19 per cent of students achieved this benchmark. Slovenia reported 17 per cent of students at the Advanced benchmark.

In Australia, just seven per cent of Year 8 students reached the Advanced benchmark in science. The international median was also seven per cent of students attaining this level. Australia's percentage of achievers at the Advanced benchmark was exceeded by New Zealand (10%), Sweden (10%), Ireland (10%), Hong Kong (12%), the United States (12%), Hungary (12%), Israel (12%), the Russian Federation (14%), England (14%) and Kazakhstan (15%).

Sixty-nine per cent of Australian students achieved at least the Intermediate benchmark, which is the proficient standard for Australia. However, just under one-third (31%) of Australian Year 8 students were found to be performing at or below the Low benchmark (22% performed at the Low benchmark and a further 9% did not reach the Low benchmark).

Country	% of students at or above the proficient standard for Australia	SE
Singapore	90	1.1
Japan	89	0.6
Chinese Taipei	86	0.6
Korea	85	0.8
Hong Kong	85	1.5
Slovenia	84	1.0
Russian Federation	81	1.8
Canada	78	1.1
England	77	1.9
Ireland	77	1.3
United States	75	1.2
Kazakhstan	74	1.8
Hungary	74	1.7
Sweden	73	1.6
Lithuania	72	1.4
Australia	69	1.3
Norway (9)	68	1.4
New Zealand	67	1.5
Italy	64	1.2
Israel	64	1.7
Turkey	59	1.6
Malta	57	0.8
United Arab Emirates	53	0.9
Malaysia	52	1.9
Bahrain	49	1.0
Qatar	46	1.2
Oman	45	1.0
Iran	42	1.9
Thailand	41	2.3
Chile	40	1.6
Georgia	38	1.4
Jordan	34	1.2
Kuwait	29	1.7
Lebanon	24	1.7
Botswana (9)	23	0.9
Saudi Arabia	22	1.5
Egypt	20	1.2
Morocco	17	0.8
South Africa (9)	14	1.8
International median	64	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.4 Percentages of students at the international benchmarks for Year 8 science, by country

Trends in Year 8 science achievement

Looking at the overall trends in Year 8 science achievement during the 1995–2015 period, there have been more countries with increases than with decreases. Of the 16 participating countries with data spanning this period, nine countries had increases in average science achievement, three countries had decreases and four countries had no difference. Lithuania had the greatest improvement from 1995 to 2015, with an increase in average science achievement of 58 score points.

Figure 5.5 shows trends in Year 8 science achievement for some selected countries that have comparable data from previous TIMSS assessments. Rather than include graphs showing changes for all countries, we have provided just a few, for interest and comparison. The countries that have been included are those with which we usually make comparisons: the United States, England and New Zealand, along with one of the higher-achieving countries, Singapore, and Slovenia, which showed a large change over this time. The figure provides a graphical depiction of change in Year 8 average achievement in science across the TIMSS assessment years (1995–2015).

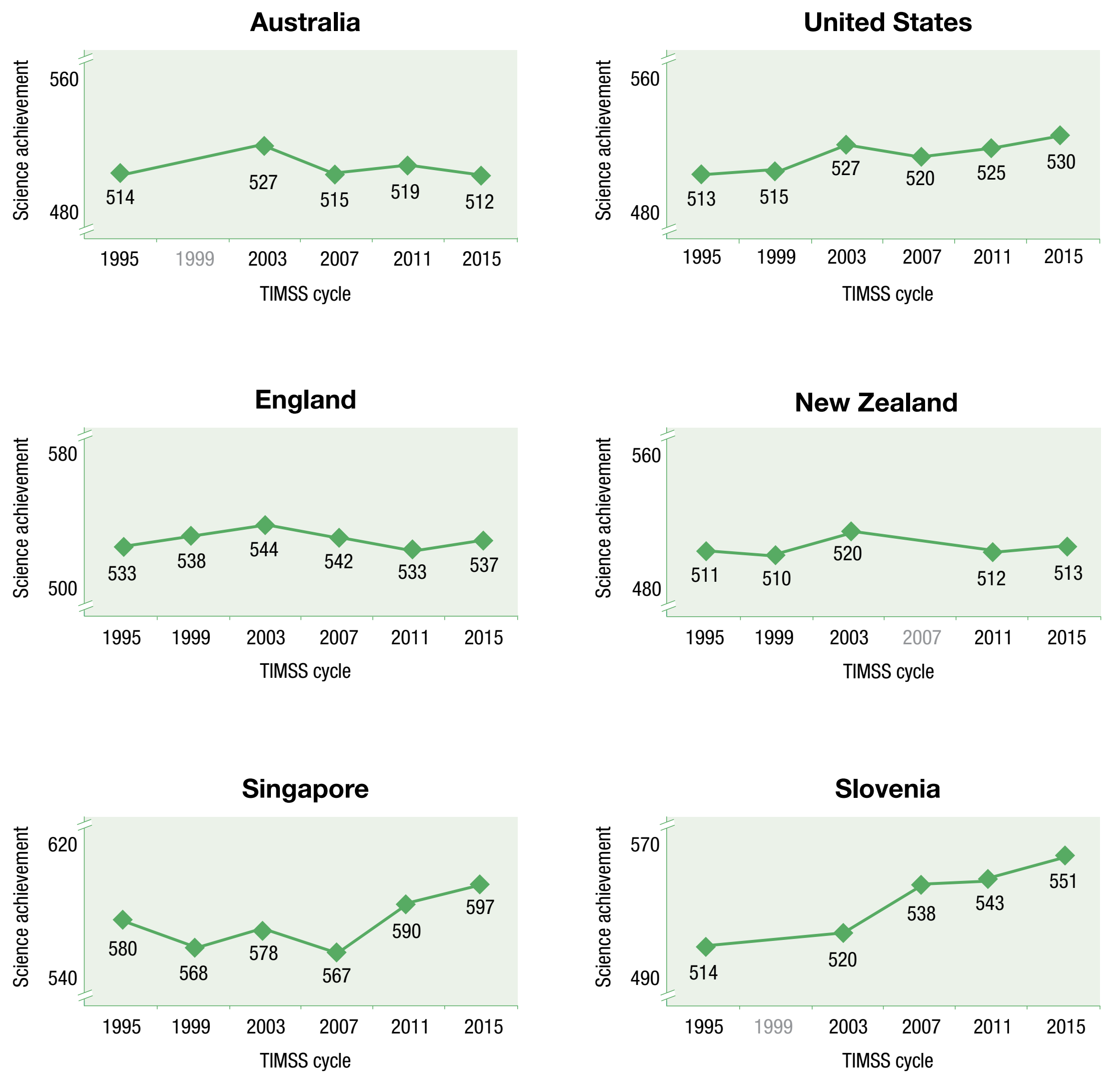


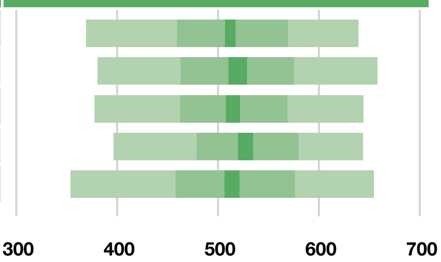
FIGURE 5.5 Trends in Year 8 science achievement scores, 1995–2015, selected countries

With the exception of TIMSS 2003, Australia's score at Year 8 in science since 1995 has been relatively stable. There was an improvement in 2003 but this was followed by a decline in 2007 – scores have not fluctuated much since then. A similar situation can be seen for New Zealand and England, whose scores are largely unchanged since 1995.

In contrast, the growth in achievement in Slovenia over the 20 years since TIMSS 1995 is impressive, with improvement at every cycle. Slovenia's score was the same as Australia's in 1995, but in 2015 Slovenia was one of the top-five-performing countries. Likewise, while Singapore has experienced some ups and downs, it improved its already high score to attain an average achievement level heading towards that of the Advanced benchmark. Scores in the United States since TIMSS 1995 – when its score was the same as Australia's – have fallen only once since then, in TIMSS 2007, and otherwise are significantly higher than in TIMSS 1995, meaning that the United States' score has ended up significantly higher than Australia's in 2015.

The spread of science achievement scores for Australian Year 8 students has decreased since 1995. Figure 5.6 displays the distribution of science achievement for Australian Year 8 students across the cycles. The figure shows that students comprising the 5th percentile (or lowest-performing 5% of students) were performing at a higher level in 2015 than in 1995. In comparison, those comprising the 95th percentile (the top 5% of students) were performing at a slightly lower level in 2015 than in 1995.

			Differences between years				
	Mean	SE	2011	2007	2003	1995	Science achievement distribution
2015	512	2.7	-7	-3	-15 ↓	-2	
2011	519	4.7		4	-8	6	
2007	515	3.6			-12 ↓	1	
2003	527	3.9				13 ↑	
1995	514	3.9					



Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

See Reader's Guide for interpretation of graph.

FIGURE 5.6 Trends in Year 8 science achievement score and distribution, 1995–2015, Australia

Table 5.4 displays each country's position relative to that of Australia in each TIMSS cycle (please see Appendix B for the mean scores by cycle for each country). The United States, Hungary and Sweden recorded scores not significantly different to Australia's in TIMSS 2011, but attained scores significantly higher than Australia's in TIMSS 2015. Slovenia, the Russian Federation, Ireland, the United States and Hong Kong scored at an equivalent level to that of Australia in 1995 and outperformed Australia in 2015. Lithuania was outperformed by Australia in TIMSS 1995 but scored at an equivalent level in TIMSS 2015.

TABLE 5.4 Relative trends in Year 8 science achievement, by country

Country	Position relative to Australia 2015	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Singapore	↑	↑	↑	↑	↑
Japan	↑	↑	↑	↑	↑
Chinese Taipei	↑	↑	↑	↑	–
Korea	↑	↑	↑	↑	↑
Slovenia	↑	↑	↑	•	•
Hong Kong	↑	↑	↑	↑	•
Russian Federation	↑	↑	↑	↓	•
England	↑	↑	↑	↑	↑
Kazakhstan	↑	↓	–	–	–
Ireland	↑	–	–	–	•
United States	↑	•	•	•	•
Hungary	↑	•	↑	↑	↑
Canada	↑	–	–	–	–
Sweden	↑	•	•	•	↑
Lithuania	•	•	•	•	↓
New Zealand	•	•	–	•	•
Australia					
Norway (9)	•	–	–	–	–
Israel	•	•	–	–	–
Italy	↓	↓	↓	↓	–
Turkey	↓	↓	–	–	–
Malta	↓	–	↓	–	–
United Arab Emirates	↓	↓	–	–	–
Malaysia	↓	↓	↓	↓	–
Bahrain	↓	↓	↓	↓	–
Qatar	↓	↓	–	–	–
Iran	↓	↓	↓	↓	↓
Thailand	↓	↓	↓	–	–
Oman	↓	↓	↓	–	–
Chile	↓	↓	–	↓	–
Georgia	↓	↓	↓	–	–
Jordan	↓	↓	↓	↓	–
Kuwait	↓	–	↓	–	–
Lebanon	↓	↓	↓	↓	–
Saudi Arabia	↓	↓	–	–	–
Morocco	↓	↓	–	–	–
Botswana (9)	↓	↓	–	–	–
Egypt	↓	–	↓	↓	–
South Africa (9)	↓	↓	–	–	–

↑ Score significantly higher than Australia's.

↓ Score significantly lower than Australia's.

• Score not significantly different to that of Australia.

– Did not participate in this cycle.

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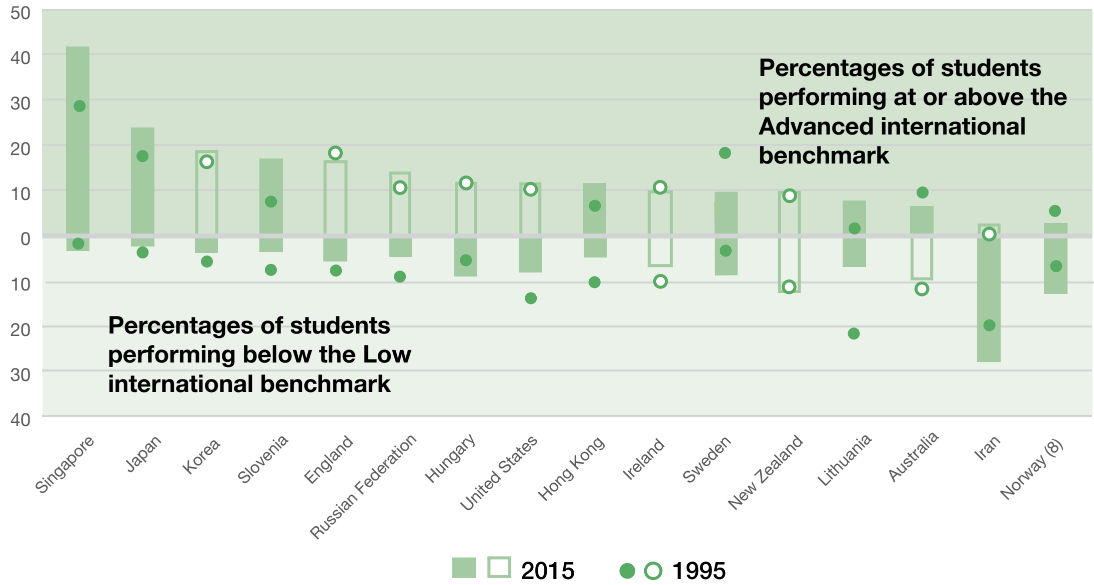
Figure 5.7 shows the trends in the percentages of students achieving the Advanced international benchmark and those not achieving the Low international benchmark for countries that participated in both TIMSS 1995 and TIMSS 2015.

In five of the 16 countries that participated in both TIMSS 1995 and TIMSS 2015 (Singapore, Japan, Slovenia, Hong Kong and Lithuania), the percentages of Year 8 students achieving the Advanced international benchmark in science significantly increased over the 20 years. In three countries (Australia, Sweden and Norway) the percentages of students achieving the Advanced benchmark actually declined over the 20 years.

In terms of achieving the Low international benchmark, three of the 16 countries showed no significant difference, eight countries showed a reduction in the number of students falling below the Low benchmark and five countries reported an increase in the percentage of students falling below the Low benchmark over the 20-year period.



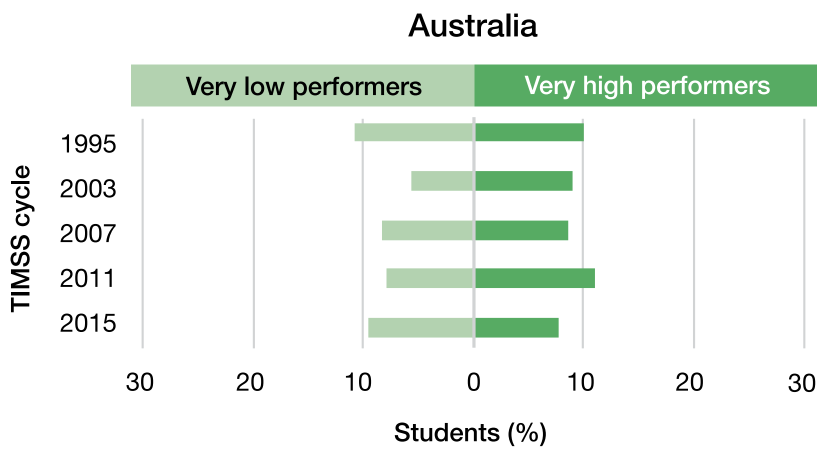
Note: A coloured bar and a coloured circle indicate that the difference in the percentages of students between TIMSS 1995 and TIMSS 2015 was significant.

FIGURE 5.7 Percentages of very high- and very low-achieving students in Year 8 science in TIMSS 1995 and TIMSS 2015, by country

Chapter 5

Figure 5.8 shows the trends in the percentages of Australian Year 8 students achieving the Advanced international benchmark and those not achieving the Low international benchmark in science in all cycles since TIMSS 1995. The figure shows a significant decrease in the percentage of Australian Year 8 students achieving the Advanced benchmark from 1995 to 2015, declining from 10 per cent to seven per cent.

In terms of the percentages of students not achieving the Low benchmark, there was a significant drop in 2003. Unfortunately, the percentage of students not achieving the Low benchmark has increased again since 2003, such that the percentage in 2015 is not significantly different to that in 1995.



Note: The terms 'very low performers' and 'very high performers' refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 5.8 Percentages of very high- and very low-achieving students in Year 8 science in TIMSS 1995 to TIMSS 2015, Australia

Trends across year levels: Year 4 to Year 8 cohort analysis

One of the benefits of administering TIMSS on a four-year cycle is that it allows for an examination of changes over time within a cohort of students, given that the Year 4 students assessed in 2011 were assessed as the Year 8 cohort in 2015. The results are presented in Table 5.5, which shows the average science achievement as a difference from the TIMSS scale centrepoint (500) for the Year 4 students in 2011 on the left and the Year 8 students in 2015 on the right.

TABLE 5.5 Relative achievement in science of 2011 Year 4 students and 2015 Year 8 students, by country

Year 4 2011		
Country	Achievement difference from TIMSS scale centrepoint	SE
Korea	87 ↑	2.1
Singapore	83 ↑	3.4
Japan	59 ↑	1.9
Russian Federation	52 ↑	3.4
Chinese Taipei	52 ↑	2.2
United States	44 ↑	2.1
Hong Kong	35 ↑	3.7
Hungary	34 ↑	3.7
Sweden	33 ↑	2.8
England	29 ↑	3.0
Italy	24 ↑	2.7
Slovenia	20 ↑	2.6
Australia	16 ↑	2.9
Lithuania	15 ↑	2.4
New Zealand	-3	2.4
Kazakhstan	-5	5.1
Norway (4)	-6 ↓	2.5
Chile	-20 ↓	2.5
Turkey	-37 ↓	4.7
Georgia	-45 ↓	3.9
Iran	-47 ↓	3.8
Bahrain	-51 ↓	3.5
Saudi Arabia	-71 ↓	5.5
United Arab Emirates	-72 ↓	2.5
Qatar	-106 ↓	4.3
Oman	-123 ↓	4.3
Morocco	-236 ↓	4.4

Year 8 2015		
Country	Achievement difference from TIMSS scale centrepoint	SE
Singapore	97 ↑	3.2
Japan	71 ↑	1.8
Chinese Taipei	69 ↑	2.1
Korea	56 ↑	2.2
Slovenia	51 ↑	2.4
Hong Kong	46 ↑	3.9
Russian Federation	44 ↑	4.2
England	37 ↑	3.8
Kazakhstan	33 ↑	4.4
United States	30 ↑	2.8
Hungary	27 ↑	3.4
Sweden	22 ↑	3.4
Lithuania	22 ↑	3.0
New Zealand	13 ↑	3.1
Australia	12 ↑	2.7
Italy	-1	2.4
Turkey	-7	4.0
Norway (8)	-11 ↓	2.4
United Arab Emirates	-23 ↓	2.3
Bahrain	-34 ↓	2.2
Qatar	-43 ↓	3.0
Iran	-44 ↓	4.0
Oman	-45 ↓	2.7
Chile	-46 ↓	3.1
Georgia	-57 ↓	3.1
Saudi Arabia	-104 ↓	4.5
Morocco	-107 ↓	2.5

↑ Country mean is significantly higher than the TIMSS scale centrepoint.

↓ Country mean is significantly lower than the TIMSS scale centrepoint.

Thirteen countries – Singapore, Japan, Chinese Taipei, Korea, Slovenia, Hong Kong, the Russian Federation, England, the United States, Hungary, Sweden, Lithuania and Australia – retained a position above the scale centrepoint from Year 4 in 2011 to Year 8 in 2015 (although not in the same order of average achievement). Kazakhstan and New Zealand improved their position from equal to the scale centrepoint in Year 4 in 2011 to above the scale centrepoint in Year 8 in 2015, while Turkey improved from below to equal to the scale centrepoint. Only Italy had a relative decline in achievement from Year 4 to Year 8, moving from a position above the centrepoint in Year 4 in 2011 to one below the centrepoint in Year 8 in 2015.

Australia's Year 8 science results at the national level

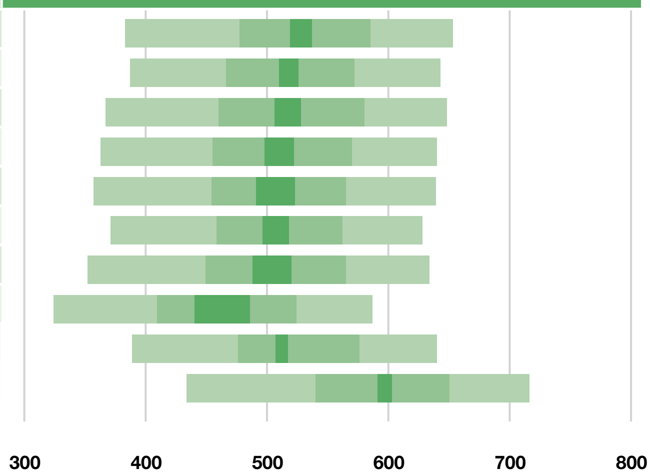
Figure 5.9 presents the distribution of Year 8 science performance for each of the Australian jurisdictions for TIMSS 2015. To place the jurisdiction results in perspective, the means and distributions for Australia as a whole, and for Singapore, the highest-achieving country at Year 8 in science, are also included in this figure. The jurisdictions are shown in order from highest to lowest mean scores.

Figure 5.9 should be read in conjunction with Table 5.6, which presents the multiple comparisons of average performance between the jurisdictions and indicates which jurisdiction's performance does, or does not, differ significantly from the performance of each of the other jurisdictions.

Figure 5.9 and Table 5.6 together show that the Australian Capital Territory was the highest-performing jurisdiction. Its students performed significantly higher, on average, than students in all jurisdictions except Victoria and Western Australia. Students in the Northern Territory performed significantly below students in all other jurisdictions. The spread in average science achievement across jurisdictions was quite large, with an overall range of 64 score points, from 463 for the Northern Territory to 528 for the Australian Capital Territory.

The distribution of responses was only slightly variable between the jurisdictions. Victoria and Queensland displayed the narrowest distribution of responses, with a range of 257 score points, while South Australia had the widest range, with 283 score points separating the 5th and 95th percentiles.

Jurisdiction	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
ACT	528	4.6	270	
VIC	518	4.1	257	
WA	518	5.7	282	
NSW	511	6.1	277	
SA	507	8.3	283	
QLD	507	5.6	257	
TAS	503	8.0	281	
NT	463	11.9	264	
Australia	512	2.7	270	
Singapore	597	3.2	288	



Note: See Reader's Guide for interpretation of graph.

FIGURE 5.9 Mean scores and distribution of Year 8 science achievement, by jurisdiction

TABLE 5.6 Multiple comparisons of Year 8 science achievement, by jurisdiction

Jurisdiction	Mean	SE	ACT	VIC	WA	NSW	SA	QLD	TAS	NT
ACT	528	4.6		•	•	↑	↑	↑	↑	↑
VIC	518	4.1	•		•	•	•	•	•	↑
WA	518	5.7	•	•		•	•	•	•	↑
NSW	511	6.1	↓	•	•		•	•	•	↑
SA	507	8.3	↓	•	•	•		•	•	↑
QLD	507	5.6	↓	•	•	•	•		•	↑
TAS	503	8.0	↓	•	•	•	•	•		↑
NT	463	11.9	↓	↓	↓	↓	↓	↓	↓	

Note: Read across the row to compare a state/territory's performance with the performance of each jurisdiction listed in the column heading.

↑ Average performance statistically significantly higher than in comparison jurisdiction.

• No statistically significant difference from comparison jurisdiction.

↓ Average performance statistically significantly lower than in comparison jurisdiction.

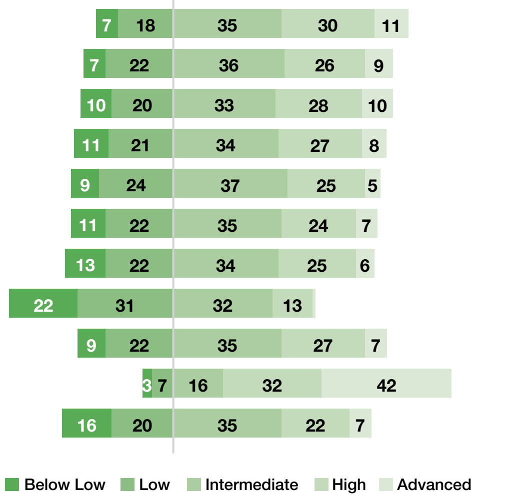
Performance at the international benchmarks by jurisdiction

Figure 5.10 shows the percentage of students in each jurisdiction at each of the international benchmarks for Year 8 science, along with the percentages for Australia as a whole, Singapore (as the highest-scoring country) and the international median for comparison.

The jurisdiction with the highest percentage of students achieving the Advanced benchmark was the Australian Capital Territory, in which 11 per cent of students achieved the highest level. Ten per cent of Western Australian and nine per cent of Victorian students achieved this benchmark. The Northern Territory had the lowest proportion of students at this level, with just one per cent achieving the Advanced benchmark. This is well short of the 42 per cent of students in Singapore who performed at this level, though most Australian jurisdictions performed at a level very similar to that of the international median (7%).

Cause for concern is the proportion of students who did not reach the Intermediate benchmark, which is the proficient standard for Australia. Fifty-three per cent of students in the Northern Territory did not reach the Intermediate benchmark in science at Year 8. In the other jurisdictions, this proportion ranged from 24 per cent in the Australian Capital Territory to 34 per cent in Tasmania.

Jurisdiction	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
ACT	76	2.3	
VIC	71	1.6	
WA	70	2.5	
NSW	68	3.1	
QLD	67	2.8	
SA	67	3.3	
TAS	66	4.0	
NT	47	6.3	
Australia	69	1.3	
Singapore	90	1.1	
International median	64		



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

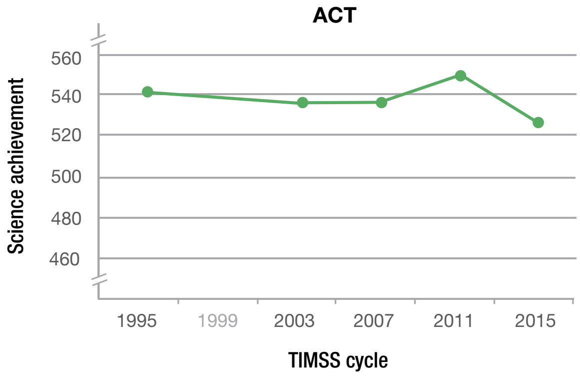
Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.10 Percentages of Australian students at the international benchmarks for Year 8 science, by jurisdiction

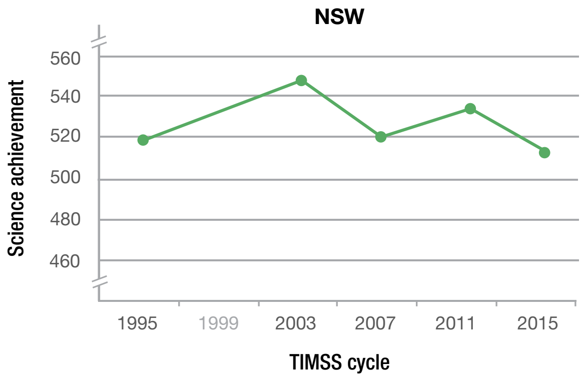
Trends in Year 8 science achievement by jurisdiction

Figure 5.11 presents the trends in science achievement for each of the jurisdictions for each cycle of TIMSS (1995, 2003, 2007, 2011 and 2015) and also an indication of the statistical significance of the difference between cycles (please see Appendix C for the mean scores by cycle for each jurisdiction).

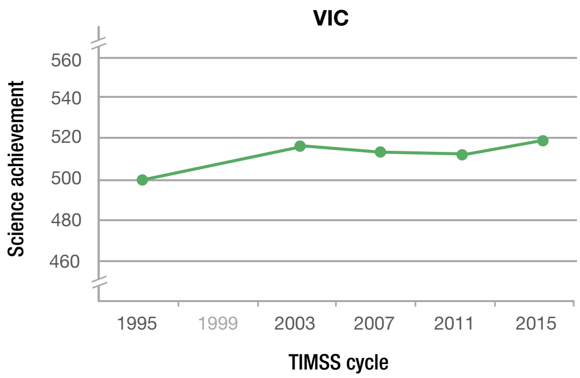
The only change from TIMSS 2011 to TIMSS 2015 was a significant decline in the score for the Australian Capital Territory. The only significant difference from TIMSS 1995 was for Victoria, which scored significantly higher in TIMSS 2015 than in TIMSS 1995.



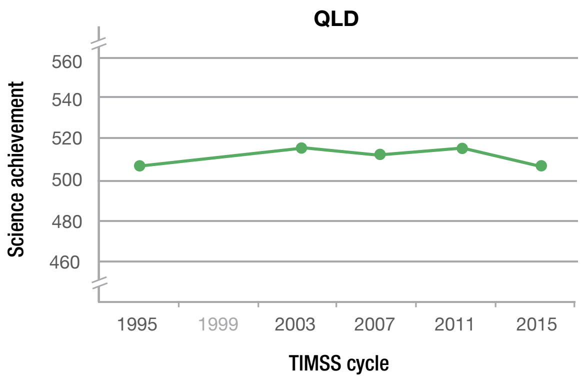
Differences between years				
	2011	2007	2003	1995
2015	-23 ↓	-10	-10	-15
2011		13	13	8
2007			0	-5
2003				-5



Differences between years				
	2011	2007	2003	1995
2015	-21	-10	-36 ↓	-8
2011		11	-16	13
2007			-26	2
2003				29 ↑



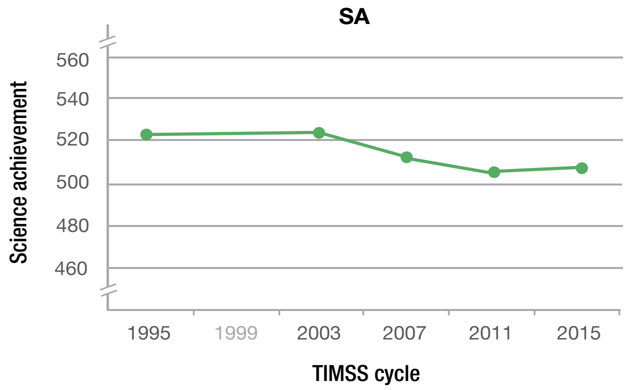
Differences between years				
	2011	2007	2003	1995
2015	6	5	3	19 ↑
2011		0	-3	13
2007			-3	13
2003				16



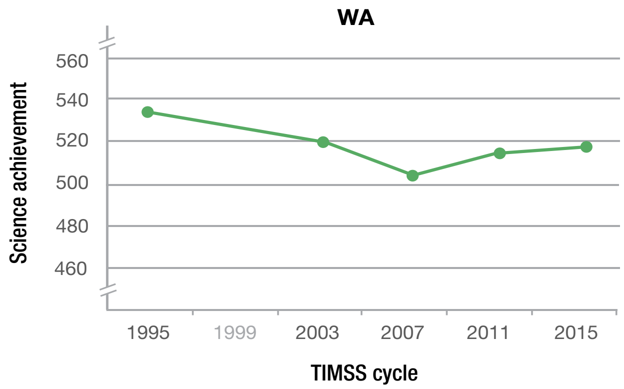
Differences between years				
	2011	2007	2003	1995
2015	-9	-6	-9	0
2011		3	0	9
2007			-3	6
2003				8

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

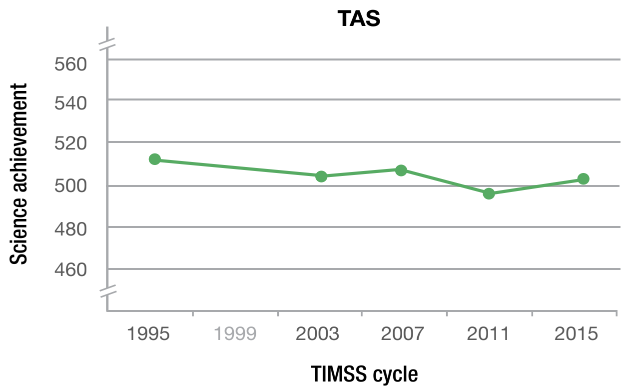
FIGURE 5.11 Trends in Year 8 science achievement within Australia, 1995–2015, by jurisdiction



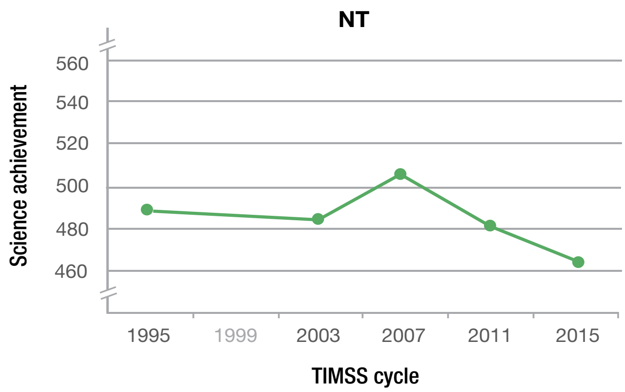
Differences between years				
	2011	2007	2003	1995
2015	1	-5	-17	-16
2011		-6	-18	-18 ↓
2007			-12	-11
2003				1



Differences between years				
	2011	2007	2003	1995
2015	3	11	-3	-16
2011		8	-6	-19
2007			-14	-27 ↓
2003				-13



Differences between years				
	2011	2007	2003	1995
2015	7	-4	-1	-10
2011		-11	-8	-17
2007			3	-7
2003				-10



Differences between years				
	2011	2007	2003	1995
2015	-18	-39 ↓	-19	-24
2011		-21	-1	-6
2007			20	15
2003				-5

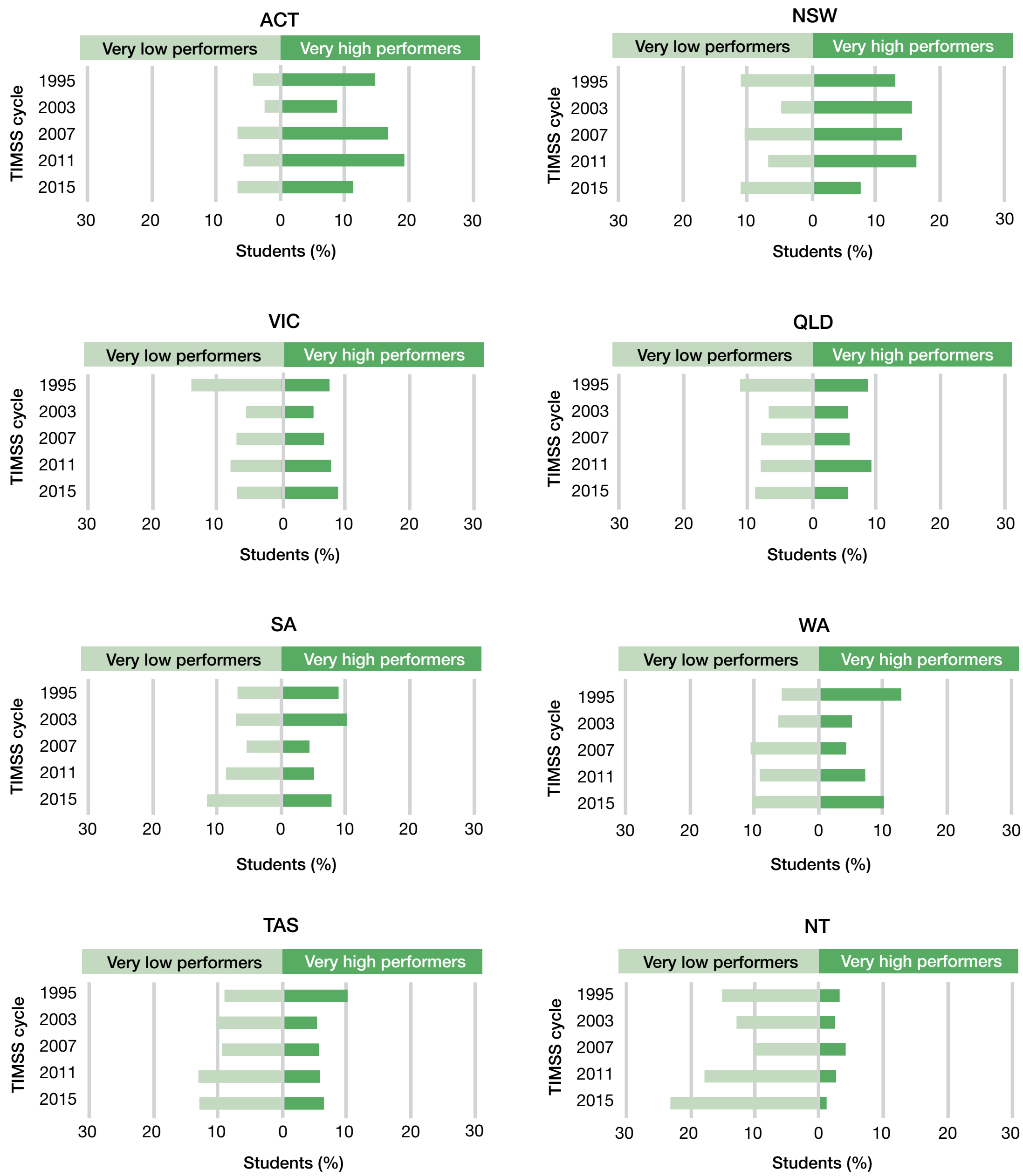
Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

FIGURE 5.11 Trends in Year 8 science achievement within Australia, 1995–2015, by jurisdiction (cont.)

Figure 5.12 shows the percentage of students achieving the Advanced international benchmark in Year 8 science, as well as the percentage of students not achieving the Low international benchmark, for each Australian jurisdiction for all TIMSS cycles from 1995 through to 2015.

The percentages of students not achieving the Low benchmark increased in five of the Australian jurisdictions over the 20-year period from 1995 to 2015. The increase (of about five percentage points) was statistically significant in South Australia and Western Australia. Of the remaining jurisdictions, only Victoria reported a statistically significant drop (of seven percentage points) in the proportion of students who did not achieve the Low benchmark.

Most jurisdictions (except Victoria) experienced a decrease in the percentage of students achieving the Advanced benchmark from 1995 to 2015. However, this was not statistically significant for any jurisdiction.



Note: The terms ‘very low performers’ and ‘very high performers’ refer, respectively, to the percentages of students who did not achieve the Low international benchmark and the percentages of students who achieved the Advanced international benchmark.

FIGURE 5.12 Percentages of very high- and very low-achieving students in Year 8 science in TIMSS 1995 to TIMSS 2015, by jurisdiction

Table 5.7 presents the cohort comparisons for the Australian jurisdictions. Year 4 students in the Australian Capital Territory, Victoria, New South Wales and Tasmania achieved at a level higher than the TIMSS scale centrepoint in 2011. Students in the Australian Capital Territory and Victoria retained a position above the TIMSS scale centrepoint in Year 8 in TIMSS 2015. Year 8 students in New South Wales and Tasmania, however, fell to a position equivalent to the TIMSS scale centrepoint in 2015. Year 8 students in Western Australia achieved a scale score significantly above the centrepoint, while Year 8 students in the Northern Territory achieved at a significantly lower level than the TIMSS scale centrepoint in 2015.

TABLE 5.7 Relative achievement in science of Australian 2011 Year 4 students and 2015 Year 8 students, by jurisdiction

Year 4 2011			Year 8 2015		
Jurisdiction	Achievement difference from TIMSS scale centrepoint	SE	Jurisdiction	Achievement difference from TIMSS scale centrepoint	SE
ACT	47 ↑	5.2	ACT	28 ↑	4.6
VIC	29 ↑	5.1	VIC	18 ↑	4.1
NSW	22 ↑	5.6	WA	18 ↑	5.7
TAS	18 ↑	7.1	NSW	11	6.1
SA	6	5.3	SA	7	8.3
WA	2	5.8	QLD	7	5.6
QLD	1	6.1	TAS	3	8.0
NT	-9	13.2	NT	-37 ↓	11.9

↑ Jurisdiction mean is significantly higher than the TIMSS scale centrepoint.

↓ Jurisdiction mean is significantly lower than the TIMSS scale centrepoint.

Chapter 5

Australia's Year 8 science achievement for different demographic groups

Year 8 science achievement by sex

Figure 5.13 shows the performance of male and female Year 8 students in science achievement across the countries participating in TIMSS 2015. This figure presents average achievement separately for females and males, as well as the differences between the averages. Sex differences are shown by a bar indicating the size and direction of each difference (in favour of males or females) and whether the difference was statistically significant (indicated by a darkened bar). Countries are presented in the figure in increasing order of the difference between females and males in average achievement.

Figure 5.13 shows that on average across the TIMSS 2015 countries, there was a significant sex difference in science in favour of females. Females achieved significantly higher average scores than males in 15 of the participating countries, including many of the countries located in the Middle East. The significant differences in favour of females ranged in size from seven score points in Morocco to 55 score points in Saudi Arabia. Males achieved significantly higher average scores than females in five countries. Across the participating countries, the significant differences in favour of males ranged in size from five score points in the United States to 17 score points in Hungary.

In Australia, as well as in 19 other countries, there was no significant difference between females and males in Year 8 science achievement.

Country	Female % of students	Female SE of %	Female Mean	Female SE	Male % of students	Male SE of %	Male Mean	Male SE	Difference (absolute value)	SE
Saudi Arabia	51	1.6	423	4.9	49	1.6	368	8.0	55	9.5
Bahrain	48	0.9	492	3.2	52	0.9	442	3.4	50	5.0
Kuwait	50	2.5	434	5.1	50	2.5	387	8.2	47	8.7
Oman	48	1.7	478	2.9	52	1.7	433	3.6	45	4.4
Jordan	50	2.6	447	4.0	50	2.6	405	5.3	41	6.7
United Arab Emirates	50	2.5	492	3.5	50	2.5	461	4.4	31	6.7
Qatar	50	3.0	471	3.6	50	3.0	441	5.2	30	6.0
Botswana (9)	51	0.6	403	3.3	49	0.6	381	3.1	22	3.3
Thailand	54	1.5	465	4.4	46	1.5	445	5.2	20	4.8
Turkey	48	0.8	503	4.1	52	0.8	484	4.5	19	3.1
Egypt	53	2.3	377	5.9	47	2.3	364	5.4	13	7.6
Lebanon	53	1.6	403	4.9	47	1.6	393	6.7	10	4.7
Malaysia	50	1.8	476	4.0	50	1.8	466	4.8	10	3.5
South Africa (9)	51	1.1	362	6.7	49	1.1	353	5.5	9	5.1
Malta	49	0.3	485	2.2	51	0.3	477	2.2	8	3.1
Morocco	46	0.7	397	2.3	54	0.7	390	3.4	7	3.0
Kazakhstan	49	0.9	536	5.2	51	0.9	530	4.5	6	3.9
Israel	49	1.2	510	4.1	51	1.2	504	4.7	6	4.1
Iran	48	0.9	459	4.4	52	0.9	454	6.6	5	8.0
Slovenia	48	0.7	553	2.8	52	0.7	549	2.7	4	2.7
Ireland	50	1.1	531	2.8	50	1.1	529	3.9	2	3.7
England	51	1.6	537	4.7	49	1.6	536	4.5	1	5.2
Japan	51	1.0	571	2.2	49	1.0	570	2.5	1	3.1
Lithuania	50	0.8	520	3.3	50	0.8	519	3.4	1	3.7
New Zealand	51	2.0	513	3.2	49	2.0	512	4.3	1	4.2
Georgia	47	0.9	444	3.3	53	0.9	443	3.9	1	3.7
Sweden	48	1.0	523	4.2	52	1.0	522	3.5	1	3.4
Singapore	49	0.6	596	3.3	51	0.6	597	4.0	1	3.7
Chinese Taipei	49	0.8	568	2.3	51	0.8	571	2.6	3	2.6
Korea	47	0.5	554	2.2	53	0.5	557	2.8	3	2.7
Norway (9)	50	0.7	507	3.1	50	0.7	511	3.2	4	2.9
Russian Federation	49	0.9	542	4.6	51	0.9	546	4.3	4	3.0
Canada	51	1.0	524	2.2	49	1.0	529	2.7	5	2.3
Australia	51	1.6	510	3.4	49	1.6	515	3.0	5	3.4
United States	50	0.6	527	3.1	50	0.6	533	3.0	5	2.0
Italy	49	0.8	494	3.0	51	0.8	504	2.6	10	2.7
Hong Kong	47	2.1	540	4.2	53	2.1	551	4.9	10	4.6
Chile	48	1.8	448	3.6	52	1.8	460	4.1	12	4.8
Hungary	50	0.9	519	3.9	50	0.9	535	3.6	17	3.2
International average	50	0.2	491	0.6	50	0.2	481	0.7		

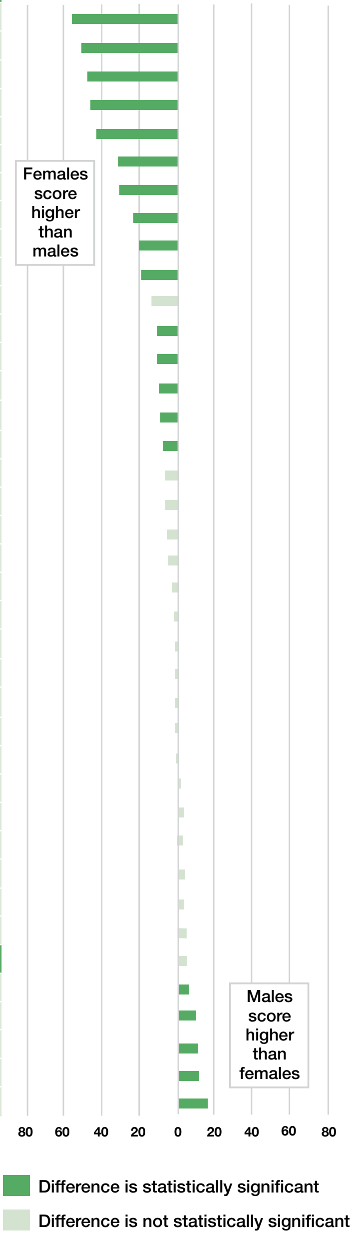
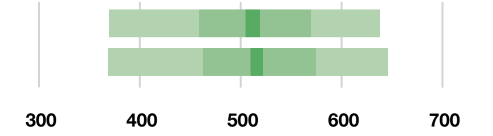


FIGURE 5.13 Sex differences in Year 8 science achievement, by country

Figure 5.14 confirms the lack of significant sex difference in average science achievement in Australia, but shows a slightly greater range of scores for Year 8 male students (275 score points) than for Year 8 female students (264 score points), with most of the difference being seen at the higher end of the distribution.

Sex	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Female	51	510	3.4	264	
Male	49	515	3.0	275	



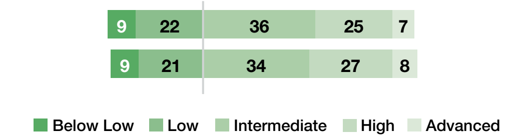
Note: See Reader's Guide for interpretation of graph.

FIGURE 5.14 Mean scores and distribution of Year 8 science achievement within Australia, by sex

Performance at the international benchmarks by sex

Figure 5.15 shows the percentages of Australian students at each of the international benchmarks in Year 8 science by sex. In Australia, a very similar percentage of Year 8 males and females achieved at each of the benchmarks.

Sex	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Female	68	1.7	
Male	70	1.6	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.15 Percentages of Australian students at the international benchmarks for Year 8 science, by sex

Trends in science achievement by sex

Figure 5.16 provides a graphic representation of trends from 1995 to 2015 in the science achievement of male and female Year 8 students in Australia. While in all previous cycles of TIMSS, Australian males in Year 8 scored significantly higher than females, the 2015 results show that this gap has closed. The 2015 cycle of TIMSS is the first in which there are no sex differences in science achievement at the Year 8 level.

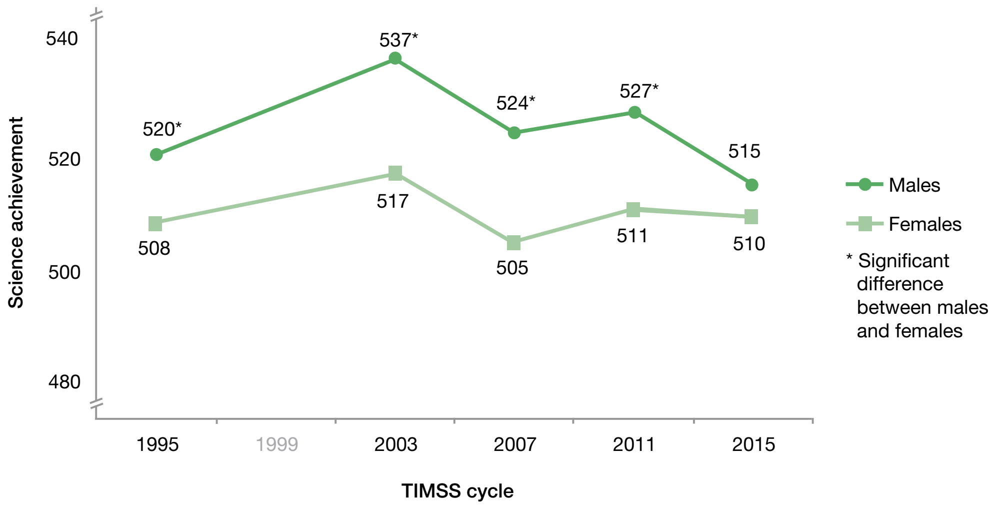


FIGURE 5.16 Trends in Year 8 science achievement within Australia, 1995–2015, by sex

Sex difference in science achievement by jurisdiction

Figure 5.17 shows the sex differences in Year 8 science by jurisdiction. While there was a tendency for males to perform slightly higher than females in most jurisdictions (Victoria, Tasmania, Queensland, Australian Capital Territory and New South Wales), no difference was significant. In the Northern Territory, Western Australia and South Australia, females slightly outperformed males; however, these differences were not significant.

Jurisdiction	Female		Male		Difference (absolute value)	SE
	Mean	SE	Mean	SE		
NT	467	12.5	461	12.1	7	10.0
WA	518	6.3	517	8.2	1	8.9
SA	508	10.8	507	8.6	0	10.3
VIC	518	6.0	519	4.3	1	6.7
TAS	501	12.2	506	8.8	5	14.1
QLD	504	5.9	510	8.1	6	8.5
ACT	523	6.5	532	7.9	9	11.4
NSW	505	8.4	517	6.0	12	8.4

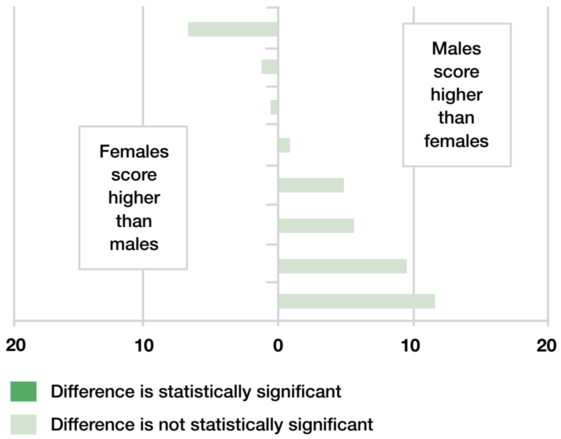
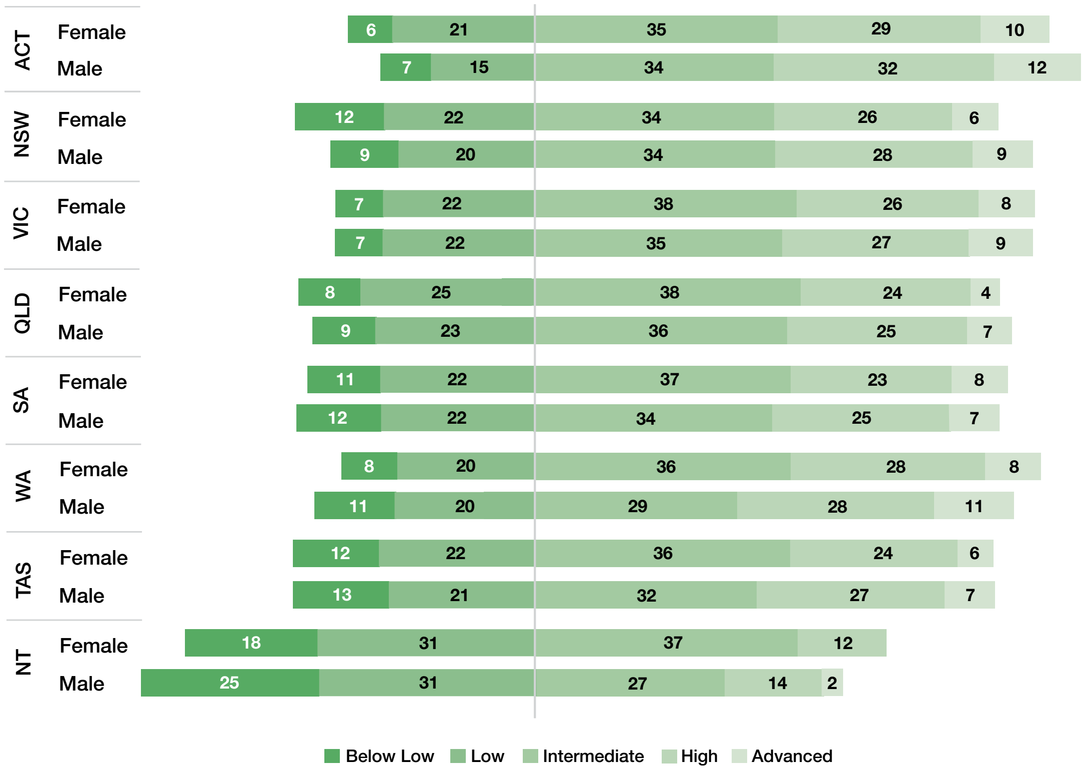


FIGURE 5.17 Sex differences in Year 8 science achievement within Australia, by jurisdiction

Figure 5.18 shows the percentages of students at each of the international benchmarks in Year 8 science in each jurisdiction, by sex. This figure highlights only a slight variation in performance for male and female Year 8 students across jurisdictions. In particular, there was no significant difference in the percentages of male and female students achieving the Advanced benchmark in any jurisdiction. Likewise, there was no significant difference in the percentages of male and female students achieving at or above the Intermediate benchmark (the proficient standard for Australia) in any jurisdiction.

Of concern, however, is that half of the female students and 56 per cent of the male students in the Northern Territory did not achieve the Intermediate benchmark. In several other jurisdictions, the proportions not achieving this basic level were also worrying – around one-third of both male and female students in Tasmania, South Australia and Queensland, and of female students in New South Wales.



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.18 Percentages of Australian students at the international benchmarks for Year 8 science, by sex within jurisdiction

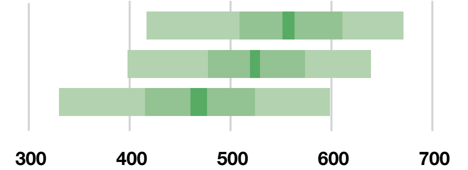
Year 8 science achievement by books in the home

Socioeconomic status has been found (in TIMSS and other studies) to be related to achievement. In TIMSS, the number of books in the home is used as a proxy for socioeconomic status. This section presents Australian students' science achievement according to the number of books in the home. For more information about this variable, please refer to the Reader's Guide.

Figure 5.19 provides the percentage of students in each category, and the average achievement score for students in each group. The majority of the Australian students (48%) reported having an *average number of books* and only 21 per cent reported having *many books* at home. At this year level, the 21 per cent of students who reported having *many books* in the home gained a substantial advantage, scoring on average 33 score points higher than the next category of students and more than three-quarters of a standard deviation, 88 score points, higher than students with a *few books* in the home. Even having an *average number of books* in the home has a substantial relationship with achievement, with these students scoring, on average, half a standard deviation, 55 score points, higher than the students with just a *few books* in the home.

Figure 5.19 also shows the distribution of scores in science achievement of Year 8 students for each category of books at home. The spread of scores between the 5th and 95th percentiles does not vary greatly from one group to another, ranging from 239 to 266 score points. Those students who reported having a *few books* in the home had the widest range of scores, while the spread of scores was narrowest for the group that reported an *average number of books* at home.

Number of books in the home	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Many books	21	556	3.0	252	
Average number of books	48	523	2.4	239	
A few books	31	468	3.9	266	



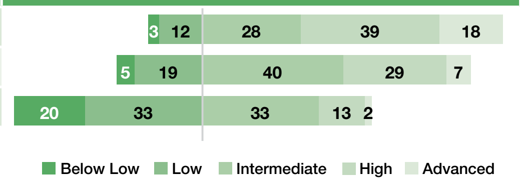
Note: See Reader's Guide for interpretation of graph.

FIGURE 5.19 Mean scores and distribution of Year 8 science achievement within Australia, by number of books in the home

Figure 5.20 presents the percentages of students at each of the international benchmarks according to the number of books in the home. Eighteen per cent of the students who reported having *many books* in the home achieved the Advanced benchmark, compared to seven per cent of those who reported having an *average number of books*, and just two per cent of students who reported having only a *few books* at home.

At the lower end of the achievement spectrum, 15 per cent of students with *many books* did not achieve the Intermediate benchmark (the proficient standard for Australia), with just three per cent not achieving the Low benchmark. By comparison, 52 per cent of students who reported a *few books* in the home did not achieve the Intermediate benchmark, with 20 per cent not achieving the Low benchmark.

Number of books in the home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Many books	85	1.7	
Average number of books	76	1.2	
A few books	48	2.1	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.20 Percentages of Australian students at the international benchmarks for Year 8 science, by number of books in the home

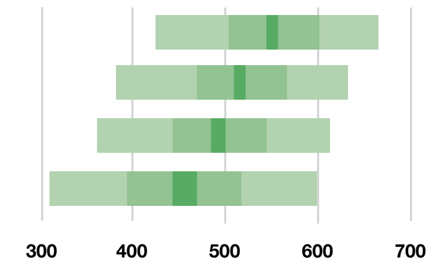
Year 8 science achievement by level of parental education

Parental education has also been found to be strongly related to student achievement. This section presents Australian students' science achievement according to the level of parental education. For more information about this variable, please refer to the Reader's Guide.

As can be seen in Figure 5.21, mean achievement increases as the level of parental education increases, with students who have at least one parent with a university degree having an average science score a substantial 93 score points higher than that of students whose parents did not complete secondary school, 57 score points higher than the average score for students for whom the highest level of parental education was completing secondary school and 36 score points higher than that of students whose parents completed post-secondary education but not university. All differences are statistically significant.

Figure 5.21 also shows the spread of scores in science achievement at Year 8 for the different parental education groups. The spread of scores between the 5th and 95th percentiles varies from 239 score points for students who have at least one parent with a university degree to 288 score points for students whose parents did not complete secondary school.

Parental education	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Completed university degree	41	551	3.2	239	
Completed post-secondary but not university	30	515	2.9	248	
Completed upper secondary education	21	494	4.1	251	
Did not complete upper secondary education	8	458	6.8	288	

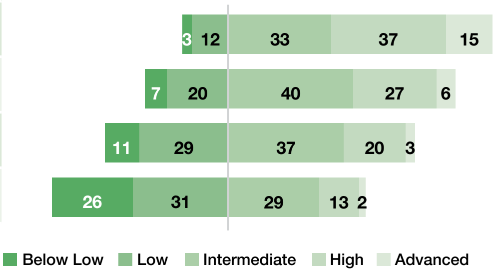


Note: See Reader's Guide for interpretation of graph.

FIGURE 5.21 Mean scores and distribution of Year 8 science achievement within Australia, by parental education

Figure 5.22 shows the percentages of students at each of the benchmarks according to level of parental education. Fifteen per cent of students who had at least one parent complete a university degree reached the Advanced benchmark, compared to six per cent of students who had a parent who undertook some other form of post-secondary education and three per cent or less for the two other groups. Furthermore, 57 per cent of students whose parents did not complete secondary school did not reach the Intermediate benchmark (the proficient standard for Australia), compared to 15 per cent of students with at least one parent holding a university degree.

Parental education	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Completed university degree	85	1.3	
Completed post-secondary but not university	73	1.6	
Completed upper secondary education	61	3.3	
Did not complete upper secondary education	43	3.8	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.22 Percentages of Australian students at the international benchmarks for Year 8 science, by parental education

Chapter 5

Year 8 science achievement by educational resources in the home

The presence or absence of educational resources in the home expresses potential advantage or disadvantage for students that may reflect the ability of parents to provide materially for their children or indicate differences in practical and psychological support for academic achievement. This section presents Australian students' science achievement according to the number of educational resources in the home. For more information about this variable, please refer to the Reader's Guide.

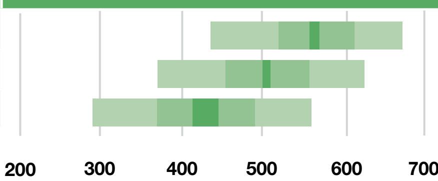
Figure 5.23 presents the percentage of Australian students in each of the three groups formed for the Home Educational Resources scale, along with the average science achievement for each group.

Australia had one of the highest proportions of Year 8 students who had *many resources* at home, with 23 per cent of students in this category, similar to Sweden (also 23%), the United States (22%), Canada (21%), and England and New Zealand (both 19%). Only Korea and Norway had higher percentages of students in this category (37 and 29%, respectively). The proportion of Australian students with only a *few resources* at home (4%) was also quite low by international standards. The majority of Australian students (73%) fell into the middle category of *some resources*.

Year 8 students who had *many resources* in the home performed at a significantly higher level than those who had *some resources*, who again performed at a significantly higher level than those who had *few resources*. Australian Year 8 students who had *many resources* scored, on average, 59 score points higher than those who had *some resources*, whose average achievement was 73 score points higher than those with *few resources* at home. The average achievement of those with *many resources* was 133 score points more than those with *few resources*, a difference that is one and one-third standard deviations on the TIMSS Year 8 science scale.

Figure 5.23 also shows the spread of scores in science achievement at Year 8 for the different levels of the Home Educational Resources scale. The spread of scores between the 5th and 95th percentiles varies from 235 score points for students with *many resources* in the home to 270 score points for students with *few resources* at home.

Number of resources in the home	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Many resources	23	562	2.8	235	
Some resources	73	503	2.5	253	
Few resources	4	429	8.4	270	

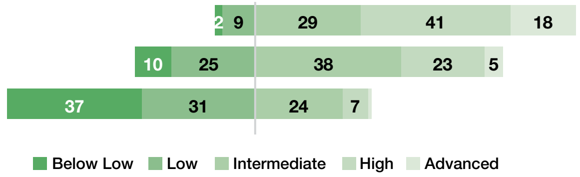


Note: See Reader's Guide for interpretation of graph.

FIGURE 5.23 Mean scores and distribution of Year 8 science achievement within Australia, by educational resources in the home

Figure 5.24 shows the percentage of Year 8 students at each of the international benchmarks for each category of the Home Educational Resources scale. This shows clearly that more resources are associated with higher levels of achievement. While 18 per cent of students with *many resources* achieved the Advanced benchmark, this decreased to five per cent of students with *some resources* and only one per cent of students with *few resources*. Sixty-nine per cent of students with *few resources* and 34 per cent with *some resources* failed to meet the Intermediate benchmark (the proficient standard for Australia). Only 12 per cent of students with *many resources* failed to reach the Intermediate benchmark.

Number of resources in the home	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Many resources	88	1.4	
Some resources	66	1.3	
Few resources	31	4.9	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.24 Percentages of Australian students at the international benchmarks for Year 8 science, by educational resources in the home

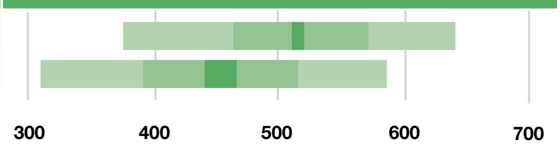
Year 8 science achievement by Indigenous background

The education attainment of Australia's Indigenous students in core subject areas such as science is an important issue, and previous TIMSS studies have provided a picture of Indigenous achievement in this area. This section presents Australian students' science achievement according to Indigenous status. For more information about this variable, please refer to the Reader's Guide.

The means in Figure 5.25 clearly show that Indigenous students at the Year 8 level did not perform as well as their non-Indigenous counterparts. At Year 8, Indigenous students achieved an average score of 453, which was 62 score points lower than the average score of non-Indigenous students of 515 score points (a statistically significant difference).

Figure 5.25 also shows the spread of scores (between the 5th and 95th percentiles) for Indigenous and non-Indigenous students in science achievement at Year 8. The figure indicates that the spread was similar for the two groups (265 score points for non-Indigenous students and 277 for Indigenous).

Indigenous background	% of students	Mean	SE	Gap 95th–5th percentiles	Science achievement distribution
Non-Indigenous	95	515	2.6	265	
Indigenous	5	453	6.6	277	



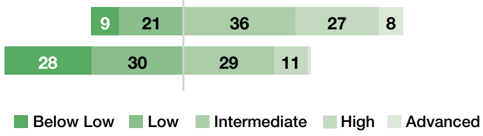
Note: See Reader's Guide for interpretation of graph.

FIGURE 5.25 Mean scores and distribution of Year 8 science achievement within Australia, by Indigenous background

Figure 5.26 adds to the picture of science performance by showing the percentages of Indigenous students and non-Indigenous students in Year 8 at each of the international benchmarks for science.

One per cent of Indigenous students achieved the Advanced benchmark, compared to eight per cent of non-Indigenous students. At the other end of the achievement spectrum, 28 per cent of Year 8 Indigenous students did not reach the Low benchmark, compared to nine per cent of non-Indigenous students, while a total of 58 per cent of Indigenous students and 30 per cent of non-Indigenous students did not achieve the Intermediate benchmark (the proficient standard for Australia).

Indigenous background	% of students at or above the proficient standard for Australia	SE	Performance at each of the TIMSS international benchmarks
Non-Indigenous	70	1.3	
Indigenous	42	3.0	



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.26 Percentages of Australian students at the international benchmarks for Year 8 science, by Indigenous background

Figure 5.27 shows trends in achievement for Indigenous and non-Indigenous students over the period from 1995 to 2015. The only significant difference in scores between any TIMSS cycle is that non-Indigenous students' scores have declined significantly between TIMSS 2003 and TIMSS 2015. The difference in 2015 between Indigenous and non-Indigenous students was significant, as it has been in each year of testing, and has not decreased measurably over 20 years.

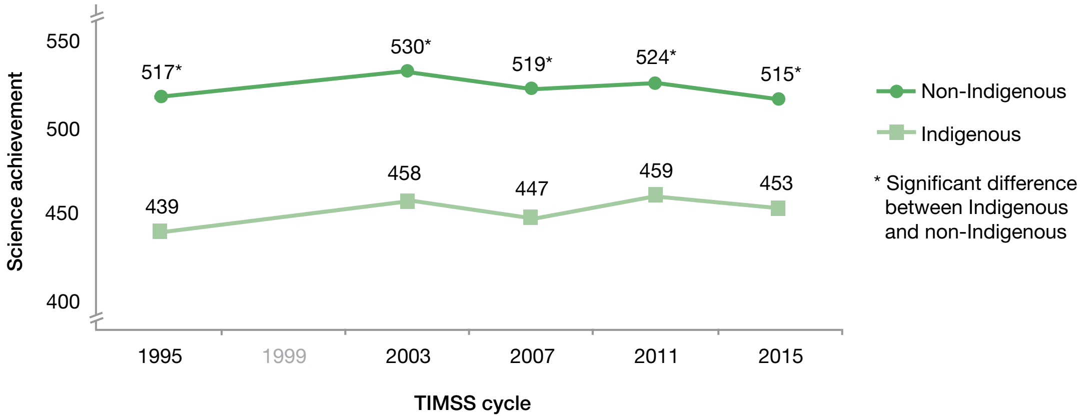


FIGURE 5.27 Trends in Year 8 science achievement within Australia, 1995–2015, by Indigenous background

Year 8 science achievement by language spoken at home

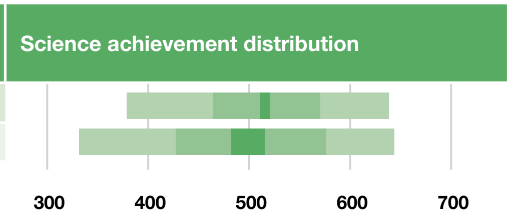
How often English is spoken at home is a factor that has been associated with Year 8 science achievement in past cycles of TIMSS. Students who come from homes in which English is not spoken frequently have less exposure to the language of instruction and test, which could place them at a disadvantage. This section presents Australian students' science achievement according to whether a language other than English is spoken as the main language at home. For more information about this variable, please refer to the Reader's Guide.

Figure 5.28 shows that while the majority of students tested in Year 8 spoke English 'always' or 'almost always' at home, there was a group of around seven per cent of students for whom this was not true. Students who spoke mainly English at home achieved an average scale score that was a statistically significant 16 score points higher than that for students who did not speak English at home 'always' or 'almost always'.

for students who spoke a language other than English at home, and 263 score points for those who spoke mainly English at home.

This provides some interesting information about students who spoke a language other than English at home. At the 95th percentile of achievement, the scores of students who spoke a language other than English at home were as high as or higher than those of English-speaking students; however, at the 5th percentile, students who spoke a language other than English at home were scoring, on average, about half a standard deviation lower than English-speaking students. Clearly, this makes it difficult to categorise non-English speakers as either high or low achievers, and further information could be valuable in determining whether there are particular characteristics of this group of students that would allow us to identify the sorts of problems that they experience in our schools.

Language spoken at home	% of students	Mean	SE	Gap 95th–5th percentiles
English	93	514	2.4	263
Other	7	498	8.6	317



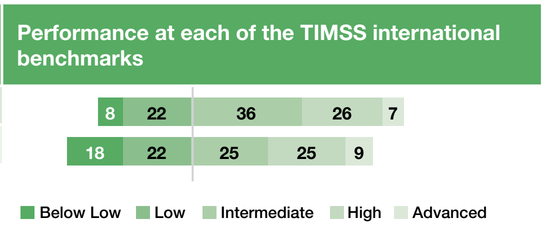
Note: See Reader's Guide for interpretation of graph.

FIGURE 5.28 Mean scores and distribution of Year 8 science achievement within Australia, by language spoken at home

Figure 5.29 further exemplifies this pattern, showing that around the same proportion of non-English-speaking students achieved the Advanced benchmark (9% compared to 7% of English-speaking students) and High benchmark (25% vs 26%, respectively), but that larger proportions of English-speaking than non-English-speaking students performed at the Intermediate benchmark.

More students who spoke a language other than English at home did not reach the Low benchmark – 18 per cent, compared to eight per cent of English-speaking students – and the same proportion of each group performed at the Low benchmark, resulting in 41 per cent of students who spoke a language other than English at home and 30 per cent of English-speaking students not achieving the Intermediate benchmark (the proficient standard for Australia).

Language spoken at home	% of students at or above the proficient standard for Australia	SE
English	70	1.2
Other	59	3.8



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.29 Percentages of Australian students at the international benchmarks for Year 8 science, by language spoken at home

Year 8 science achievement by geographic location of the school

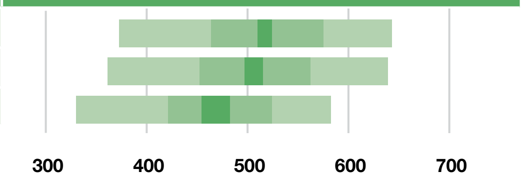
Past cycles of TIMSS have found that students attending schools in remote or regional areas of Australia are often at an educational disadvantage compared to students attending metropolitan schools. This section presents Australian students' science achievement according to the geographic location of the school. For more information about this variable, please refer to the Reader's Guide.

The means and standard errors of students attending schools in the three location categories are shown in Figure 5.30. It should be noted that the percentage of students in remote schools is very small (less than 1% of students); therefore, the level of uncertainty in estimating the mean will be very large, which is reflected in very large standard errors. This reduces the likelihood that significant differences between groups will be found (please see the Reader's Guide).

Students attending schools in metropolitan areas achieved, on average, 11 score points higher than students attending schools in provincial areas, and 48 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 37 score points higher than students attending schools in remote areas. All these differences are statistically significant.

The distribution of scores for the three groups is similar, with the spread of achievement widest for students attending schools in provincial areas and narrowest for those attending schools in remote areas.

Geographic location	% of students	Mean	SE	Gap 95th–5th percentiles
Metropolitan	71	516	3.5	267
Provincial	29	504	4.3	273
Remote	0	468	7.0	250

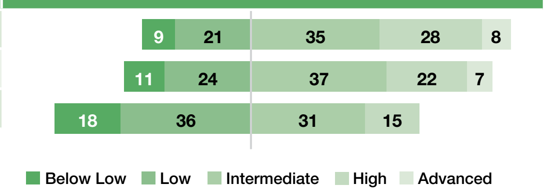


Note: See Reader's Guide for interpretation of graph.

FIGURE 5.30 Mean scores and distribution of Year 8 science achievement within Australia, by geographic location

Figure 5.31 shows the percentages of Year 8 students at each of the international benchmarks by geographic location. Around one-third of students in metropolitan and provincial areas (30 and 35%, respectively) and more than half (53%) of students in remote areas did not achieve the Intermediate benchmark (the proficient standard for Australia). Eight per cent of students in metropolitan areas achieved the Advanced benchmark, compared to seven per cent in provincial areas and less than one per cent in remote areas.

Geographic location	% of students at or above the proficient standard for Australia	SE
Metropolitan	70	1.7
Provincial	65	2.3
Remote	47	6.9



Note: In cases in which the proportion of students in a benchmark band is 1% or less, the numeric label will not appear on the band. This convention has been used for all figures about benchmarks in the chapter.

Due to rounding, some percentages in the figure may not match to totals in the text. See the Reader's Guide for more information.

FIGURE 5.31 Percentages of Australian students at the international benchmarks for Year 8 science, by geographic location

This chapter so far has reported on achievement on the TIMSS Year 8 science scale, examining achievement in terms of jurisdiction, sex, number of books in the home, parental education, educational resources in the home, Indigenous background, language spoken at home and geographic location of the school. The next section of this chapter examines achievement in the Year 8 science content and cognitive domains.

Achievement in the TIMSS science content and cognitive domains

As noted earlier in the chapter, the TIMSS science assessment can be described in terms of content and cognitive domains. The content domains outline the subject matter to be assessed and include *biology*, *chemistry*, *physics* and *Earth science* at Year 8. The cognitive domains detail the thinking processes that students will need to use. The cognitive domains are *knowing*, *applying* and *reasoning*. Each item is associated with a single content domain and a single cognitive domain. This allows student performance to be described in terms of achievement in each of the domains.

To allow comparisons of student achievement across the domains, the content and cognitive achievement scales at each year level were constructed to have the same average level of difficulty. The following tables present the average achievement in each of the Year 8 science content and cognitive domains for Australia as a whole, for each of the Australian jurisdictions, for males and females and for Indigenous and non-Indigenous students, as well as showing trends for Australia in the content and cognitive domains since 2007.

Science content domains

Table 5.8 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 8 achievement in the science content domains.

Australian Year 8 students performed significantly higher than the overall science score in the content domains of *biology* and *Earth science*, and lower in *chemistry* and *physics*.

In general, this pattern of relative achievement across the content domains was also found for the jurisdictions (with only a few instances in which there was no significant difference, such as for *biology* and *Earth science* for the Northern Territory).

There were differences in the relative strengths and weaknesses of males and females across the domains. For example, the difference between science overall and *biology* was greater for females than for males, whereas in *Earth science* the difference was greater for males than for females. There was no significant difference between science overall and *physics* for males, whereas females scored significantly lower in the *physics* domain than in science overall. There were significant sex differences in average score for *physics* and *Earth science*, both in favour of males.

The pattern of relative achievement across the domains was similar for Indigenous and non-Indigenous students, although the difference between science overall and *chemistry* was greater for Indigenous students than for non-Indigenous students.

TABLE 5.8 Relative mean achievement in the Year 8 science content domains, for Australia and by jurisdiction, sex and Indigenous background

	Science overall		*Biology*		Differences between science overall and *biology*		*Chemistry*		Differences between science overall and *chemistry*		*Physics*		Differences between science overall and *physics*		*Earth science*		Differences between science overall and *Earth science*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	512	2.7	522	2.8	**10**	**1.3**	493	3.3	**-19**	**1.3**	505	2.7	**-7**	**0.7**	522	2.9	**10**	**1.8**
ACT	528	4.6	10	2.0	**10**	**2.0**	510	5.6	**-18**	**2.5**	523	5.0	**-5**	**2.1**	540	5.4	**13**	**2.4**
NSW	511	6.1	10	1.8	**10**	**1.8**	490	6.8	**-21**	**2.2**	503	6.1	**-8**	**1.6**	521	6.4	**10**	**2.3**
VIC	518	4.1	8	3.3	**8**	**3.3**	501	4.5	**-17**	**2.3**	511	3.7	**-8**	**2.3**	525	4.6	6	4.2
QLD	507	5.6	10	1.8	**10**	**1.8**	487	6.7	**-20**	**2.2**	499	6.3	**-8**	**1.9**	518	5.9	**12**	**1.9**
SA	507	8.3	10	2.1	**10**	**2.1**	488	9.5	**-20**	**3.0**	500	8.5	**-7**	**2.7**	519	7.9	**11**	**1.9**
WA	518	5.7	10	1.8	**10**	**1.9**	501	6.8	**-17**	**2.8**	511	5.8	**-6**	**2.6**	529	5.8	**12**	**2.1**
TAS	503	8.0	11	3.5	**11**	**3.5**	481	9.9	**-22**	**3.4**	499	7.7	-4	3.7	517	7.7	**13**	**4.5**
NT	463	11.9	7	5.5	6	5.6	436	13.2	**-27**	**6.4**	451	13.0	**-12**	**4.5**	471	11.5	8	6.1
Female	510	3.4	524	3.4	**14**	**1.8**	494	4.2	**-16**	**1.8**	496	3.3	**-13**	**1.0**	514	3.5	**4**	**2.0**
Male	515	3.0	520	3.3	**5**	**1.5**	492	3.5	**-23**	**1.4**	513	3.0	-1	1.1	530	3.4	**16**	**2.2**
Non-Indigenous	515	2.6	525	2.7	**10**	**1.4**	496	3.3	**-19**	**1.4**	507	2.6	**-7**	**0.7**	524	2.8	**10**	**1.7**
Indigenous	453	6.6	463	7.0	**10**	**3.5**	424	7.2	**-28**	**3.6**	444	7.2	**-8**	**3.6**	467	6.8	**15**	**4.0**

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 5.9 shows the trends in achievement for the content domains for Australia as a whole. This demonstrates a large degree of consistency with previous cycles – with the exception of the *chemistry* content domain, for which the average score in 2015 was significantly lower than it was in 2007.

TABLE 5.9 Trends in mean achievement in the Year 8 science content domains, for Australia

	Biology				*Chemistry*				*Physics*				*Earth science*			
			Differences between years				Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	522	2.8	-5	3	493	3.3	-8	-12 ↓	505	2.7	-6	-4	522	2.9	-11	1
2011	527	4.8		8	501	5.0		-3	511	5.1		2	533	5.5		13
2007	519	3.8			504	4.0			509	4.3			521	4.4		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Science cognitive domains

Table 5.10 provides the scores for Australia, the jurisdictions, by sex and by Indigenous background for Year 8 achievement in the science cognitive domains.

In Australia, student performance in each of the cognitive domains was similar to performance in science overall at all levels, by jurisdiction, by sex and for Indigenous and non-Indigenous students. The only significant differences with science overall were for female students within the *knowing* and *applying* domains.

There was a significant difference in average score for males and females within the *knowing* domain, in favour of males.

TABLE 5.10 Relative mean achievement in the Year 8 science cognitive domains, for Australia and by jurisdiction, sex and Indigenous background

	Science overall		*Knowing*		Differences between science overall and *knowing*		*Applying*		Differences between science overall and *applying*		*Reasoning*		Differences between science overall and *reasoning*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	512	2.7	510	2.7	-2	1.1	512	2.9	0	0.8	513	2.8	1	1.0
ACT	528	4.6	529	5.4	1	2.9	529	5.1	1	2.0	528	4.8	1	1.5
NSW	511	6.1	509	6.2	-1	1.9	510	6.4	0	1.5	511	6.3	0	1.7
VIC	518	4.1	516	3.8	-2	2.0	519	4.5	0	2.8	519	4.3	1	2.3
QLD	507	5.6	505	6.0	-1	2.4	508	6.1	1	2.0	507	5.8	0	2.3
SA	507	8.3	506	8.0	-1	2.3	508	8.5	1	1.8	509	8.0	2	2.4
WA	518	5.7	515	6.0	-3	1.9	520	6.3	2	2.4	519	5.7	1	2.1
TAS	503	8.0	504	7.9	0	4.8	504	8.3	1	4.2	505	7.6	2	3.5
NT	463	11.9	461	13.5	-3	5.4	460	12.9	-3	6.5	461	12.4	-2	7.4
Female	510	3.4	505	3.2	**-4**	**1.5**	512	3.5	**2**	**1.0**	511	3.3	1	0.9
Male	515	3.0	516	3.1	1	1.2	513	3.4	-1	1.4	515	3.2	0	1.4
Non-Indigenous	515	2.6	513	2.6	-2	1.2	515	2.8	1	0.8	515	2.7	0	1.0
Indigenous	453	6.6	453	6.6	0	2.6	449	7.0	-4	2.9	455	6.6	3	3.4

Note: Bolded values indicate a statistically significant difference.

Due to rounding, some results may appear inconsistent.

Table 5.11 shows the trends in achievement for the cognitive domains for Australia as a whole. For the *reasoning* cognitive domain, the average score in 2015 was significantly lower that it was in both 2007 and 2011.

TABLE 5.11 Trends in mean achievement in the Year 8 science cognitive domains, for Australia

	Knowing				*Applying*				*Reasoning*			
			Differences between years				Differences between years				Differences between years	
	Mean	SE	2011	2007	Mean	SE	2011	2007	Mean	SE	2011	2007
2015	510	2.7	-4	6	512	2.9	-5	1	513	2.8	-14 ↓	-18 ↓
2011	514	5.1		9	517	4.5		6	526	5.0		-4
2007	505	3.7			511	3.7			530	4.1		

Note: Read across the row to determine if the performance in the row year is significantly higher (↑) or significantly lower (↓) than the performance in the column year.

Chapter 5

Chapter

6

Schools and the school environment for learning

Key findings

- Thirty-eight per cent of Year 4 students and 56 per cent of Year 8 students attended schools with a principal who had completed a postgraduate university degree.
- Students attending schools with a *more affluent* student body had average achievement more than 60 score points higher than those attending a school with a *more disadvantaged* student body.
- Students in schools whose principals indicated that 50 per cent or less of the students had English as their first language tended to have lower average achievement than students in schools whose principals indicated that more than 50 per cent of the student population had English as their first language.
- Students attending schools where less than 25 per cent of students had literacy and numeracy skills upon entry to school had lower achievement than students attending schools where more than 25 per cent of students had literacy and numeracy skills upon entry to school.
- Forty-four per cent of Year 4 students and 51 per cent of Year 8 students attended schools where mathematics instruction was *not affected* by resource shortages, while 30 per cent of Year 4 students and 53 per cent of Year 8 students attended schools where science instruction was *not affected* by resource shortages.
- Around 50 per cent of students at both Year 4 and Year 8 were taught by mathematics and science teachers that reported *hardly any problems* with school conditions and resources.
- Australian Year 4 students with a *high sense of school belonging* scored around 40 score points higher than those with *little sense of school belonging*, while Australian Year 8 students with a *high sense of school belonging* scored around 70 score points higher than those with *little sense of school belonging*.
- There was a clear relationship between the achievement of Australian students and principals' and teachers' reports of school emphasis on academic success, with a higher school emphasis on academic success associated with higher achievement.

- Teacher job satisfaction was relatively high, with only three per cent of Year 4 students being taught by a teacher that was *less than satisfied*, while 11 per cent of Year 8 students were taught by a mathematics teacher that was *less than satisfied* and 15 per cent were taught by a science teacher that was *less than satisfied*.
- Around a quarter of Australian Year 4 students and just under one-third of Year 8 students were taught by teachers that faced *few challenges* in teaching. There were no statistically significant differences in achievement according to the degree to which teachers experienced challenges in teaching.
- There was a clear relationship between the achievement of Australian students and principals' reports of school discipline problems, with fewer discipline problems associated with higher achievement.
- There was a clear relationship between the achievement of Australian students and teachers' reports of their school being safe and orderly, with more *safe and orderly* schools associated with higher achievement.
- Twenty per cent of Australian Year 4 students and nine per cent of Year 8 students reported being bullied *almost weekly*. Students reporting *almost never* being bullied had average achievement more than 30 score points higher than those reporting being bullied *almost weekly*.

The contexts in which teaching and learning occur constitute an important component of the TIMSS model and the data from the contextual questionnaires provide insight into the influences on student achievement. This chapter, and the two following, present the results from the contextual questionnaires. This chapter focuses on schools and the school environment for learning mathematics and science. Chapter 7 addresses the teachers and the teaching of mathematics and science, while Chapter 8 analyses student attitudes to learning mathematics and science.

In each of these chapters the results are presented in figures and in the text without standard errors. In Appendix D the same data are presented in tables that show the standard errors, along with the data for the international average.

It should also be noted that, because TIMSS focuses on student outcomes, the results from the school and teacher questionnaires are presented with regard to students. That is, each result is reported as the percentage of students attending a school that has a certain characteristic or the percentage of students that have a teacher that responded in a particular way.

School contexts for mathematics and science learning

Principals' qualifications – formal education

Table 6.1 shows the percentages of Year 4 and Year 8 students that attended schools headed by a principal who had completed a postgraduate university degree, or a bachelor's degree or equivalent, or who did not complete a bachelor's degree. The table shows Australian results and the international average.

TABLE 6.1 Principals' formal education, Australia and the international average

	Percentage of students by principals' educational level					
	Completed postgraduate university degree		Completed bachelor's degree or equivalent but not a postgraduate degree*		Did not complete bachelor's degree	
	% of students	SE	% of students	SE	% of students	SE
	Year 4					
Australia	38	3.9	59	4.1	3	1.4
International average	48**	0.4	46**	0.5	6**	0.3
	Year 8					
Australia	56	3.3	43	3.1	1	1.0
International average	50	0.5	47	0.5	3	0.2

Note: Due to rounding, totals may not add to 100%.

*This category includes principals who completed a graduate diploma of education following completion of an undergraduate degree.

**The international average for Year 4 science varies from that of mathematics by 1% or less so that the relevant percentages are 49%, 45% and 6%. This difference is due to a difference in the number of countries participating in Year 4 science compared to Year 4 mathematics (please see the Reader's Guide for more information).

At Year 4, 38 per cent of Australian students attended schools with a principal who had completed a postgraduate university degree (i.e. doctorate, master's or other postgraduate degree), compared to 48 per cent (49% for science), on average, across countries.

At Year 8, 56 per cent of Australian students attended schools with a principal who had completed a postgraduate university degree, compared to 50 per cent, on average, across countries.

The percentage of students attending school with a principal who had completed a postgraduate degree varied widely among participating TIMSS countries. In the United States, almost 100 per cent of students (97% at Year 4 and 98% at Year 8) attended schools headed by a principal who had completed a postgraduate degree, whereas in Japan, by way of contrast, less than 10 per cent of students (9% at Year 4 and 8% at Year 8) attended schools with a principal who had completed a postgraduate degree. In many cases, the percentage of students attending school with a principal who had completed a postgraduate degree was higher at Year 8 than at Year 4. Australia is an example, along with New Zealand (44% at Year 4 and 65% at Year 8), Ireland (37% at Year 4 and 65% at Year 8) and England (57% at Year 4 and 87% at Year 8).

Principals' years of experience

Table 6.2 shows the percentages of students according to the experience of their principal – expressed as the number of years that their principal has worked in the position of school principal. The table shows Australian results and the international average.

TABLE 6.2 Principals' years of experience, Australia and the international average

	Percentage of students by principals' years of experience								Average years of experience as a principal	
	20 years or more		At least 10 but less than 20 years		At least 5 but less than 10 years		Less than 5 years			
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	Number of years	SE
	Year 4									
Australia	18	3.0	31	3.5	26	3.4	25	3.9	11	0.6
International average	13	0.4	30	0.5	28	0.5	29	0.5	10	0.1
	Year 8									
Australia	12	2.4	32	4.3	32	4.1	23	3.4	10	0.5
International average	12	0.4	27	0.5	29	0.6	32	0.6	9	0.1

Note: Due to rounding, totals may not add to 100%.

At Year 4, 18 per cent of students attended schools with a principal who had 20 years of experience as a principal; 31 per cent attended schools with a principal who had at least 10 but less than 20 years' experience; 26 per cent attended schools with a principal who had at least five years but less than 10 years' experience; and 25 per cent of students attended schools where the principal had less than five years of experience as a principal. On average, Australian principals had 11 years of experience, compared to the international average of 10 years.

At Year 8, 12 per cent of students attended schools with a principal who had 20 years of experience as a principal; 32 per cent attended schools with a principal who had at least 10 but less than 20 years' experience; 32 per cent attended schools with a principal who had at least five years but less than 10 years' experience; and 23 per cent of students attended schools where the principal had less than five years of experience as a principal. On average, Australian principals had 10 years of experience, compared to the international average of nine years.

School socioeconomic composition

The socioeconomic composition of schools has been found to have an effect on student achievement (e.g. Liu et al., 2015). Accordingly, the TIMSS 2015 school questionnaire asked school principals to report on the socioeconomic composition of their school by indicating what percentage of students came from economically affluent homes and what percentage came from economically disadvantaged homes. The responses to these questions were then used to create three categories of school socioeconomic composition:

- *more affluent* – schools where more than 25 per cent of the student body comes from economically affluent homes and not more than 25 per cent from economically disadvantaged homes
- *more disadvantaged* – schools where more than 25 per cent of the student body comes from economically disadvantaged homes and not more than 25 per cent from economically affluent homes
- *neither more affluent nor more disadvantaged* – all other response combinations.

Figure 6.1 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

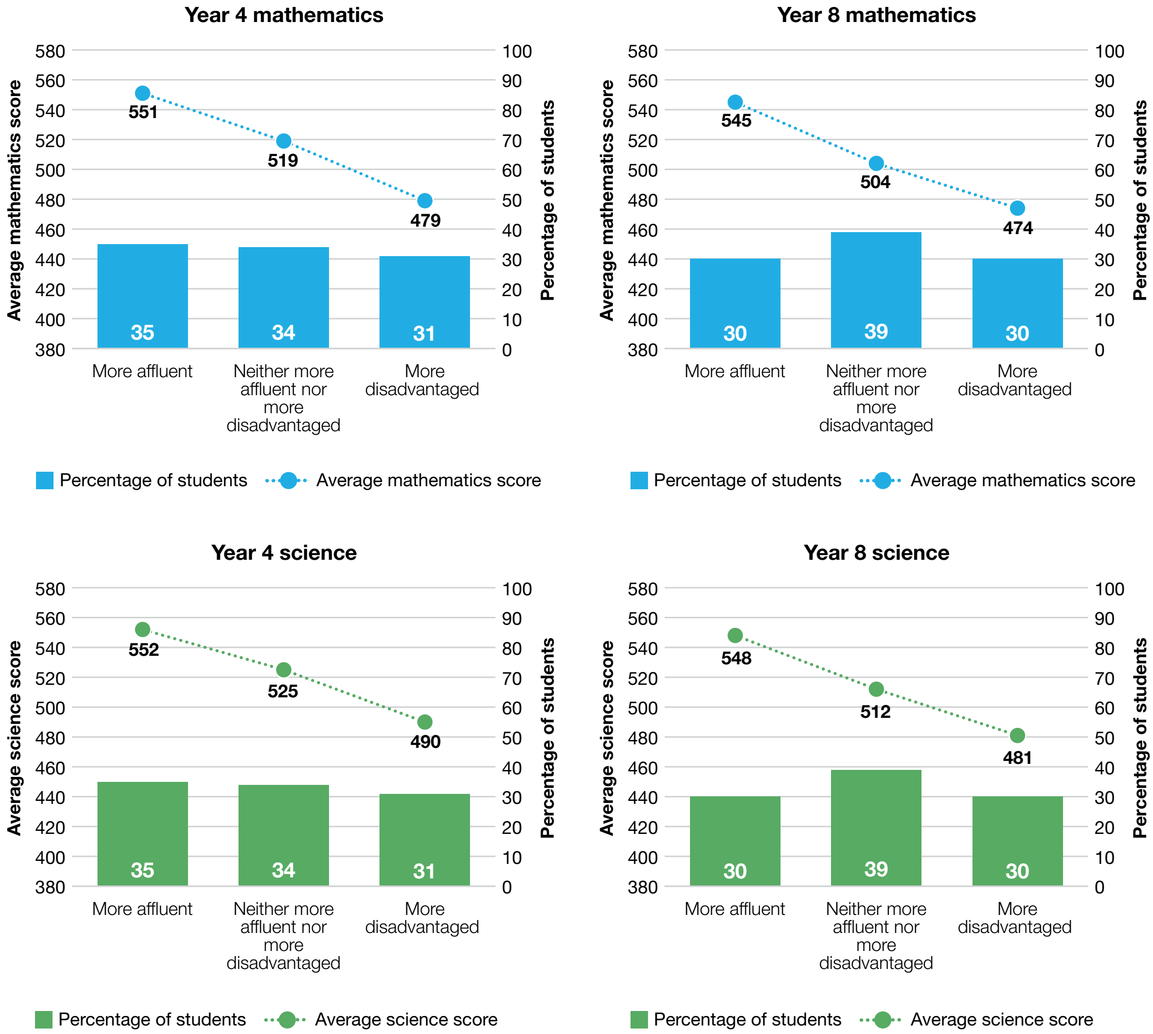


FIGURE 6.1 Socioeconomic composition of schools and Australian student achievement in mathematics and science

Chapter 6

At Year 4, 35 per cent of Australian students attended *more affluent* schools; 34 per cent attended schools that were *neither more affluent nor more disadvantaged*; and 31 per cent attended schools the economic background of whose student body was *more disadvantaged*. This distribution is similar to that of the international average, the percentages of which were 37 per cent *more affluent*, 35 per cent *neither more affluent nor more disadvantaged* and 29 per cent *more disadvantaged* (for science, the percentages for the international average were 38%, 35% and 27%).

At Year 8, 30 per cent of Australian students attended *more affluent* schools; 39 per cent attended schools that were *neither more affluent nor more disadvantaged*; and 30 per cent attended schools the economic background of whose student body was *more disadvantaged*. This distribution is similar to that of the international average, the percentages of which were 31 per cent *more affluent*, 34 per cent *neither more affluent nor more disadvantaged* and 36 per cent *more disadvantaged.*

As can be seen in Figure 6.1, there was a clear relationship between composition of the student body and student achievement for mathematics and science at both Year 4 and Year 8. A substantial gap was recorded between students attending schools with a *more affluent* student body and those attending schools with a *more disadvantaged* student body. This gap amounted to 72 score points for Year 4 mathematics; 71 score points for Year 8 mathematics; 62 score points for Year 4 science; and 67 score points for Year 8 science. Internationally, on average, the gap was around 43 score points at Year 4 and 55 score points at Year 8, for both mathematics and science.

Language background of school populations

When a student body is composed predominantly of students who do not have the language of instruction as a native language, educational and cultural complexities may challenge schools and teachers. The TIMSS 2015 school questionnaire asked Australian principals what proportion of the student body had English as their first language.

Figure 6.2 presents the proportions of students in each of three response categories, along with their average mathematics and science scores.

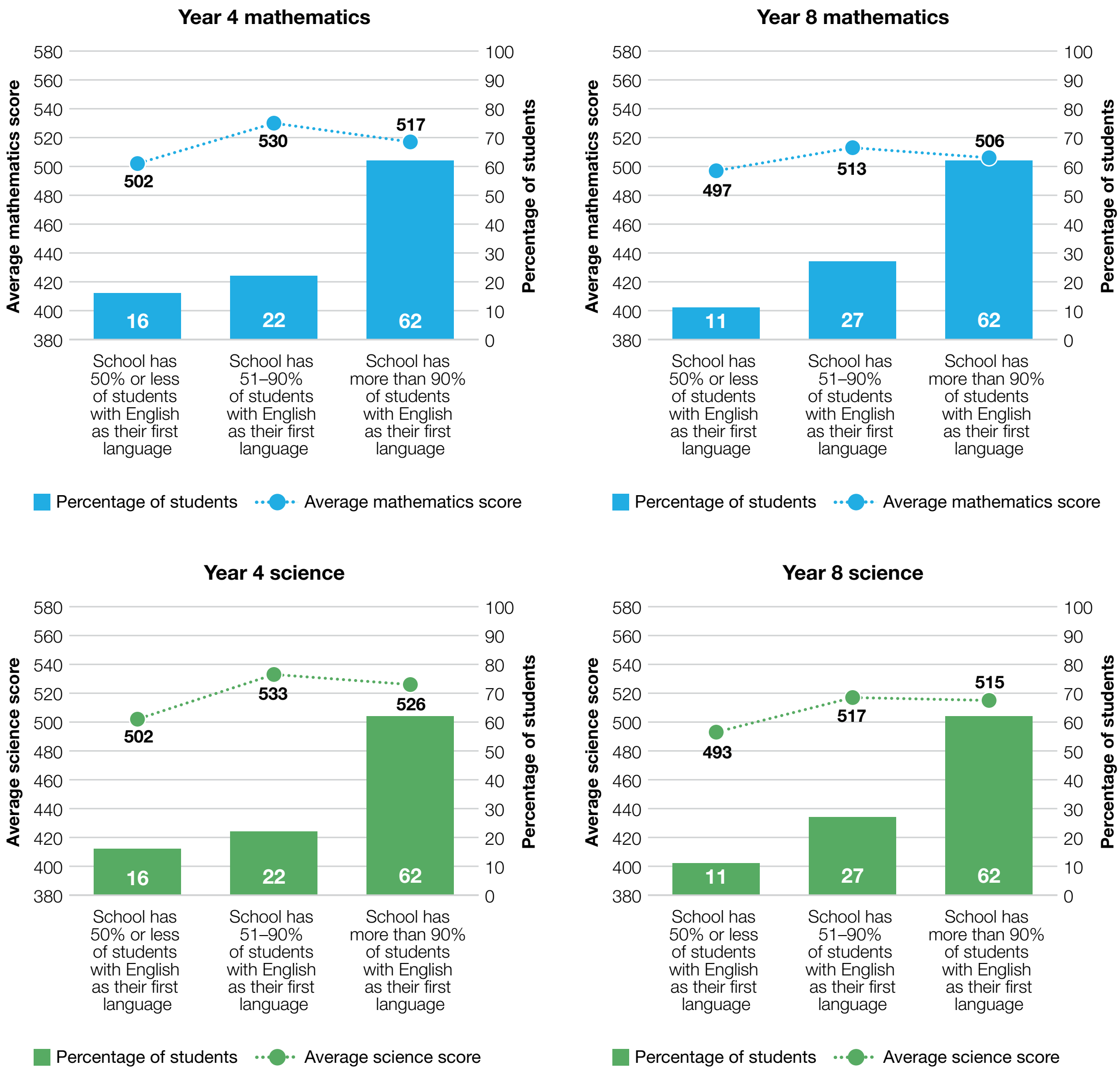


FIGURE 6.2 Language background of schools' populations and Australian student achievement in mathematics and science

At Year 4, 62 per cent of Australian students attended schools where *more than 90 per cent of students had English as their first language*; 22 per cent attended schools where *51–90 per cent of students had English as their first language*; and 16 per cent attended schools where *50 per cent or less of students had English as their first language.* In comparison, internationally, on average, 66 per cent of students attended schools where *more than 90 per cent* of students had the language of the test as their native language; 17 per cent attended schools where *51–90 per cent* of students had the language of the test as their native language; and 16 per cent attended schools where *50 per cent or less* of students had the language of the test as their native language (for science, the percentages for the international average were 67%, 18% and 15%).

At Year 8, 62 per cent of Australian students attended schools where *more than 90 per cent of students had English as their first language*; 27 per cent attended schools where *51–90 per cent of students had English as their first language*; and 11 per cent attended schools where *50 per cent or less of students had English as their first language*. In comparison, internationally, on average, 64 per cent of students attended schools where *more than 90 per cent* of students had the language of the test as their native language; 14 per cent attended schools where *51–90 per cent* of students had the language of the test as their native language; and 22 per cent attended schools where *50 per cent or less* of students had the language of the test as their native language.

As can be seen in Figure 6.2, students in schools where *50 per cent or less of the students had English as their first language* tended to have lower average achievement than students in either of the other two groups. However, the only significant differences were those for Year 4 mathematics between students at schools with *51–90 per cent of students with English as their first language* and students at schools where *50 per cent or less of the students had English as their first language* (a 28 score-point difference) and for Year 4 and Year 8 science between students in schools where *50 per cent or less of the students had English as their first language* and students in the other two groups (with differences ranging between 23 and 31 score points).

Students entering school with literacy and numeracy skills

Year 4 principals were asked to comment on how many students in their school ('more than 75 per cent', '51–75 per cent', '25–50 per cent' or 'less than 25 per cent') can do the following when they begin the first year of primary school:

- recognise most of the letters of the alphabet
- read some words
- read sentences
- write letters of the alphabet
- write some words
- count up to 100 or higher
- recognise written numbers from 1 to 10
- recognise written numbers higher than 10
- write numbers from 1 to 10
- do simple addition
- do simple subtraction.

Principals' responses to these items were combined to create the Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills scale. Students were then assigned to three groups based on their principal's scale score.

Year 4 students who attended *schools where more than 75 per cent enter with skills* had a score on the scale of at least 11.7, which corresponds to principals reporting that over 75 per cent of the students have six of the skills and 51–75 per cent of the students have five of the skills, on average. Students who attended *schools where less than 25 per cent enter with skills* had a score no higher than 8.6, which corresponds to principals reporting that less than 25 per cent of the students have six of the skills and 25–50 per cent of the students have five of the skills, on average. All other students attended *schools where 25 per cent to 75 per cent enter with skills*.

Figure 6.3 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

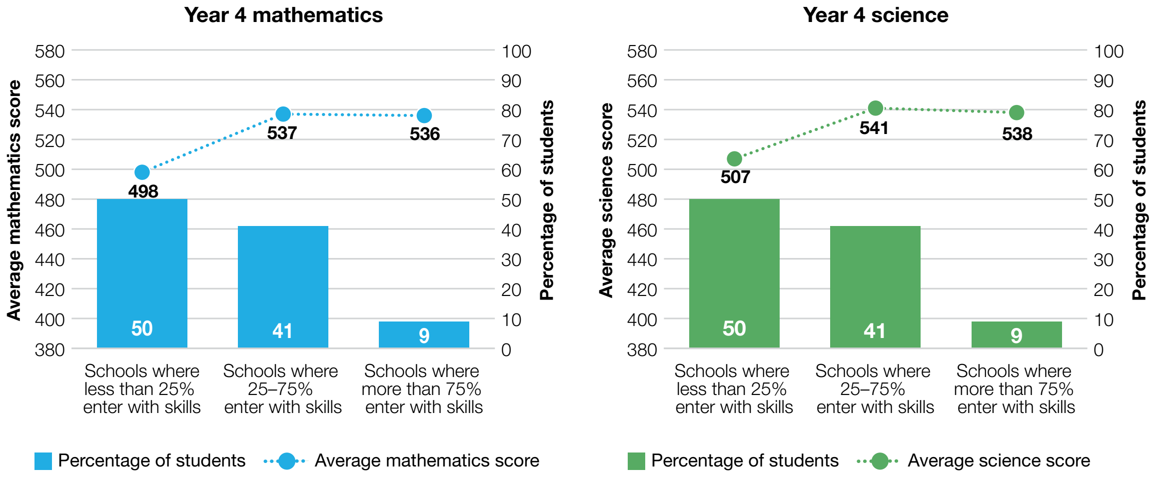


FIGURE 6.3 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills scale and Australian student achievement in mathematics and science

At Year 4, nine per cent of Australian students attended schools where *more than 75 per cent of students enter school with literacy and numeracy skills*; 41 per cent attended schools where *25–75 per cent enter school with literacy and numeracy skills*; and 50 per cent attended schools where *less than 25 per cent enter school with literacy and numeracy skills.* In comparison, internationally, on average, 21 per cent of students attended schools where *more than 75 per cent of students enter school with literacy and numeracy skills*; 54 per cent attended schools where *25–75 per cent enter school with literacy and numeracy skills*; and 24 per cent attended schools where *less than 25 per cent enter school with literacy and numeracy skills* (for science, the percentages for the international average were 22%, 54% and 24%).

Figure 6.3 indicates that some interesting conclusions may be drawn from the TIMSS data, as follows:

- No significant difference was recorded in average achievement between Australian students attending schools where *more than 75 per cent* of students started school with literacy and numeracy skills and their Australian peers attending schools *25–75 per cent* of whose students started school with literacy and numeracy skills.
- Those Australian students attending schools where *less than 25 per cent* of students had literacy and numeracy skills upon entry to school recorded an average mathematics score that was almost 40 score points lower than the scores recorded by the other two groups. In science, the difference was just over 30 score points. A similar size gap was found internationally.

What school resources are available to support learning?

Instruction affected by mathematics resource shortages

Principals were asked to comment on how much their school's capacity to provide instruction ('not at all', 'a little', 'some' or 'a lot') was affected by a shortage of – or inadequacy in – the following general and mathematics instruction resources:

General school resources

- instructional materials (e.g. textbooks)
- supplies (e.g. papers, pencils, materials)
- school buildings and grounds

- heating/cooling and lighting systems
- instructional space (e.g. classrooms)
- technologically competent staff
- audio-visual resources for delivery of instruction (e.g. interactive white boards, digital projectors)
- computer technology for teaching and learning (e.g. computers or tablets for student use).

Resources for mathematics instruction

- teachers with a specialisation in mathematics
- computer software/applications for mathematics instruction
- library resources relevant to mathematics instruction
- calculators for mathematics instruction
- concrete objects or materials to help students understand quantities or procedures.

Principals' responses to these items were combined to create the Mathematics Resource Shortages scale. Students were then assigned to groups based on their principal's scale score.

At Year 4, students attending schools where instruction was *not affected* by resource shortages had a score on the scale of at least 11.1, which corresponds to principals reporting that shortages affected instruction 'not at all' for seven of the 13 resources and 'a little' for the other six, on average. Students attending schools where instruction was *affected a lot* had a score no higher than 6.9, which corresponds to principals reporting that shortages affected instruction 'a lot' for seven of the 13 resources and 'some' for the other six, on average. All other students attended schools where instruction was *affected* by resource shortages.

At Year 8, students attending schools where instruction was *not affected* by resource shortages had a score on the scale of at least 11.1, which corresponds to principals reporting that shortages affected instruction 'not at all' for seven of the 13 resources and 'a little' for the other six, on average. Students attending schools where instruction was *affected a lot* had a score no higher than 7.5, which corresponds to principals reporting that shortages affected instruction 'a lot' for seven of the 13 resources and 'some' for the other six, on average. All other students attended schools where instruction was *affected* by resource shortages.

Figure 6.4 presents the proportions of students in each of these categories, along with their average mathematics scores.

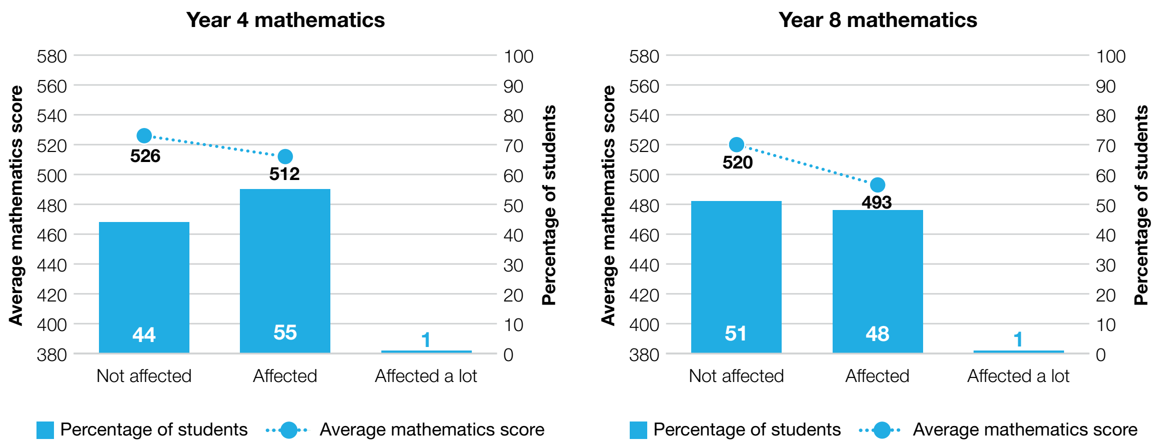


FIGURE 6.4 The Mathematics Resource Shortages scale and Australian student achievement in mathematics

At Year 4, 44 per cent of Australian students attended schools where mathematics instruction was *not affected* by resource shortages; 55 per cent attended schools where mathematics instruction was *affected*; and one per cent attended schools where mathematics instruction was *affected a lot* by resource shortages. In comparison, internationally, on average, 27 per cent of students attended schools where mathematics instruction was *not affected* by resource shortages; 69 per cent attended schools where mathematics instruction was *affected*; and four per cent attended schools where mathematics instruction was *affected a lo*t by resource shortages.

At Year 8, 51 per cent of Australian students attended schools where mathematics instruction was *not affected* by resource shortages; 48 per cent attended schools where mathematics instruction was *affected*; and one per cent attended schools where mathematics instruction was *affected a lot* by resource shortages. In comparison, internationally, on average, 27 per cent of students attended schools where mathematics instruction was *not affected* by resource shortages; 66 per cent attended schools where mathematics instruction was *affected*; and six per cent attended schools where mathematics instruction was *affected a lot* by resource shortages.

Interestingly, while there were no significant differences between the groups in terms of average mathematics achievement at Year 4, Australian Year 8 students who attended schools where mathematics instruction was *not affecte*d by resource shortages achieved an average mathematics score that was significantly higher than that for students attending schools where instruction was *affected* (student percentages in the *affected a lot* category were too small to calculate average achievement).

Instruction affected by science resource shortages

Principals were asked to comment on how much their school's capacity to provide instruction ('not at all', 'a little', 'some' or 'a lot') was affected by a shortage of – or inadequacy in – the following general and science instruction resources:

General school resources

- instructional materials (e.g. textbooks)
- supplies (e.g. papers, pencils, materials)
- school buildings and grounds
- heating/cooling and lighting systems
- instructional space (e.g. classrooms)
- technologically competent staff
- audio-visual resources for delivery of instruction (e.g. interactive white boards, digital projectors)
- computer technology for teaching and learning (e.g. computers or tablets for student use).

Resources for science instruction

- teachers with a specialisation in science
- computer software/applications for science instruction
- library resources relevant to science instruction
- science equipment and materials for experiments
- calculators for science instruction (Year 8 only).

Principals' responses to these items were combined to create the Science Resource Shortages scale. Students were then assigned to three groups based on their principal's scale score.

At Year 4, students attending schools where instruction was *not affected* by resource shortages had a score on the scale of at least 11.2, which corresponds to principals reporting that shortages affected instruction 'not at all' for six of the 12 resources and 'a little' for the other six, on average. Students attending schools where instruction was *affected a lot* had a score no higher than 7.2, which corresponds to principals reporting that shortages affected instruction 'a lot' for six of the 12 resources and 'some' for the other six, on average. All other students attended schools where instruction was *affected* by resource shortages.

At Year 8, students attending schools where instruction was *not affected* by resource shortages had a score on the scale of at least 11.2, which corresponds to principals reporting that shortages affected instruction 'not at all' for seven of the 13 resources and 'a little' for the other six, on average. Students attending schools where instruction was *affected a lot* had a score no higher than 7.4, which corresponds to principals reporting that shortages affected instruction ‘a lot’ for seven of the 13 resources and ‘some’ for the other six, on average. All other students attended schools where instruction was *affected* by resource shortages.

Figure 6.5 presents the proportions of students in each of these categories, along with their average science scores.

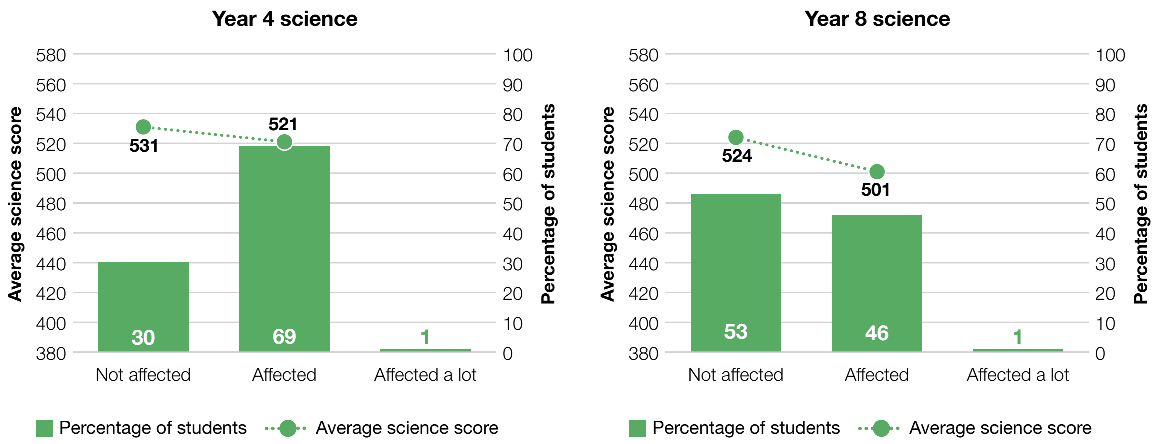


FIGURE 6.5 The Science Resource Shortages scale and Australian student achievement in science

At Year 4, 30 per cent of Australian students attended schools where science instruction was *not affected* by resource shortages; 69 per cent attended schools where science instruction was *affected*; and one per cent attended schools where science instruction was *affected a lot* by resource shortages. In comparison, internationally, on average, 25 per cent of students attended schools where science instruction was *not affected* by resource shortages; 69 per cent attended schools where science instruction was *affected*; and five per cent attended schools where science instruction was *affected a lot* by resource shortages.

At Year 8, 53 per cent of Australian students attended schools where science instruction was *not affected* by resource shortages; 46 per cent attended schools where science instruction was *affected*; and one per cent attended schools where science instruction was *affected a lot* by resource shortages. In comparison, internationally, on average, 27 per cent of students attended schools where science instruction was *not affected* by resource shortages; 65 per cent attended schools where science instruction was *affected*; and seven per cent attended schools where science instruction was *affected a lot* by resource shortages.

Interestingly, while there were no significant differences between the groups in terms of average science achievement at Year 4, Australian Year 8 students who attended schools where science instruction was *not affected* by resource shortages achieved an average science score that was significantly higher than that for students attending schools where instruction was *affected* (student percentages in the *affected a lot* category were too small to calculate average achievement).

Teachers’ reports of school conditions and resources

Teachers were asked to characterise the severity of problems (‘not a problem’, ‘minor problem’, ‘moderate problem’ or ‘serious problem’) affecting each of the following school conditions/resources:

- The school building needs significant repair.
- Teachers do not have adequate workspace (e.g. preparation, collaboration, meeting with students).
- Teachers do not have adequate instructional materials and supplies.
- The school classrooms are not cleaned often enough.
- The school classrooms need maintenance work.
- Teachers do not have adequate technological resources.
- Teachers do not have adequate support for using technology.

Chapter 6

Teachers' responses to these items were combined to create the Problems with School Conditions and Resources scale. Students were then assigned to three groups based on their teacher's scale score.

At Year 4, students whose teachers reported *hardly any problems* with their school conditions and resources had a score on the scale of at least 10.6, which corresponds to teachers reporting 'not a problem' for four of the seven conditions and resources and 'minor problem' for the other three, on average. Students whose teachers reported *moderate to severe problems* had a score no higher than 8.2, which corresponds to teachers reporting 'moderate problem' for four of the seven conditions and resources and 'minor problem' for the other three, on average. All other students had teachers that reported *minor problems* with their school conditions and resources.

At Year 8, students whose teachers reported *hardly any problems* with their school conditions and resources had a score on the scale of at least 10.9, which corresponds to teachers reporting 'not a problem' for four of the seven conditions and resources and 'minor problem' for the other three, on average. Students whose teachers reported *moderate to severe problems* had a score no higher than 8.5, which corresponds to teachers reporting 'moderate problem' for four of the seven conditions and resources and 'minor problem' for the other three, on average. All other students had teachers that reported *minor problems* with their school conditions and resources.

Figure 6.6 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

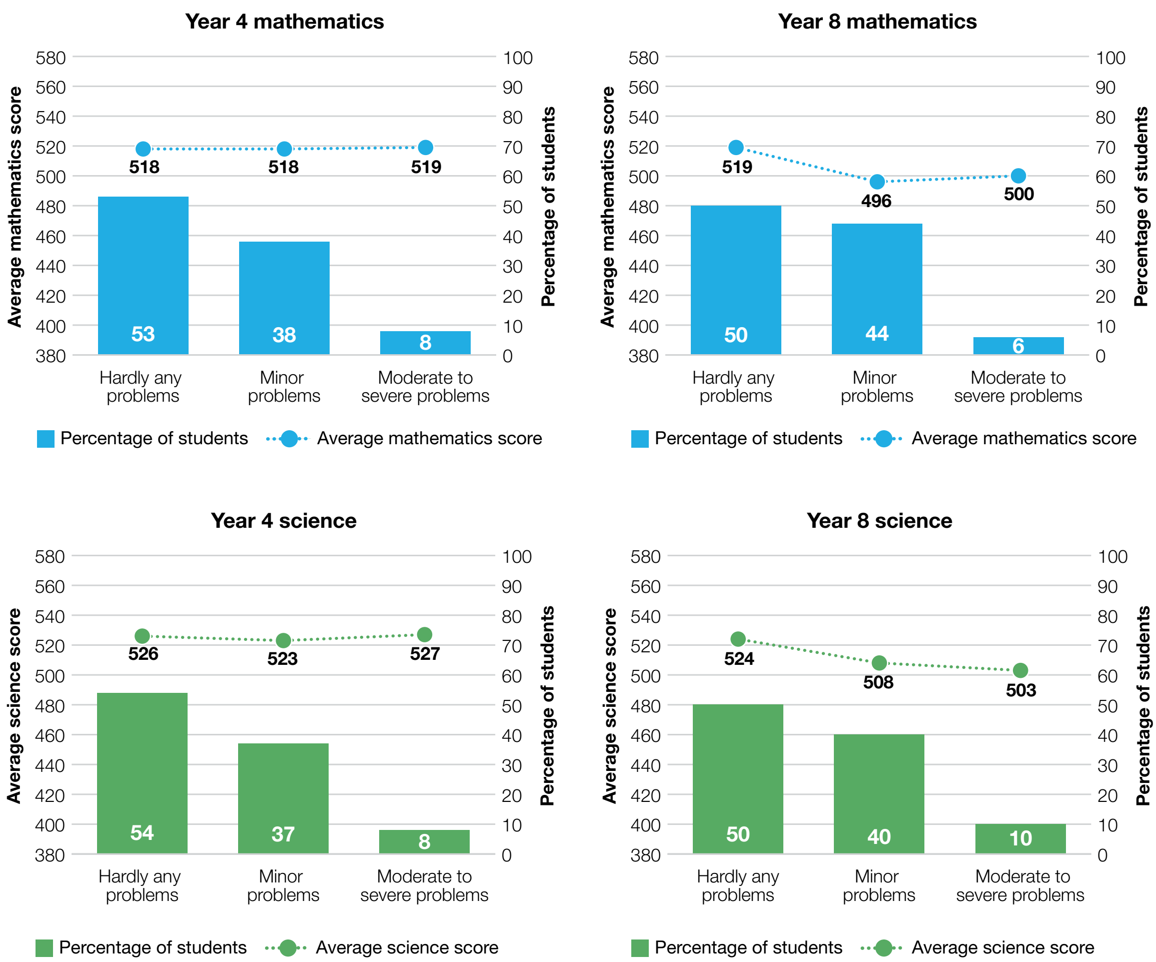


FIGURE 6.6 The Problems with School Conditions and Resources scale and Australian student achievement in mathematics and science

At Year 4, 53 per cent of Australian students were taught by mathematics teachers that reported *hardly any problems* with school conditions and resources; 38 per cent were taught by mathematics teachers that reported *minor problems* with school conditions and resources; and eight per cent were taught by mathematics teachers that reported *moderate to severe problems* with school conditions and resources. In comparison, internationally, on average, 37 per cent of students were taught by mathematics teachers that reported *hardly any problems* with school conditions and resources; 43 per cent were taught by mathematics teachers that reported *minor problems* with school conditions and resources; and 20 per cent were taught by mathematics teachers that reported *moderate to severe problems* with school conditions and resources. The percentages were very similar (a difference of 1% or less) when the responses for science teachers are considered (both within Australia and internationally).

At Year 8, 50 per cent of Australian students were taught by mathematics teachers that reported *hardly any problems* with school conditions and resources; 44 per cent were taught by mathematics teachers that reported *minor problems* with school conditions and resources; and six per cent were taught by mathematics teachers that reported *moderate to severe problems* with school conditions and resources. In comparison, internationally, on average, 34 per cent of students were taught by mathematics teachers that reported *hardly any problems* with school conditions and resources; 44 per cent were taught by mathematics teachers that reported *minor problems* with school conditions and resources; and 22 per cent were taught by mathematics teachers that reported *moderate to severe problems* with school conditions and resources.

At Year 8, 50 per cent of Australian students were taught by science teachers that reported *hardly any problem*s with school conditions and resources; 40 per cent were taught by science teachers that reported *minor problems* with school conditions and resources; and 10 per cent were taught by science teachers that reported *moderate to severe problems* with school conditions and resources. In comparison, internationally, on average, 34 per cent of students were taught by science teachers that reported *hardly any problems* with school conditions and resources; 43 per cent were taught by science teachers that reported *minor problems* with school conditions and resources; and 23 per cent were taught by science teachers that reported *moderate to severe problem*s with school conditions and resources.

Interestingly, while there were no significant differences between the groups in terms of average mathematics and science achievement at Year 4, Australian Year 8 students who were taught by mathematics teachers that reported *hardly any problem*s with school conditions and resources achieved an average mathematics score that was significantly higher than that for students whose teachers reported the presence of *minor problems*. Australian Year 8 students who were taught by science teachers that reported *hardly any problems* with school conditions and resources achieved an average science score that was significantly higher than the average score achieved by the two other groups – those students whose teachers reported *minor problem*s affecting conditions and resources, and those whose teachers reported *moderate to severe problem*s.

Chapter 6

School climate

Students' sense of belonging

Students were asked to comment on how they felt about being at school. Students indicated how much they agreed ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with the following seven statements:

- I like being in school.
- I feel safe when I am at school.
- I feel like I belong at this school.
- I like to see my classmates at school.
- Teachers at my school are fair to me.
- I am proud to go to this school.
- I learn a lot in school.

Responses to these items were combined to create the Students' Sense of School Belonging scale, and scale scores were used to classify students according to three response groups.

At Year 4, students with a *high sense of school belonging* had a score on the scale of at least 9.1, which corresponds to their 'agreeing a lot' with four of the seven statements and 'agreeing a little' with each of the other three statements, on average. Students with *little sense of school belonging* had a score no higher than 6.8, which corresponds to their 'disagreeing a little' with four of the seven statements and 'agreeing a little' with each of the other three statements, on average. All other students had a *sense of school belonging*.

At Year 8, students with a *high sense of school belonging* had a score on the scale of at least 10.3, which corresponds to their 'agreeing a lot' with four of the seven statements and 'agreeing a little' with each of the other three statements, on average. Students with *little sense of school belonging* had a score no higher than 7.5, which corresponds to their 'disagreeing a little' with four of the seven statements and 'agreeing a little' with each of the other three statements, on average. All other students had a *sense of school belonging*.

Figure 6.7 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

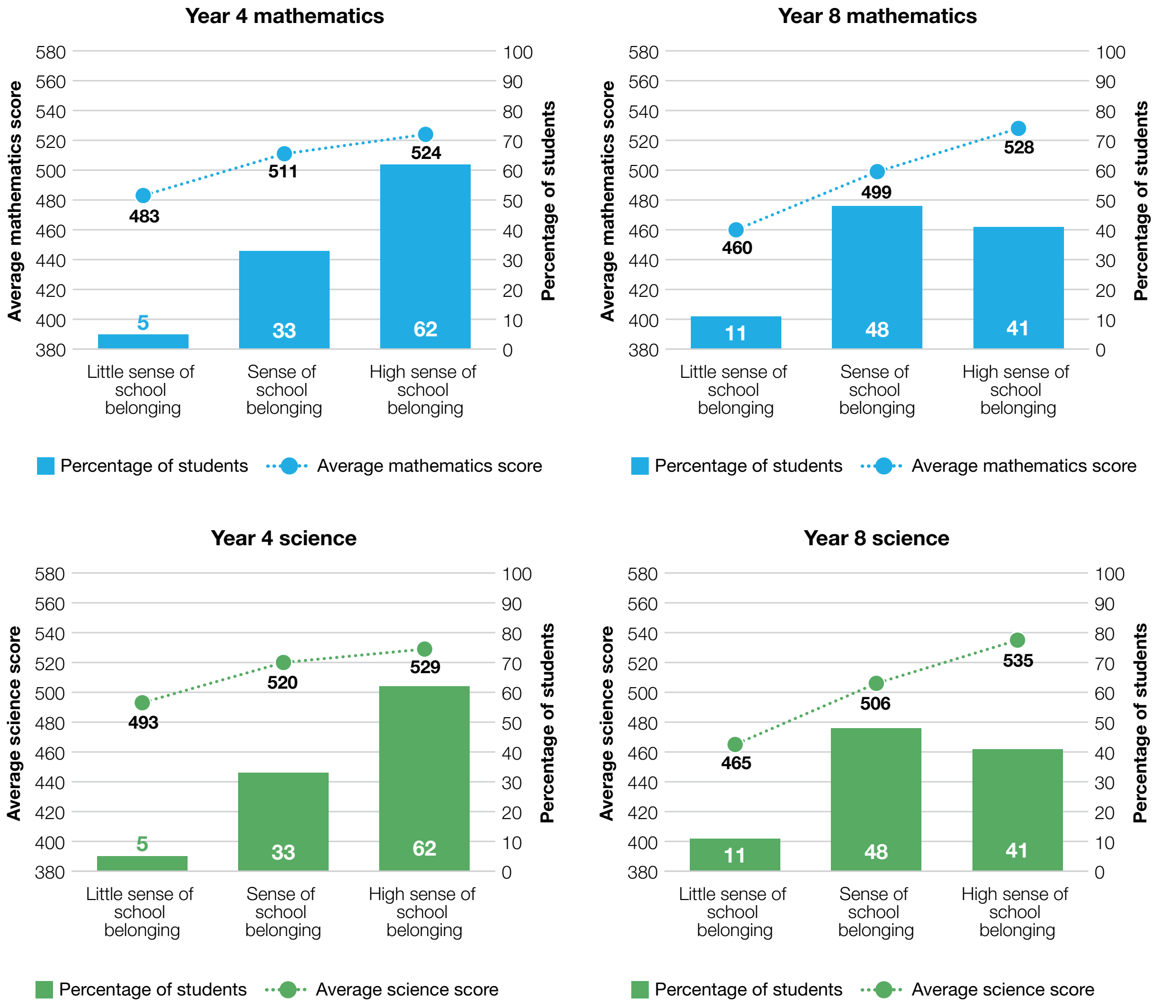


FIGURE 6.7 The Students' Sense of School Belonging scale and Australian student achievement in mathematics and science

At Year 4, 62 per cent of Australian students had a *high sense of school belonging*; 33 per cent had a *sense of school belonging*; and five per cent had *little sense of school belonging*. In comparison, internationally, on average, 66 per cent of Year 4 students had a *high sense of school belonging*; 30 per cent had a *sense of school belonging*; and four per cent had *little sense of school belonging*.

At Year 8, 41 per cent of Australian students had a *high sense of school belonging*; 48 per cent had a *sense of school belonging*; and 11 per cent had *little sense of school belonging*. In comparison, internationally, on average, 44 per cent of Year 8 students had a *high sense of school belonging*; 47 per cent had a *sense of school belonging*; and nine per cent had *little sense of school belonging*.

As can be seen in Figure 6.7, there was a clear relationship between the achievement of Australian students and students' sense of school belonging, with a higher sense of school belonging associated with higher achievement. The relationship appears stronger at Year 8 than at Year 4. At Year 4, Australian students with a *high sense of school belonging* scored around 40 score points higher than those with *little sense of school belonging*. In comparison, Australian Year 8 students with a *high sense of school belonging* scored around 70 score points higher than those with *little sense of school belonging*. Internationally, on average, the gap was around 25 score points at Year 4 and around 35 score points at Year 8.

School emphasis on academic success – principals' reports

The views of principals regarding the academic climate of their schools, that is, the degree to which a school supports and encourages academic success, were collected using principals' ratings (of 'very high', 'high', 'medium', 'low' or 'very low') of the following 13 aspects:

- teachers' understanding of the school's curricular goals
- teachers' degree of success in implementing the school's curriculum
- teachers' expectations for student achievement
- teachers working together to improve student achievement
- teachers' ability to inspire students
- parental involvement in school activities
- parental commitment to ensure that students are ready to learn
- parental expectations for student achievement
- parental support for student achievement
- parental pressure for the school to maintain high academic standards
- students' desire to do well in school
- students' ability to reach school's academic goals
- students' respect for classmates who excel in school.

The principals' responses were combined to create the School Emphasis on Academic Success scale. Students were then assigned to three groups based on their principal's scale score.

At Year 4, students attending schools whose principals reported a *very high emphasis* on academic success had a score on the scale of at least 13.0, which corresponds to principals characterising seven of the 13 aspects as 'very high' and the other six as 'high', on average. Students attending schools with a *medium emphasis* on academic success had a score no higher than 9.2, which corresponds to principals characterising seven of the 13 aspects as 'medium' and the other six as 'high', on average. All other students attended schools with a high emphasis on academic success.

At Year 8, students attending schools whose principals reported a *very high emphasis* on academic success had a score on the scale of at least 13.1, which corresponds to principals characterising seven of the 13 aspects as 'very high' and the other six as 'high', on average. Students attending schools with a *medium emphasis* on academic success had a score no higher than 9.6, which corresponds to principals characterising seven of the 13 aspects as 'medium' and the other six as 'high', on average. All other students attended schools with a *high emphasis* on academic success.

Figure 6.8 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

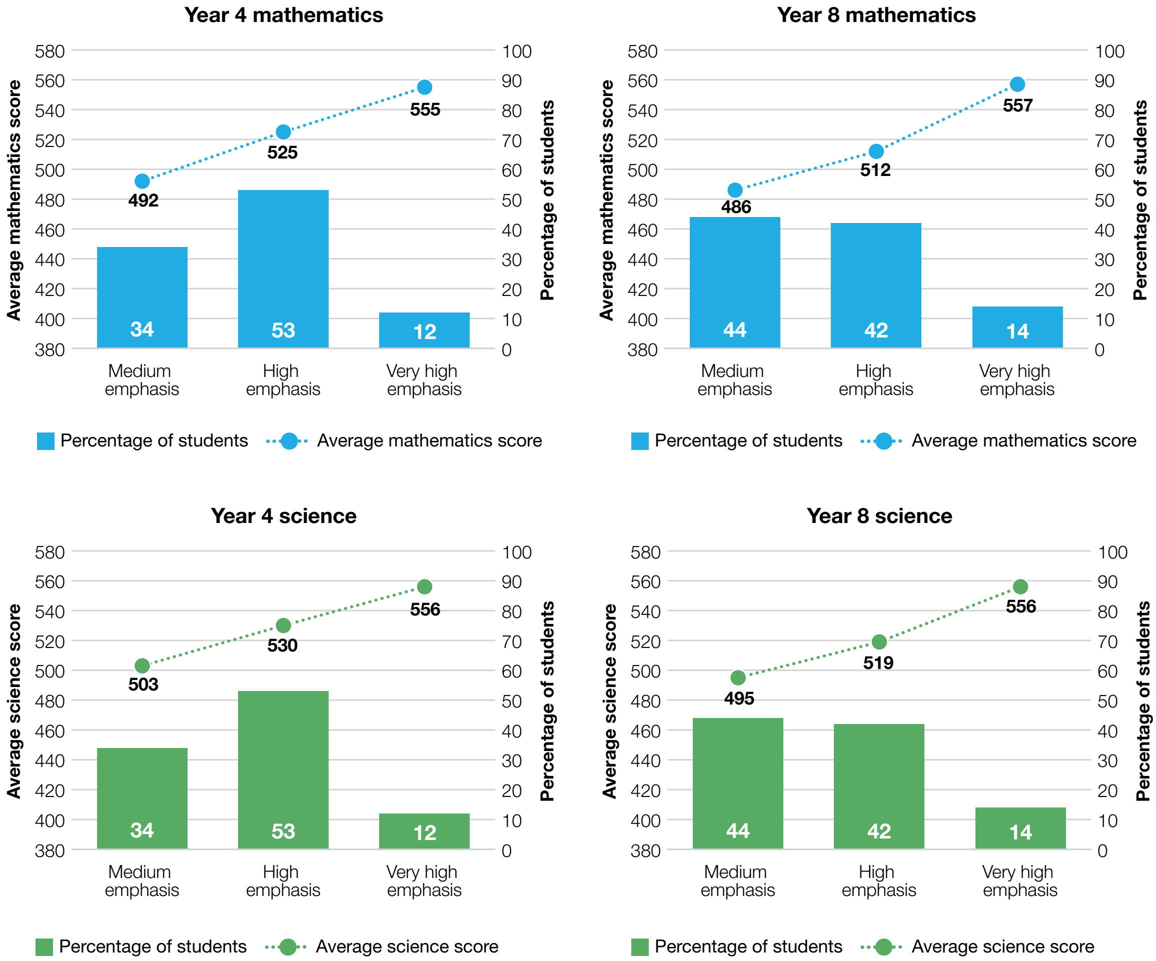


FIGURE 6.8 The School Emphasis on Academic Success scale (principals' reports) and Australian student achievement in mathematics and science

At Year 4, 12 per cent of Australian students attended schools whose principals reported a *very high emphasis* on academic success; 53 per cent attended schools whose principals reported a *high emphasis*; and 34 per cent attended schools whose principals reported a *medium emphasis* on academic success. In comparison, internationally, on average, seven per cent of students attended schools whose principals reported a *very high emphasis* on academic success; 54 per cent attended schools whose principals reported a *high emphasis*; and 39 per cent attended schools whose principals reported a *medium emphasis* on academic success (for science, the percentages for the international average were 7%, 55% and 38%).

At Year 8, 14 per cent of Australian students attended schools whose principals reported a *very high emphasis* on academic success; 42 per cent attended schools whose principals reported a *high emphasis*; and 44 per cent attended schools whose principals reported a *medium emphasis* on academic success. In comparison, internationally, on average, seven per cent of students attended schools whose principals reported a *very high emphasis* on academic success; 48 per cent attended schools whose principals reported a *high emphasis*; and 45 per cent attended schools whose principals reported a *medium emphasis* on academic success.

As can be seen in Figure 6.8, there was a clear relationship between the achievement of Australian students and principals' reports of school emphasis on academic success, with a higher school emphasis on academic success associated with higher achievement. The difference between the average achievement of Australian students that attended schools whose principals reported a *very high emphasis* on academic success and the average achievement of students attending schools whose principals reported a *medium emphasis* on academic success was between 53 score points for Year 4 science and 71 score points for Year 8 mathematics. The differences between all groups were statistically significant for both subjects at both year levels. Internationally, on average, the gap was between 34 score points for Year 4 science and 69 score points for Year 8 mathematics.

School emphasis on academic success – teachers' reports

The views of teachers regarding the academic climate of their schools, that is, the degree to which a school supports and encourages academic success, were collected using teachers' ratings (of 'very high', 'high', 'medium', 'low' or 'very low') of the following 14 aspects:

- teachers' understanding of the school's curricular goals
- teachers' degree of success in implementing the school's curriculum
- teachers' expectations for student achievement
- teachers working together to improve student achievement
- teachers' ability to inspire students
- parental involvement in school activities
- parental commitment to ensure that students are ready to learn
- parental expectations for student achievement
- parental support for student achievement
- parental pressure for the school to maintain high academic standards
- students' desire to do well in school
- students' ability to reach school's academic goals
- students' respect for classmates who excel in school
- collaboration between school leadership and teachers to plan instruction.

The teachers' responses were combined to create the School Emphasis on Academic Success scale. Students were then assigned to three groups based on their teacher's scale score.

At Year 4, students attending schools whose teachers reported a *very high emphasis* on academic success had a score on the scale of at least 12.9, which corresponds to teachers characterising seven of the 14 aspects as 'very high' and the other seven as 'high', on average. Students attending schools with a *medium emphasis* on academic success had a score no higher than 9.2, which corresponds to teachers characterising seven of the 14 aspects as 'medium' and the other seven as 'high', on average. All other students attended schools with a *high emphasis* on academic success.

At Year 8, students attending schools whose teachers reported a *very high emphasis* on academic success had a score on the scale of at least 13.4, which corresponds to teachers characterising seven of the 14 aspects as 'very high' and the other seven as 'high', on average. Students attending schools with a *medium emphasis* on academic success had a score no higher than 9.8, which corresponds to teachers characterising seven of the 14 aspects as 'medium' and the other seven as 'high', on average. All other students attended schools with a *high emphasis* on academic success.

Figure 6.9 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

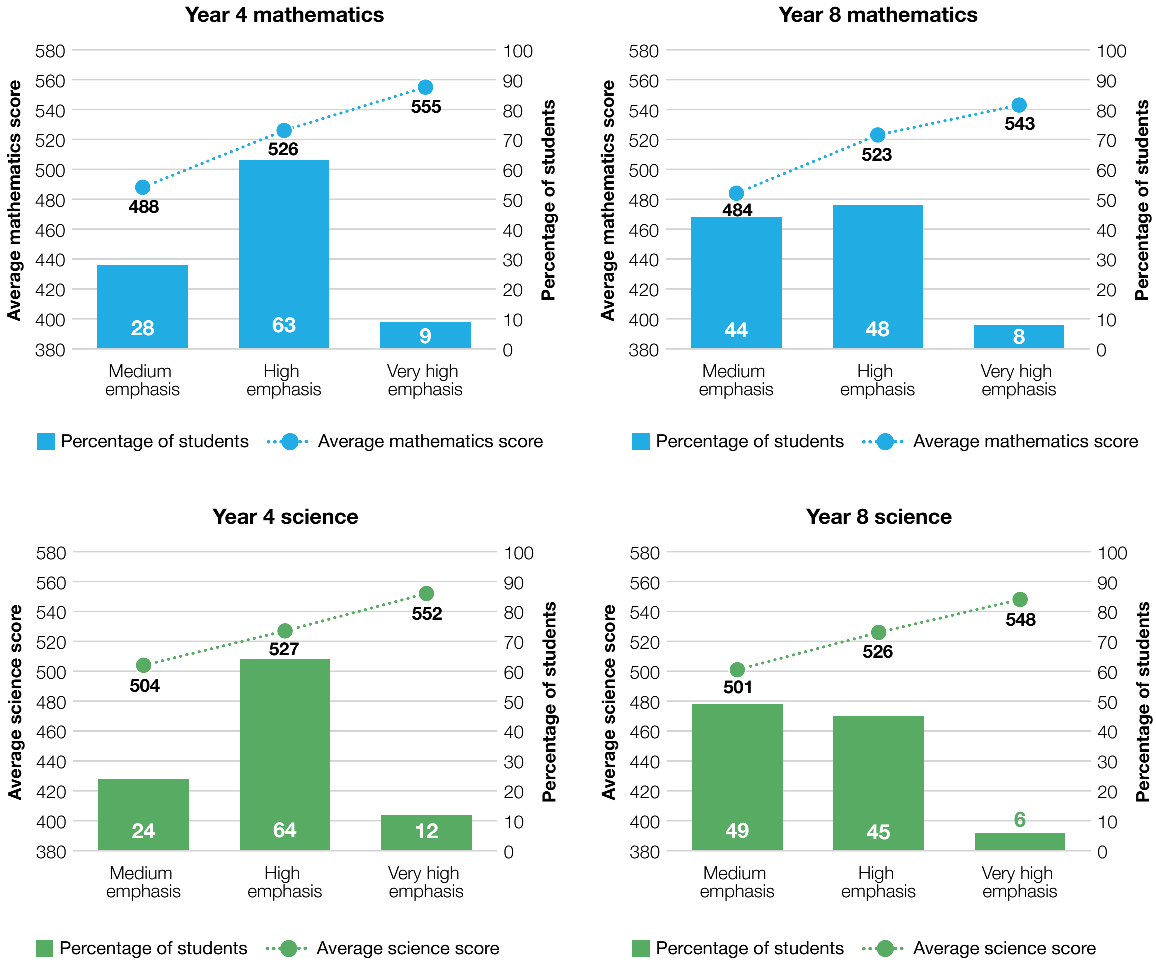


FIGURE 6.9 The School Emphasis on Academic Success scale (teachers' reports) and Australian student achievement in mathematics and science

At Year 4, nine per cent of Australian students were taught by mathematics teachers that reported a *very high emphasis* on academic success; 63 per cent were taught by mathematics teachers that reported a *high emphasis*; and 28 per cent were taught by mathematics teachers that reported a *medium emphasis* on academic success. In comparison, internationally, on average, seven per cent of students were taught by mathematics teachers that reported a *very high emphasis* on academic success; 56 per cent were taught by mathematics teachers that reported a *high emphasis*; and 36 per cent were taught by mathematics teachers that reported a *medium emphasis* on academic success.

At Year 4, 12 per cent of Australian students were taught by science teachers that reported a *very high emphasis* on academic success; 64 per cent were taught by science teachers that reported a *high emphasis*; and 24 per cent were taught by science teachers that reported a *medium emphasis* on academic success. In comparison, internationally, on average, eight per cent of students were taught by science teachers that reported a *very high emphasis* on academic success; 56 per cent were taught by science teachers that reported a *high emphasis*; and 36 per cent were taught by science teachers that reported a *medium emphasis* on academic success.

At Year 8, eight per cent of Australian students were taught by mathematics teachers that reported a *very high emphasis* on academic success; 48 per cent were taught by mathematics teachers that reported a *high emphasis*; and 44 per cent were taught by mathematics teachers that reported a *medium emphasis* on academic success. In comparison, internationally, on average, five per cent of students were taught by mathematics teachers that reported a *very high emphasis* on academic success;

46 per cent were taught by mathematics teachers that reported a *high emphasis*; and 49 per cent were taught by mathematics teachers that reported a *medium emphasis* on academic success.

At Year 8, six per cent of Australian students were taught by science teachers that reported a *very high emphasis* on academic success; 45 per cent were taught by science teachers that reported a *high emphasis*; and 49 per cent were taught by science teachers that reported a *medium emphasis* on academic success. In comparison, internationally, on average, five per cent of students were taught by science teachers that reported a *very high emphasis* on academic success; 46 per cent were taught by science teachers that reported a *high emphasis*; and 49 per cent were taught by science teachers that reported a *medium emphasis* on academic success.

As can be seen in Figure 6.9, there was a clear relationship between the achievement of Australian students and teachers' reports of school emphasis on academic success, with a higher school emphasis on academic success associated with higher achievement. The difference between the average achievement of Australian students who were taught by teachers reporting a *very high emphasis* on academic success and the average achievement of students who were taught by teachers reporting a *medium emphasis* on academic success was between 47 score points for Year 8 science and 67 score points for Year 4 mathematics. The differences between all groups were statistically significant for both subjects at Year 4. At Year 8, the difference between students who were taught by teachers reporting a *medium emphasis* on academic success and the other two groups was significant for both subjects. Internationally, on average, the gap was between 27 score points for Year 4 mathematics and 51 score points for Year 8 mathematics.

Teacher job satisfaction

Teachers' satisfaction with their careers may be an important element in the classroom and school environment, and could well impact on students' own attitudes towards learning, the classroom and their achievement.

Teachers were asked to indicate how often ('very often', 'often', 'sometimes' or 'never or almost never') they agreed with the following seven statements:

- I am content with my profession as a teacher.
- I am satisfied with being a teacher at this school.
- I find my work full of meaning and purpose.
- I am enthusiastic about my job.
- My work inspires me.
- I am proud of the work I do.
- I am going to continue teaching for as long as I can.

The teachers' responses were combined to create the Teacher Job Satisfaction scale. Students were then assigned to three groups based on their teacher's scale score.

At Year 4, students with *very satisfied* teachers had a score on the scale of at least 10.1, which corresponds to teachers responding 'very often' to four of the seven statements and responding 'often' to the other three, on average. Students with *less than satisfied* teachers had a score no higher than 6.6, which corresponds to teachers responding 'sometimes' to four of the seven statements and 'often' to the other three, on average. All other students had *satisfied* teachers.

At Year 8, students with *very satisfied* teachers had a score on the scale of at least 10.3, which corresponds to teachers responding 'very often' to four of the seven statements and responding 'often' to the other three, on average. Students with *less than satisfied* teachers had a score no higher than 7.0, which corresponds to teachers responding 'sometimes' to four of the seven statements and 'often' to the other three, on average. All other students had *satisfied* teachers.

Figure 6.10 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

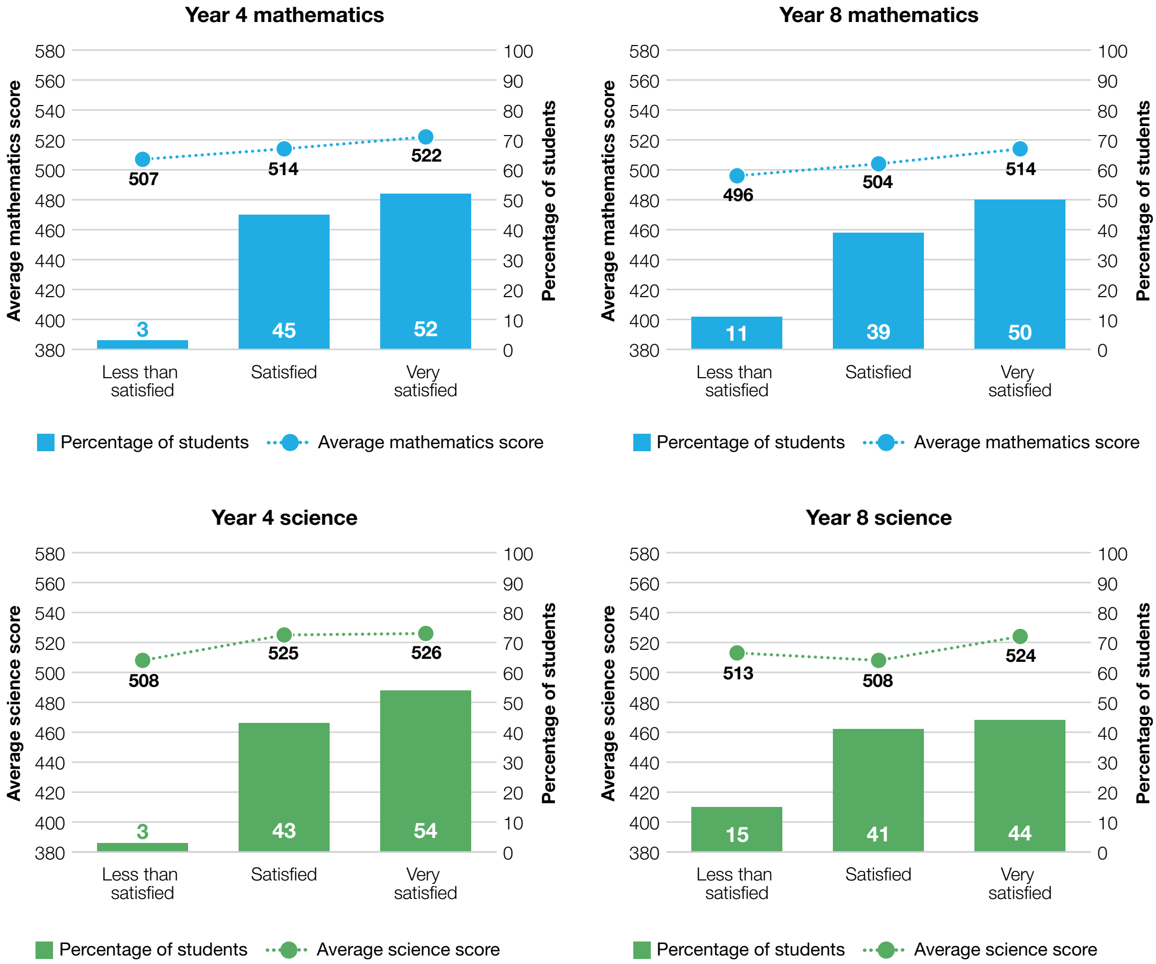


FIGURE 6.10 The Teacher Job Satisfaction scale and Australian student achievement in mathematics and science

At Year 4, 52 per cent of Australian students had mathematics teachers that reported that they were *very satisfied*; 45 per cent had mathematics teachers that reported that they were *satisfied*; and three per cent had mathematics teachers that reported that they were *less than satisfied*. In comparison, internationally, on average, 52 per cent of students had mathematics teachers that reported that they were *very satisfied*; 42 per cent had mathematics teachers that reported that they were *satisfied*; and six per cent had mathematics teachers that reported that they were *less than satisfied*. The percentages were very similar (a difference of 2% or less) when the responses for science teachers are considered (both within Australia and internationally).

At Year 8, 50 per cent of Australian students had mathematics teachers that reported that they were *very satisfied*; 39 per cent had mathematics teachers that reported that they were *satisfied*; and 11 per cent had mathematics teachers that reported that they were *less than satisfied*. In comparison, internationally, on average, 50 per cent of students had mathematics teachers that reported that they were *very satisfied*; 43 per cent had mathematics teachers that reported that they were *satisfied*; and seven per cent had mathematics teachers that reported that they were *less than satisfied*.

At Year 8, 44 per cent of Australian students had science teachers that reported that they were *very satisfied*; 41 per cent had science teachers that reported that they were *satisfied*; and 15 per cent had science teachers that reported that they were *less than satisfied*. In comparison, internationally, on average, 49 per cent of students had science teachers that reported that they were *very satisfied*;

42 per cent had science teachers that reported that they were *satisfied*; and nine per cent had science teachers that reported that they were *less than satisfied*.

There was no clear relationship between the Teacher Job Satisfaction scale and mathematics and science achievement. All differences between groups are relatively small, and the only significant differences found were for Australian Year 8 students whose mathematics teachers reported that they were *very satisfied* compared to those whose mathematics teachers reported that they were *less than satisfied* and for Australian Year 8 students whose science teachers reported that they were *very satisfied* compared to those whose science teachers reported that they were *satisfied*.

Challenges facing teachers

Teachers were asked to indicate the extent to which they agreed ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with the following eight statements:

- There are too many students in the classes.
- I have too much material to cover in class.
- I have too many teaching hours.
- I need more time to prepare for class.
- I need more time to assist individual students.
- I feel too much pressure from parents.
- I have difficulty keeping up with all of the changes to the curriculum.
- I have too many administrative tasks.

The teachers' responses were combined to create the Challenges Facing Teachers scale. Students were then assigned to three groups based on their teacher's scale score.

At Year 4, students whose teachers faced *few challenges* had a score on the scale of at least 10.4, which corresponds to teachers 'disagreeing a little' with four of the eight statements and 'agreeing a little' with the other four, on average. Students whose teachers faced *many challenges* had a score no higher than 7.1, which corresponds to teachers 'agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four, on average. All other students had teachers that reported facing *some challenges*.

At Year 8, students whose teachers faced *few challenges* had a score on the scale of at least 10.3, which corresponds to teachers 'disagreeing a little' with four of the eight statements and 'agreeing a little' with the other four, on average. Students whose teachers faced *many challenges* had a score no higher than 6.7, which corresponds to teachers 'agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four, on average. All other students had teachers that reported facing *some challenges*.

Figure 6.11 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

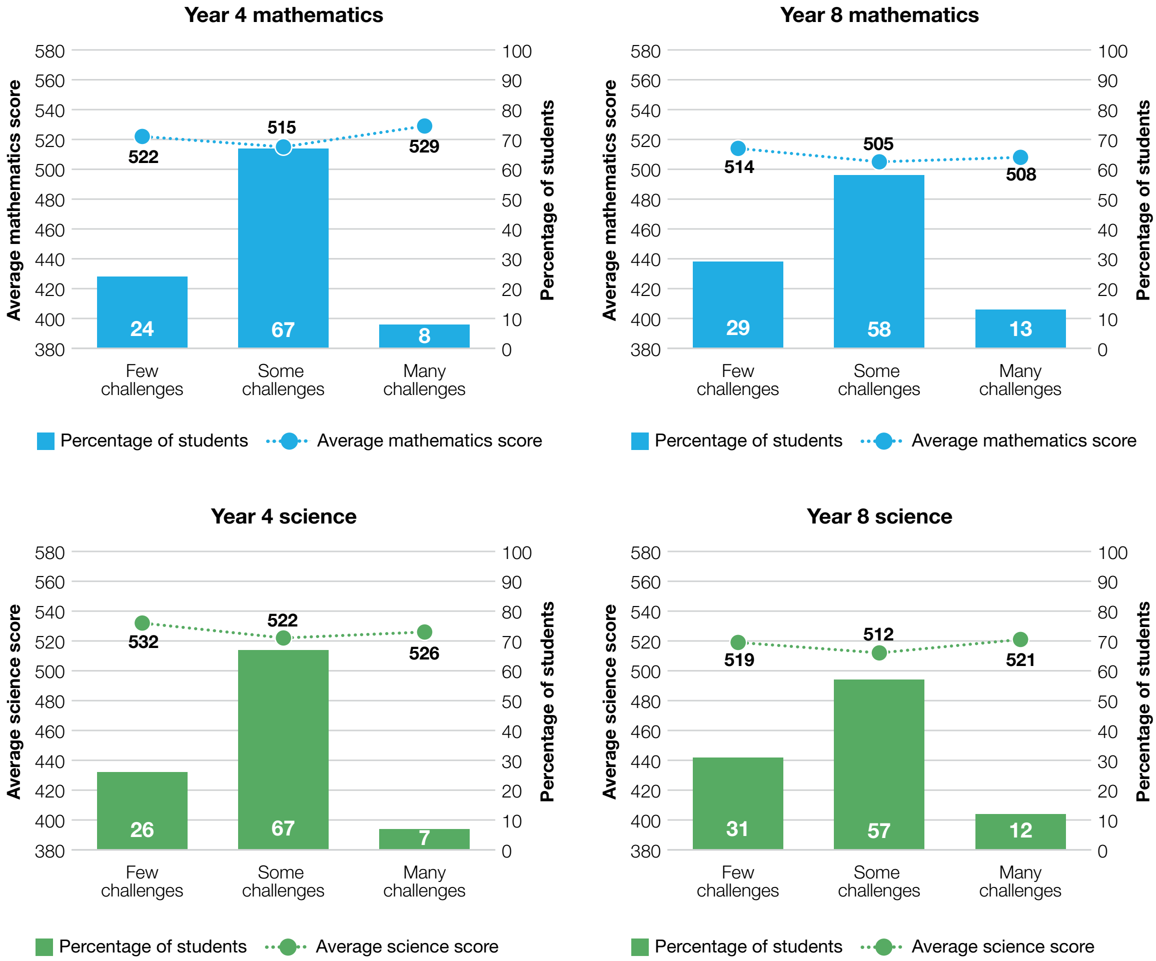


FIGURE 6.11 The Challenges Facing Teachers scale and Australian student achievement in mathematics and science

At Year 4, 24 per cent of Australian students were taught by mathematics teachers that faced *few challenges* in teaching; 67 per cent were taught by mathematics teachers that faced *some challenges* in teaching; and eight per cent were taught by mathematics teachers that faced *many challenges* in teaching. In comparison, internationally, on average, 41 per cent of students were taught by mathematics teachers that faced *few challenges* in teaching; 51 per cent were taught by mathematics teachers that faced *some challenges* in teaching; and eight per cent were taught by mathematics teachers that faced *many challenges* in teaching. The percentages were very similar (a difference of 2% or less) when the responses for science teachers are considered (both within Australia and internationally).

At Year 8, 29 per cent of Australian students were taught by mathematics teachers that faced *few challenges* in teaching; 58 per cent were taught by mathematics teachers that faced *some challenges* in teaching; and 13 per cent were taught by mathematics teachers that faced *many challenges* in teaching. In comparison, internationally, on average, 45 per cent of students were taught by mathematics teachers that faced *few challenges* in teaching; 49 per cent were taught by mathematics teachers that faced *some challenges* in teaching; and five per cent were taught by mathematics teachers that faced *many challenges* in teaching. The percentages were very similar (a difference of 2% or less) when the responses for science teachers are considered (both within Australia and internationally).

There were no significant differences between the groups in terms of mathematics and science achievement at both year levels.

Safety and discipline

Principals' reports of school discipline problems

Principals were asked to indicate the degree to which ('not a problem', 'minor problem', 'moderate problem' or 'serious problem') each of the following behaviours and issues was problematic among Year 4 or Year 8 students in their school:

- arriving late at school
- absenteeism (i.e. unjustified absences)
- classroom disturbance
- cheating
- swearing
- vandalism
- theft
- intimidation or verbal abuse among students (including texting, emailing etc.)
- physical fights among students
- intimidation or verbal abuse of teachers or staff (including texting, emailing etc.)
- physical injury to teachers or staff (Year 8 only).

The principals' responses were combined to create the School Discipline Problems scale. Students were then assigned to three groups based on their principal's scale score.

At Year 4, students in schools with *hardly any problems* had a score on the scale of at least 9.7, which corresponds to principals reporting 'not a problem' for five of the 10 issues and 'minor problem' for the other five, on average. Students in schools with *moderate to severe problems* had a score no higher than 7.6, which corresponds to principals reporting 'moderate problem' for five of the 10 issues and 'minor problem' for the other five, on average. All other students attended schools with *minor problems*.

At Year 8, students in schools with *hardly any problems* had a score on the scale of at least 10.8, which corresponds to principals reporting 'not a problem' for six of the 11 issues and 'minor problem' for the other five, on average. Students in schools with *moderate to severe problems* had a score no higher than 8.0, which corresponds to principals reporting 'moderate problem' for six of the 11 issues and 'minor problem' for the other five, on average. All other students attended schools with *minor problems*.

Figure 6.12 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

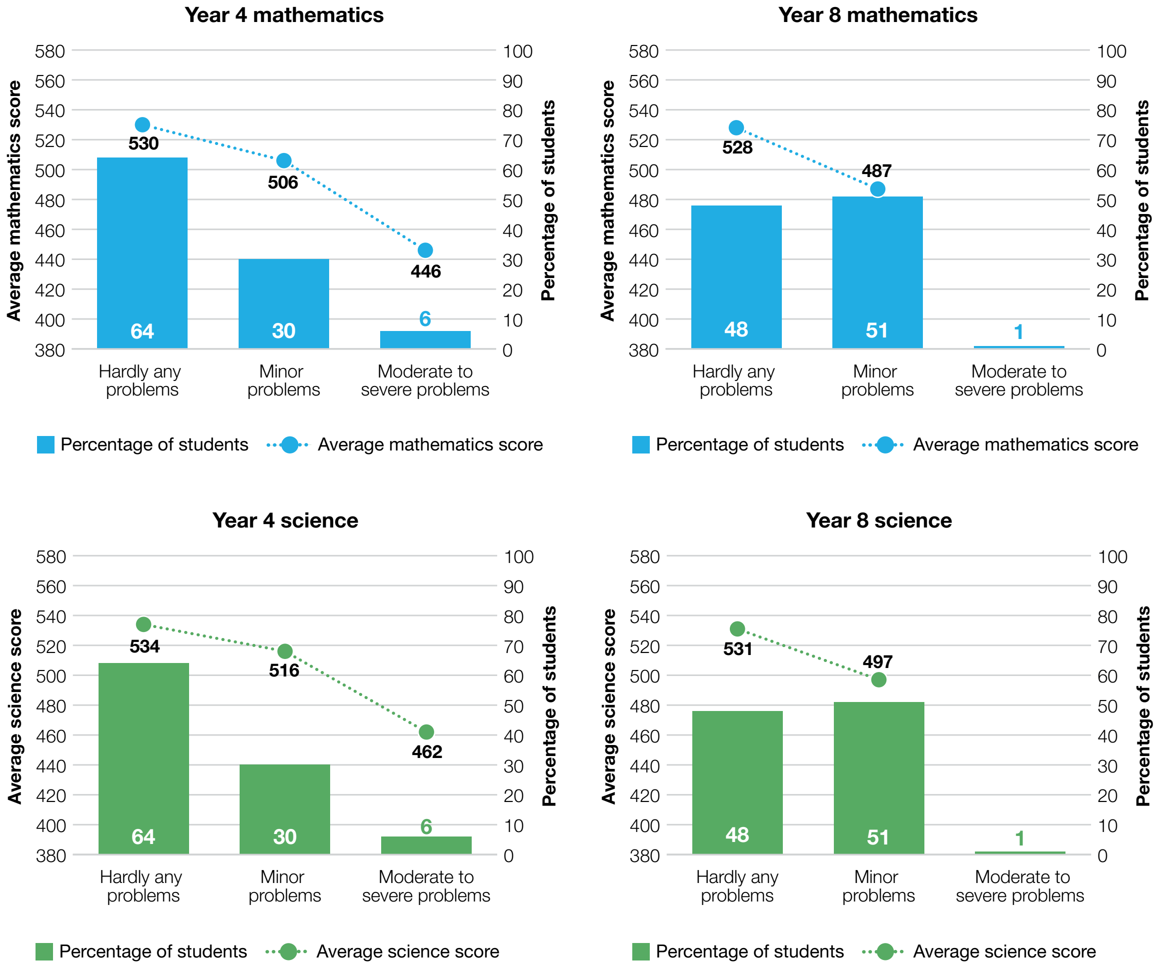


FIGURE 6.12 The School Discipline Problems scale and Australian student achievement in mathematics and science

At Year 4, 64 per cent of Australian students attended schools whose principals reported *hardly any problems* with school discipline; 30 per cent attended schools whose principals reported *minor problems*; and six per cent attended schools whose principals reported *moderate to severe problems* with school discipline. In comparison, internationally, on average, 60 per cent of students attended schools whose principals reported *hardly any problems* with school discipline; 31 per cent attended schools whose principals reported *minor problems*; and 10 per cent attended schools whose principals reported *moderate to severe problems* with school discipline (for science, the percentages for the international average were 61%, 30% and 9%).

At Year 8, 48 per cent of Australian students attended schools whose principals reported *hardly any problems* with school discipline; 51 per cent attended schools whose principals reported *minor problems*; and one per cent attended schools whose principals reported *moderate to severe problems* with school discipline. In comparison, internationally, on average, 43 per cent of students attended schools whose principals reported *hardly any problems* with school discipline; 45 per cent attended schools whose principals reported *minor problems*; and 11 per cent attended schools whose principals reported *moderate to severe problems* with school discipline.

As can be seen in Figure 6.12, there was a clear relationship between the achievement of Australian students and principals' reports of school disciplinary problems, with fewer disciplinary problems associated with higher achievement. The difference between the average achievement of Australian students that attended schools whose principals reported *hardly any problems* with school discipline and the average achievement of students attending schools whose principals reported *moderate to severe problems* with school discipline was 84 score points for Year 4 mathematics and 72 score points for Year 4 science. The difference between the average achievement of Australian students that attended schools whose principals reported *hardly any problems* with school discipline and the average achievement of students attending schools whose principals reported *minor problems* with school discipline was 41 score points for Year 8 mathematics and 34 score points for Year 8 science (the percentage of Year 8 students in schools encountering *moderate to severe problems* with school discipline was too small to calculate average achievement). The differences between all groups were statistically significant for both subjects at both year levels. Internationally, on average, the differences were smaller – around 43 score points at Year 4 and around 22 score points at Year 8 for the same comparisons.

Teachers' reports of safe and orderly schools

Teachers were asked to indicate the extent of their agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with the following eight statements:

- This school is located in a safe neighbourhood.
- I feel safe at this school.
- This school's security policies and practices are sufficient.
- The students behave in orderly manner.
- The students are respectful of the teachers.
- The students respect school property.
- This school has clear rules about student conduct.
- This school's rules are enforced in a fair and consistent manner.

The teachers' responses were combined to create the Safe and Orderly School scale. Students were then assigned to three groups based on their teacher's scale score.

At Year 4, students in *very safe and orderly* schools had a score on the scale of at least 10.0, which corresponds to teachers 'agreeing a lot' with four of the eight qualities of a safe and orderly school and 'agreeing a little' with the other four, on average. Students in *less than safe and orderly* schools had a score no higher than 6.7, which corresponds to teachers 'disagreeing a little' with four of the eight qualities and 'agreeing a little' with the other four, on average. All other students attended *safe and orderly* schools.

At Year 8, students in *very safe and orderly* schools had a score on the scale of at least 10.6, which corresponds to teachers 'agreeing a lot' with four of the eight qualities of a safe and orderly school and 'agreeing a little' with the other four, on average. Students in *less than safe and orderly* schools had a score no higher than 7.2, which corresponds to teachers 'disagreeing a little' with four of the eight qualities and 'agreeing a little' with the other four, on average. All other students attended *safe and orderly* schools.

Figure 6.13 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

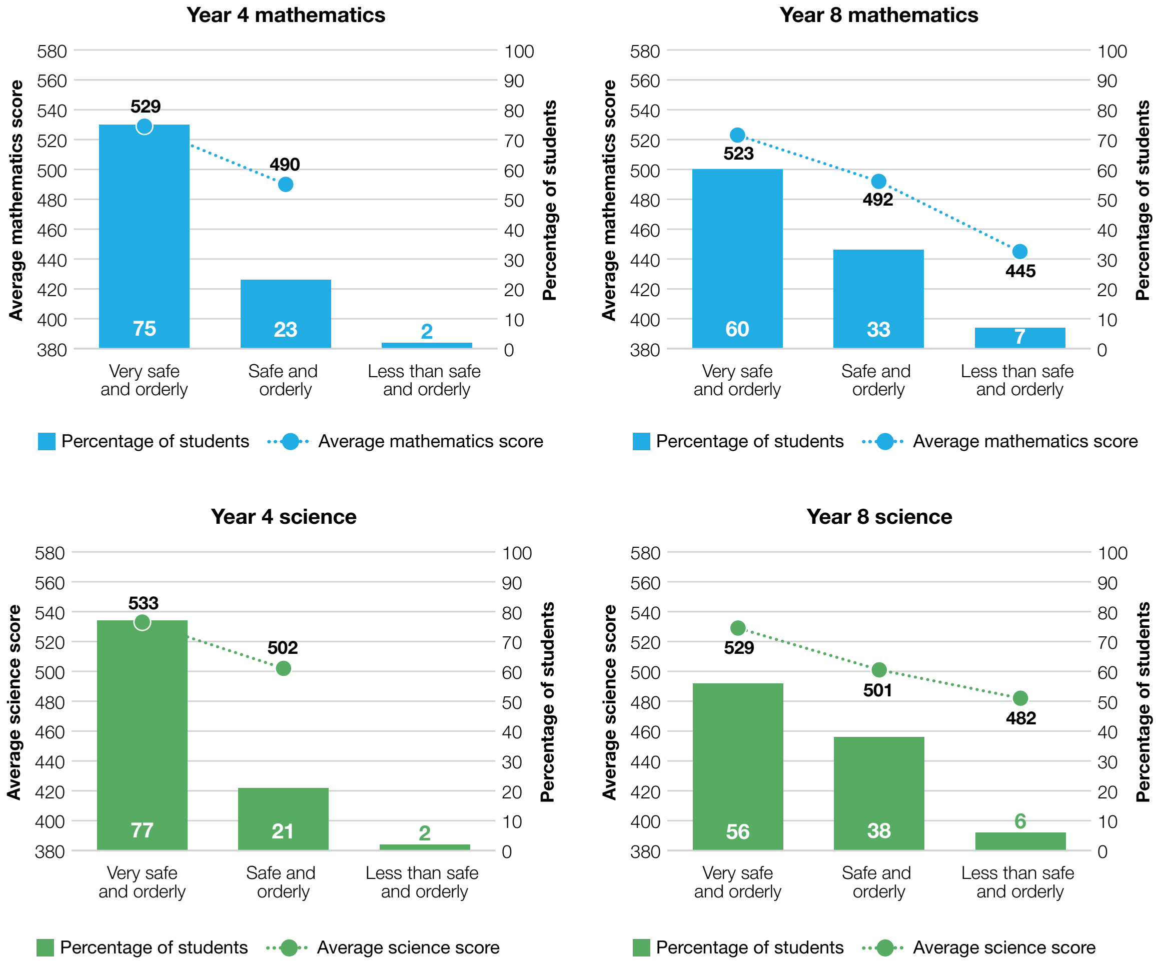


FIGURE 6.13 The Safe and Orderly School scale and Australian student achievement in mathematics and science

At Year 4, 75 per cent of Australian students had mathematics teachers that reported that their school was *very safe and orderly*; 23 per cent were in *safe and orderly* schools; and two per cent had mathematics teachers that reported that their school was *less than safe and orderly*. In comparison, internationally, on average, 56 per cent of students had mathematics teachers that reported that their school was *very safe and orderly*; 40 per cent were in *safe and orderly* schools; and four per cent had mathematics teachers that reported that their school was *less than safe and orderly*. The percentages were very similar (a difference of 2% or less) when the responses for science teachers are considered (both within Australia and internationally).

At Year 8, 60 per cent of Australian students had mathematics teachers that reported that their school was *very safe and orderly*; 33 per cent were in *safe and orderly* schools; and seven per cent had mathematics teachers that reported that their school was *less than safe and orderly*. In comparison, internationally, on average, 46 per cent of students had mathematics teachers that reported that their school was *very safe and orderly*; 46 per cent were in *safe and orderly* schools; and eight per cent had mathematics teachers that reported that their school was *less than safe and orderly*.

At Year 8, 56 per cent of Australian students had science teachers that reported that their school was *very safe and orderly*; 38 per cent were in *safe and orderly* schools; and six per cent had science teachers that reported that their school was *less than safe and orderly*. In comparison, internationally, on average, 45 per cent of students had science teachers that reported that their school was *very safe* *and orderly*; 47 per cent were in *safe and orderly* schools; and eight per cent had science teachers that reported that their school was *less than safe and orderly*.

As can be seen in Figure 6.13, there was a clear relationship between the achievement of Australian students and teachers' reports about the safety and orderliness of their school, with more safe and orderly schools associated with higher achievement. The difference between the average achievement of Australian students whose teachers reported that their school was *very safe and orderly* and the average achievement of students whose teachers reported that their school was *safe and orderly* was 39 score points for Year 4 mathematics and 30 score points for Year 4 science (the percentage of Year 4 students whose teachers reported that their school was *less than safe and orderly* was too small to calculate average achievement). The difference between the average achievement of Australian students whose teachers reported that their school was *very safe and orderly* and the average achievement of students whose teachers reported that their school was *less than safe and orderly* was 79 score points for Year 8 mathematics and 47 score points for Year 8 science. The differences between all groups were statistically significant for both subjects at both year levels. Internationally, on average, the gap was around 15 score points at Year 4 for the same comparisons and around 40 score points at Year 8.

Student reports of bullying

Students' views of their personal safety at school were collected using items that focused on their experiences of bullying behaviours. Students were asked to indicate how often ('never', 'a few times a year', 'once or twice a month' or 'at least once a week') another student had:

- teased me or called me names
- left me out of their games or activities
- spread lies about me
- stolen something from me
- hit or hurt me (e.g. shoved, hit, kicked)
- made me do things I didn't want to do
- shared embarrassing information about me
- posted embarrassing things about me online (Year 8 only)
- threatened me.

The Student Bullying scale was created by combining the responses to these items, and students were assigned to three groups based on their Student Bullying scale score.

At Year 4, students bullied *almost never* had a score on the scale of at least 9.6, which corresponds to 'never' experiencing four of the eight bullying behaviours and experiencing each of the other four behaviours 'a few times a year', on average. Students bullied *about weekly* had a score no higher than 8.0, which corresponds to their experiencing each of four of the eight behaviours 'once or twice a month' and each of the other four 'a few times a year', on average. All other students were bullied *about monthly*.

At Year 8, students bullied *almost never* had a score on the scale of at least 9.3, which corresponds to 'never' experiencing five of the nine bullying behaviours and experiencing each of the other four behaviours 'a few times a year', on average. Students bullied *about weekly* had a score no higher than 7.3, which corresponds to their experiencing each of five of the nine behaviours 'once or twice a month' and each of the other four 'a few times a year', on average. All other students were bullied *about monthly*.

Figure 6.14 presents the proportions of students in each of these categories, along with their average mathematics and science scores.

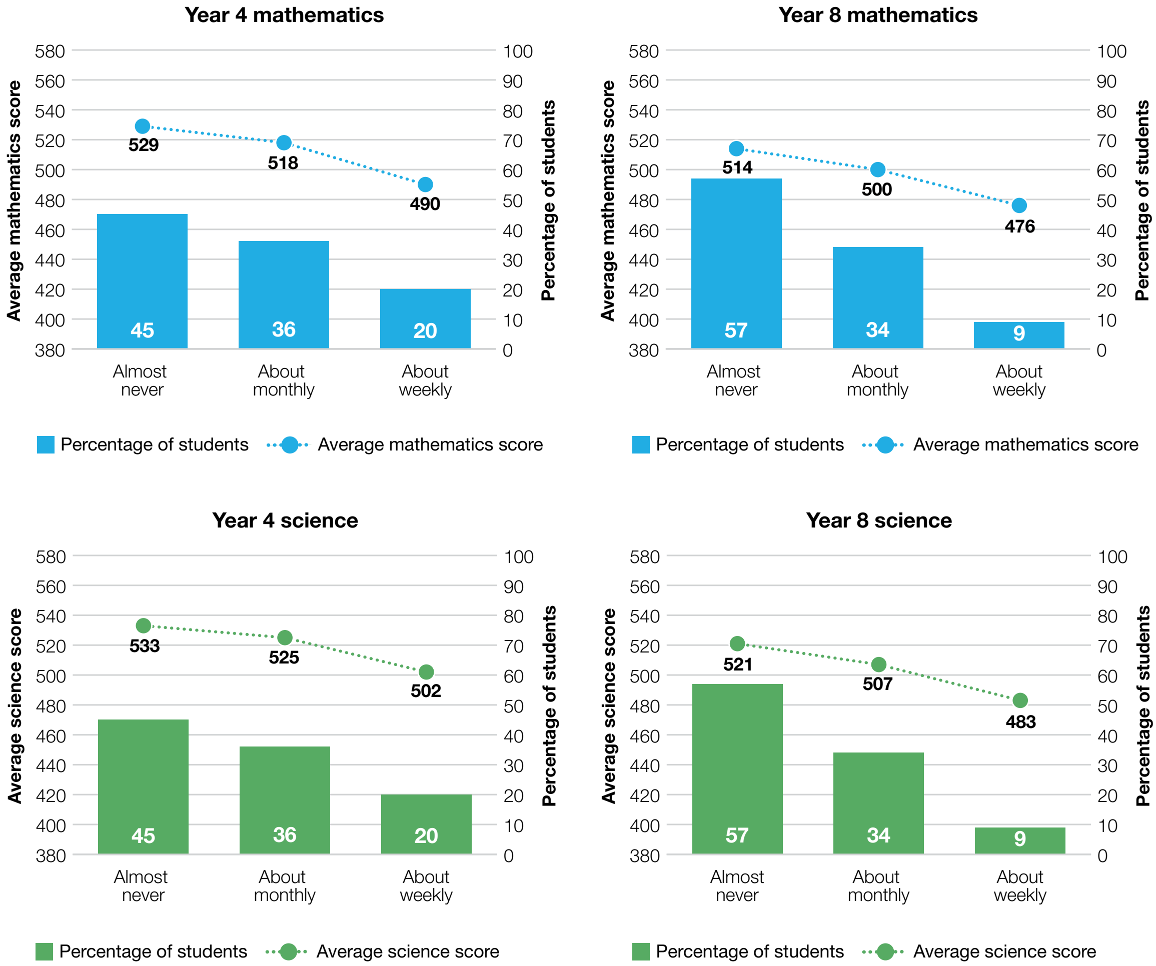


FIGURE 6.14 The Student Bullying scale and Australian student achievement in mathematics and science

At Year 4, 45 per cent of Australian students reported being bullied *almost never*; 36 per cent had been bullied *about monthly*; and 20 per cent reported being bullied *about weekly*. In comparison, internationally, on average, 56 per cent of students reported being bullied *almost never*; 29 per cent had been bullied *about monthly*; and 16 per cent reported being bullied *about weekly* (for science, the percentages for the international average were 57%, 28% and 15%).

At Year 8, 57 per cent of Australian students reported being bullied *almost never*; 34 per cent had been bullied *about monthly*; and nine per cent reported being bullied *about weekly*. In comparison, internationally, on average, 63 per cent of students reported being bullied *almost never*; 29 per cent had been bullied *about monthly*; and eight per cent reported being bullied *about weekly*.

As can be seen in Figure 6.14, there was a relationship between achievement and Australian students' experience of being bullied, with less experience of bullying by other students associated with higher achievement. The difference between the average achievement of Australian students that reported being bullied *almost never* and the average achievement of students that reported being bullied *about weekly* was between 32 score points for Year 4 science and 40 score points for Year 4 mathematics. The differences between all groups were statistically significant for both subjects at both year levels. Internationally, on average, the gap was between 34 score points for Year 4 science and 62 score points for Year 8 science.

Chapter 7

Teachers and classroom instruction

Key findings

- Eighty-three per cent of Australian Year 4 students and around 55 per cent of Australian Year 8 students were taught mathematics and science by a female teacher.
- Eighty-six per cent of Australian Year 4 students and 22 per cent of Australian Year 8 students were taught mathematics by a teacher that did not major in or take a specialisation in mathematics.
- At both Year 4 and Year 8 in Australia, emphasis was clearly placed on professional development in mathematics content, pedagogy and instruction, and curriculum, with between 60 and 70 per cent of students being taught by a mathematics teacher that had attended professional development in these areas.
- At both Year 4 and Year 8 in Australia, emphasis was clearly placed on professional development in science curriculum, with 40 per cent of Year 4 students and 68 per cent of Year 8 students being taught by a science teacher that had attended professional development in this area. At Year 8, professional development addressing individual students' needs and science pedagogy/instruction were also popular.
- In Australia, the average time spent on Year 4 mathematics instruction was 202 hours per year. At Year 8, the average time spent on mathematics instruction was 139 hours per year.
- In Australia, the average time spent on Year 4 science instruction was 57 hours per year. At Year 8, the average time spent on science instruction was 126 hours per year.
- Eighty-seven per cent of Australian Year 4 students had been taught all of the TIMSS mathematics topics before or during Year 4. At Year 8, 76 per cent of Australian students had been taught all of the TIMSS mathematics topics before or during Year 8.
- Sixty-one per cent of Australian Year 4 students had been taught all of the TIMSS science topics before or during Year 4. At Year 8, 59 per cent of Australian students had been taught all of the TIMSS science topics before or during Year 8.
- Twenty-two per cent of Australian Year 4 students and 16 per cent of Australian Year 8 students were taught science by a teacher that emphasised science investigation in *about half the lessons or more.* There was no relationship between the degree to which science teachers emphasised science investigation and average science achievement.

- Ninety-nine per cent of Australian Year 8 students but only 13 per cent of Australian Year 4 students attended a school that had a science laboratory available for use by students in that year level.
- At both Year 4 and Year 8, between 60 and 66 per cent of Australian students had computers available to use in both mathematics and science lessons.
- Australian Year 8 students were far more likely, on average, than students from other countries to use the internet to *access assignments posted online by the teacher* or to *communicate with the teacher.*
- The majority (56%) of Australian Year 8 students spent *45 minutes or less* on mathematics homework each week. However, those Australian Year 8 students that spent *more than 45 minutes* a week on mathematics homework had significantly higher average achievement than those students that spent *less than 45 minutes* a week on mathematics homework.
- The majority (73%) of Australian Year 8 students spent *45 minutes or less* on science homework each week. However, those Australian Year 8 students that spent *between 45 minutes and three hours* a week on science homework had significantly higher average achievement than those students that spent *less than 45 minutes* a week on science homework.
- There was a clear relationship between the achievement of Australian students and teachers' reports that their teaching was limited by student needs, with fewer limitations associated with higher mathematics and science achievement.
- There was a clear relationship between the achievement of Australian students and the frequency of student absences, with fewer absences associated with higher mathematics and science achievement.

Following on from Chapter 6, which focused on schools, this chapter addresses teachers and the teaching of mathematics and science.

As was the case in Chapter 6, the results in this chapter are presented in figures and in the text without standard errors. In Appendix D the same data are presented in tables that show the standard errors, along with the data for the international average.

It should also be noted that, because TIMSS focuses on student outcomes, the results from the school and teacher questionnaires are presented with regard to students. That is, each result is reported as the percentage of students attending a school that has a certain characteristic or the percentage of students taught by a teacher that responded in a particular way. Please see the Reader's Guide for more information.

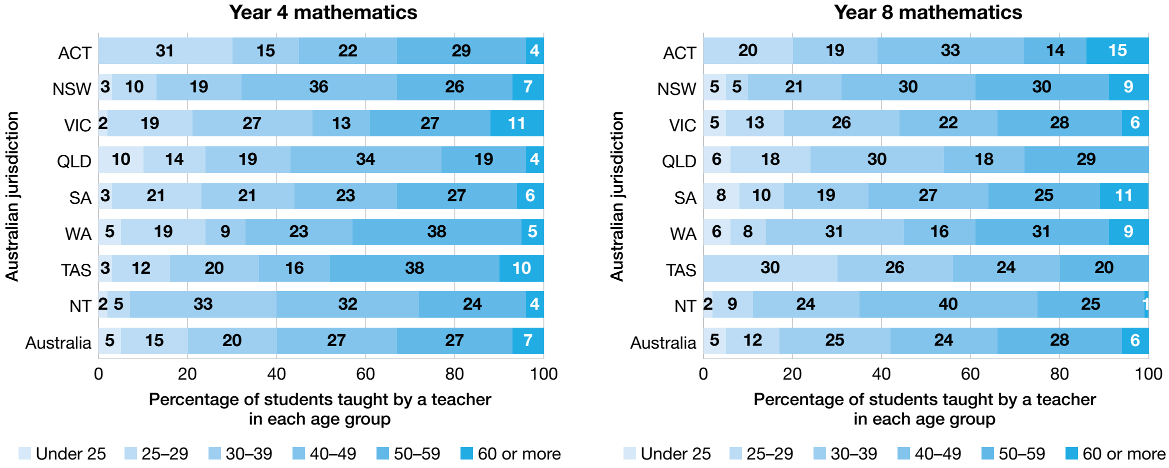
Teaching mathematics

Teachers

Age and gender

Figure 7.1 shows the percentages of Australian Year 4 and Year 8 students according to the age of their mathematics teacher. Across Australia as a whole, the majority of Year 4 and Year 8 students (55% and 52%, respectively) were taught mathematics by a teacher in their forties or fifties, with another 35 per cent (at Year 4) and 37 per cent (at Year 8) being taught mathematics by a teacher aged between 25 and 39 years. Only five per cent of students (at both year levels) had a mathematics teacher under 25 years old and six per cent (at Year 4) and seven per cent (at Year 8) had a teacher over 60 years old.

There was some variation across the states and territories in terms of the ages of the teaching force – for example, no Year 4 students in the ACT were being taught mathematics by a teacher under the age of 25, whereas 10 per cent of Year 4 students in Queensland had mathematics teachers in this age group. At Year 8, no students in Tasmania were being taught mathematics by a teacher over the age of 60, whereas 15 per cent of students in the ACT had mathematics teachers in this age group.



Note: Due to rounding, totals may not add to 100%.

FIGURE 7.1 Percentages of Australian Year 4 and Year 8 students by the age of their mathematics teachers, by jurisdiction

Figure 7.2 shows the percentages of Year 4 and Year 8 students taught mathematics by female or male teachers. On average across Australia, 83 per cent of Year 4 students and 55 per cent of Year 8 students were taught mathematics by a female teacher.

At Year 4, there was little variation across the jurisdictions, with between 82 and 88 per cent of Year 4 students being taught mathematics by a female teacher in most of the jurisdictions. However, the ACT was an exception, with only 56 per cent of students being taught mathematics by a female teacher and 44 per cent of students having a male mathematics teacher.

At Year 8, the percentage of students being taught mathematics by a female teacher was much lower than at Year 4, although it was still higher than 50 per cent in most jurisdictions. The exceptions were Western Australia, where the percentage of students with a female mathematics teacher was 45 per cent, and South Australia, where the percentage dropped to 27 per cent.

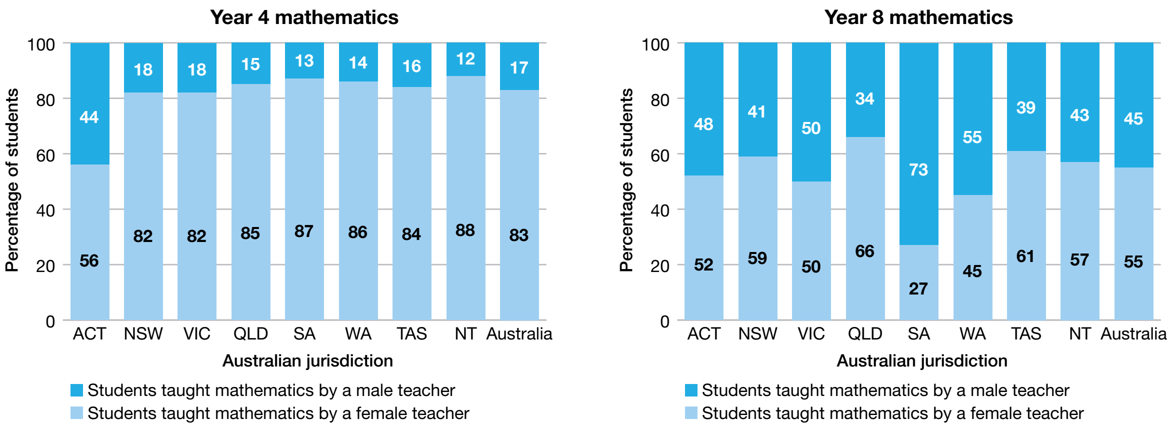


FIGURE 7.2 Percentages of Australian Year 4 and Year 8 students by the sex of their mathematics teachers, by jurisdiction

Qualifications

Table 7.1 shows the percentages of Year 4 and Year 8 students according to the highest education level of their mathematics teacher. The table shows Australian results and the international average.

TABLE 7.1 Year 4 and Year 8 mathematics teachers' formal education, Australia and the international average

	Percentage of students by mathematics teachers' educational level							
	Completed postgraduate degree		Completed bachelor's degree or equivalent but not a postgraduate degree*		Completed post-secondary education but not a bachelor's degree		No further than upper secondary education	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4							
Australia	12	2.6	81	3.2	7	1.9	0	0.0
International average	26	0.3	58	0.4	12	0.3	5	0.2
	Year 8							
Australia	20	2.7	80	2.7	0	0.0	0	0.0
International average	25	0.5	66	0.5	7	0.3	2	0.2

Note: Due to rounding, totals may not add to 100%.

*This category includes teachers who completed a graduate diploma of education following completion of an undergraduate degree.

At Year 4, 81 per cent of Australian students were taught mathematics by a teacher who had completed a bachelor's degree or equivalent, while an additional 12 per cent had a mathematics teacher who had completed a postgraduate university degree (i.e. doctorate, master's or other postgraduate degree). In comparison, on average across countries, 58 per cent of Year 4 students were taught mathematics by a teacher who had completed a bachelor's degree or equivalent, and 26 per cent were taught mathematics by a teacher who had completed a postgraduate university degree.

At Year 8, 80 per cent of Australian students were taught mathematics by a teacher who had completed a bachelor's degree or equivalent, while an additional 20 per cent had a mathematics teacher who had completed a postgraduate university degree. In comparison, on average across countries, 66 per cent of Year 8 students were taught mathematics by a teacher who had completed a bachelor's degree or equivalent, and 25 per cent were taught mathematics by a teacher who had completed a postgraduate university degree.

TIMSS reports not only on teachers' level of education attained, but also on the major(s) or specialisation(s) that teachers have undertaken during their tertiary studies. Figure 7.3 shows the percentages of Australian Year 4 and Year 8 students according to the type of major or specialisation of their mathematics teachers.

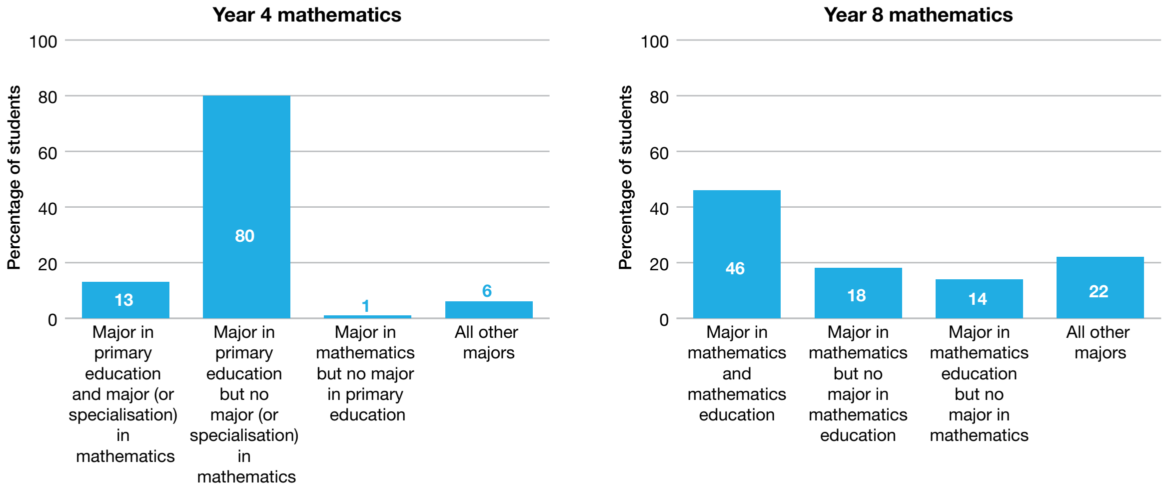


FIGURE 7.3 Percentages of Australian Year 4 and Year 8 students by the type of major of mathematics teachers

At Year 4, 80 per cent of Australian students had mathematics teachers that majored in primary education with no major or specialisation in mathematics. Thirteen per cent had mathematics teachers that majored both in mathematics and in primary education, one per cent had mathematics teachers that majored in mathematics but not in primary education and six per cent had mathematics teachers that majored neither in mathematics nor in primary education. The average performance of students with teachers with majors in both mathematics and primary education (536 score points) was significantly higher than the average performance of students with teachers with majors in primary education but not in mathematics (514 score points). There were no significant differences between the other groups.

In comparison, on average across countries, 46 per cent of Year 4 students had mathematics teachers that majored in primary education with no major or specialisation in mathematics. Twenty-seven per cent had mathematics teachers that majored both in mathematics and in primary education, 14 per cent had mathematics teachers that majored in mathematics but not in primary education, eight per cent had mathematics teachers that majored neither in mathematics nor in primary education and five per cent had mathematics teachers that had no formal education beyond upper secondary school.

At Year 8, 46 per cent of Australian students had mathematics teachers that majored both in mathematics and in mathematics education. Eighteen per cent had mathematics teachers that majored in mathematics but not in mathematics education, 14 per cent had mathematics teachers that majored in mathematics education but not in mathematics and 22 per cent had mathematics teachers that majored neither in mathematics nor in mathematics education. This means that about one-fifth of Australian Year 8 students were being taught mathematics by a teacher teaching out of field. However, there were no significant differences in terms of average mathematics achievement according to type of major attained by mathematics teachers.

In comparison, on average across countries, 36 per cent of Year 8 students had mathematics teachers that majored in mathematics as well as mathematics education. Another 36 per cent had mathematics teachers that majored in mathematics but not in mathematics education, 13 per cent had mathematics teachers that majored in mathematics education but not in mathematics, 13 per cent had mathematics teachers that majored neither in mathematics nor in mathematics education and two per cent had mathematics teachers that had no formal education beyond upper secondary school.

Years of experience

Table 7.2 shows the percentages of students according to the experience of their mathematics teacher. The table shows Australian results and the international average.

TABLE 7.2 Year 4 and Year 8 mathematics teachers' years of experience, Australia and the international average

	Percentage of students by mathematics teachers' years of experience								Average years of experience as a teacher	
	20 years or more		At least 10 but less than 20 years		At least 5 but less than 10 years		Less than 5 years			
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	Number of years	SE
	Year 4									
Australia	36	4.0	24	3.3	17	2.8	23	3.8	15	0.9
International average	40	0.5	31	0.5	16	0.4	13	0.3	17	0.1
	Year 8									
Australia	36	3.3	28	2.6	19	2.3	18	2.1	16	0.7
International average	34	0.5	30	0.5	20	0.5	17	0.4	16	0.1

Note: Due to rounding, totals may not add to 100%.

At Year 4, 36 per cent of students were taught by a mathematics teacher who had 20 years of experience; 24 per cent were taught by a mathematics teacher who had at least 10 but less than 20 years' experience; 17 per cent were taught by a mathematics teacher who had at least five but less than 10 years' experience; and 23 per cent of students were taught by a mathematics teacher who had less than five years of experience. On average, Australian Year 4 mathematics teachers had 15 years of experience, compared to the international average of 17 years.

At Year 8, 36 per cent of students were taught by a mathematics teacher who had 20 years of experience; 28 per cent were taught by a mathematics teacher who had at least 10 but less than 20 years' experience; 19 per cent were taught by a mathematics teacher who had at least five but less than 10 years' experience; and 18 per cent of students were taught by a mathematics teacher who had less than five years of experience. On average, Australian Year 8 mathematics teachers had 16 years of experience, which is the same as the international average.

Within Australia there were no significant differences in average mathematics achievement according to the years of experience of mathematics teachers at both Year 4 and Year 8. However, internationally, there appear to be small but statistically significant differences in favour of more experienced teachers.

Professional development

Many education systems, including Australia's, require registered teachers to participate in ongoing professional development – supplementary to their initial qualifications – to ensure that students benefit from up-to-date instruction methods and information.

Figure 7.4 presents the percentages of Year 4 and Year 8 students whose teachers reported participating in various forms of professional development in the past two years.

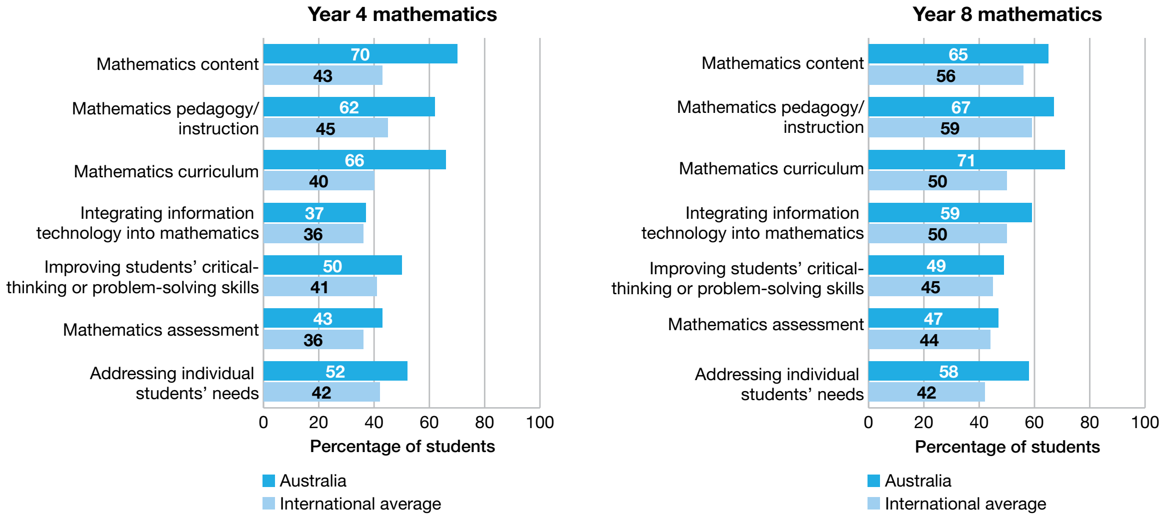


FIGURE 7.4 Percentages of Year 4 and Year 8 students by mathematics teachers' area of professional development, Australia and the international average

At Year 4 in Australia, emphasis was clearly placed on professional development in mathematics content, pedagogy and instruction, and curriculum, given that between 60 and 70 per cent of students had a mathematics teacher who attended professional development in each of these areas. Around 50 per cent of students had a mathematics teacher who attended professional development in improving students' critical-thinking or problem-solving skills and a similar amount had a mathematics teacher who attended professional development in addressing individual students' needs. Mathematics assessment and integrating information technology into mathematics were the least popular topics for professional development, as 43 per cent and 37 per cent of students (respectively) had a mathematics teacher who attended professional development in these areas. Internationally, mathematics assessment and integrating information technology into mathematics were also the least popular topics, although – compared to the Australian trend – the variation across topics was much less evident – from 36 per cent for these topics to 45 per cent for mathematics pedagogy and instruction.

At Year 8 in Australia, there was also an emphasis on professional development in mathematics content, pedagogy and instruction, and curriculum, given that over 65 per cent of students had a mathematics teacher who attended professional development in each of these areas. However, integrating information technology into mathematics and addressing individual students' needs were topics attended by the mathematics teachers of just under 60 per cent of students and, while less popular, improving students' critical-thinking or problem-solving skills and mathematics assessment were attended by the mathematics teachers of just under 50 per cent of students, which is a relatively substantial proportion. Internationally, the percentage of students who had a mathematics teacher that attended professional development in any particular topic was slightly lower than in Australia, but the pattern of popularity was similar. Two exceptions were mathematics curriculum, which had a greater emphasis in Australia than in other countries (possibly due to the introduction of the Australian Curriculum), and addressing individual students' needs, which was also more popular with Australian teachers than with teachers from elsewhere.

Instructional time

Based on teachers' reports of weekly instructional time for mathematics and principals' reports of how many days the school is open for instruction (weekly and yearly), an estimation was made of the average hours per year for mathematics instruction. In Australia, the average time spent on Year 4 mathematics instruction was 202 hours per year. Internationally, the average was 157 hours per year, with the least time spent being 100 hours per year in Korea and the most 275 hours per year in Portugal. In the United States, an average of 216 hours per year was devoted to mathematics instruction, in Northern Ireland the average was 215, while Singapore reported 201 hours, Canada 196, England 189, Ireland 165, New Zealand 163 and Hong Kong 159 hours per year of mathematics instruction at Year 4.

At Year 8, in Australia, the average time spent on mathematics instruction was 139 hours per year. Internationally, the average was 138 hours per year, with the least time spent being 99 hours per year in Sweden and the most 194 hours per year in South Africa. In Canada, an average of 168 hours per year was devoted to mathematics instruction, in the United States the average was 155, while New Zealand reported 144 hours, Hong Kong 139, Singapore 129, England 126 and Ireland 109 hours per year of mathematics instruction at Year 8.

Coverage of TIMSS topics

Teachers were asked if the students in the TIMSS class had been taught each of the TIMSS topics mostly before or during the year of assessment. Table 7.3 shows the TIMSS topics for mathematics at both Year 4 and Year 8.

TABLE 7.3 The TIMSS mathematics topics at Year 4 and Year 8

Year 4	Year 8
Number a) Concepts of whole numbers, including place value and ordering b) Adding, subtracting, multiplying and/or dividing with whole numbers c) Concepts of multiples and factors; odd and even numbers d) Concepts of fractions (fractions as parts of a whole or of a collection, or as a location on a number line) e) Adding and subtracting with fractions, comparing and ordering fractions f) Concepts of decimals, including place value and ordering, adding and subtracting with decimals g) Number sentences (finding the missing number, modelling simple situations with number sentences) h) Number patterns (extending number patterns and finding missing terms) ***Geometric shapes and measures*** a) Lines: measuring, estimating length of; parallel and perpendicular lines b) Comparing and drawing angles c) Using informal coordinate systems to locate points in a plane (e.g. in square B4) d) Elementary properties of common geometric shapes e) Reflections and rotations f) Relationships between two-dimensional and three-dimensional shapes g) Finding and estimating areas, perimeters and volumes ***Data display*** a) Reading and representing data from tables, pictographs, bar graphs or pie charts b) Drawing conclusions from data displays	***Number*** a) Computing with whole numbers b) Comparing and ordering rational numbers c) Computing with rational numbers (fractions, decimals and integers) d) Concepts of irrational numbers e) Problem solving involving percentages or proportions ***Algebra*** a) Simplifying and evaluating algebraic expressions b) Simple linear equations and inequalities c) Simultaneous (two variables) equations d) Numeric, algebraic and geometric patterns or sequences (extension, missing terms, generalisation of patterns) e) Representation of functions as ordered pairs, tables, graphs, words or equations f) Properties of functions (slopes, intercepts etc.) ***Geometry*** a) Geometric properties of angles and geometric shapes (triangles, quadrilaterals and other common polygons) b) Congruent figures and similar triangles c) Relationship between three-dimensional shapes and their two-dimensional representations d) Using appropriate measurement formulas for perimeters, circumferences, areas, surface areas and volumes e) Points on the Cartesian plane f) Translation, reflection and rotation ***Data and chance*** a) Characteristics of data sets (mean, median, mode and shape of distributions) b) Interpreting data sets (e.g. draw conclusions, make predictions and estimate values beyond given data points) c) Judging, predicting and determining the chances of possible outcomes

Figure 7.5 shows the percentages of Year 4 and Year 8 students that had been taught the TIMSS topics, on average, for each content domain. The figure shows Australian results and the international average.

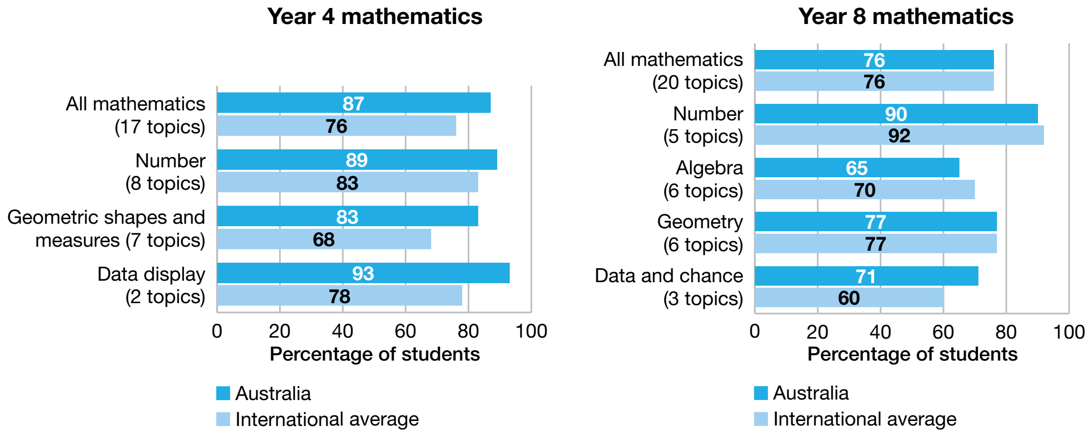


FIGURE 7.5 Percentages of Year 4 and Year 8 students taught the TIMSS mathematics topics, Australia and the international average

According to Figure 7.5, 87 per cent of Australian Year 4 students had been taught all of the TIMSS mathematics topics before or during Year 4. Across the domains, this percentage ranges from 83 per cent for *geometric shapes and measures* to 93 per cent for *data display*. Internationally, the percentage of Year 4 students that had been taught the TIMSS topics was lower than for Australia in each domain.

At Year 8, 76 per cent of Australian students had been taught all of the TIMSS mathematics topics before or during Year 8. Across the domains, this percentage ranges from 65 per cent for *algebra* to 90 per cent for *number.* Internationally, the percentage of Year 8 students that had been taught the TIMSS topics was similar to that of Australia in *number* and *geometry*, lower than for Australia in *data and chance* and higher than for Australia in *algebra*.

Computer activities in mathematics

Teachers were asked about their use of computers while teaching mathematics to the TIMSS students. Table 7.4 presents the percentages of students (for Australia and internationally) who had access to computers during mathematics classes and the different types of activities for which computers were used, as reported by teachers.

TABLE 7.4 Computer activities during mathematics lessons and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

	Computers available for students to use in mathematics lessons						Percentage of students whose teachers have them use computers at least monthly							
	Percentage of students		Mathematics achievement											
	Yes		Yes		No		To explore mathematics principles and concepts		To practise skills and procedures		To look up ideas and information		To process and analyse data*	
	% of students	SE	Mean	SE	Mean	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4													
Australia	60	3.8	520	3.5	517	6.2	53	3.8	57	3.9	49	3.8	N/A	
International average	37	0.5	510	1.0	504	0.6	26	0.4	33	0.4	27	0.4	N/A	
	Year 8													
Australia	62	3.4	512	3.5	506	5.4	51	3.5	52	3.6	48	3.6	44	3.2
International average	32	0.5	485	1.3	481	0.7	21	0.5	23	0.5	22	0.5	19	0.5

*This activity was not included at Year 4.

At both Year 4 and Year 8, around 60 per cent of Australian students had computers available for use in mathematics lessons. Internationally, 37 per cent of Year 4 students and 32 per cent of Year 8 students had computers available for use in mathematics lessons. There were only small differences in average mathematics achievement between students who had access to computers during mathematics lessons and those who did not. These differences were not statistically significant.

At Year 4, 57 per cent of Australian students were asked, by their mathematics teacher, to use computers at least monthly to practise skills and procedures, while 53 per cent were asked to explore mathematics principles and concepts, and 49 per cent were asked to look up ideas and information.

At Year 8, 52 per cent of Australian students were asked, by their mathematics teacher, to use computers at least monthly to practise skills and procedures, while 51 per cent were asked to explore mathematics principles and concepts, 48 per cent were asked to look up ideas and information, and 44 per cent were asked to process and analyse data.

Use of the internet for schoolwork

The internet is becoming increasingly prominent as a teaching and learning tool. In TIMSS 2015, Year 8 students were asked about the types of tasks for which they used the internet when doing schoolwork. Figure 7.6 presents the percentages of Year 8 students according to how they used the internet for schoolwork. The figure shows Australian results and the international average.

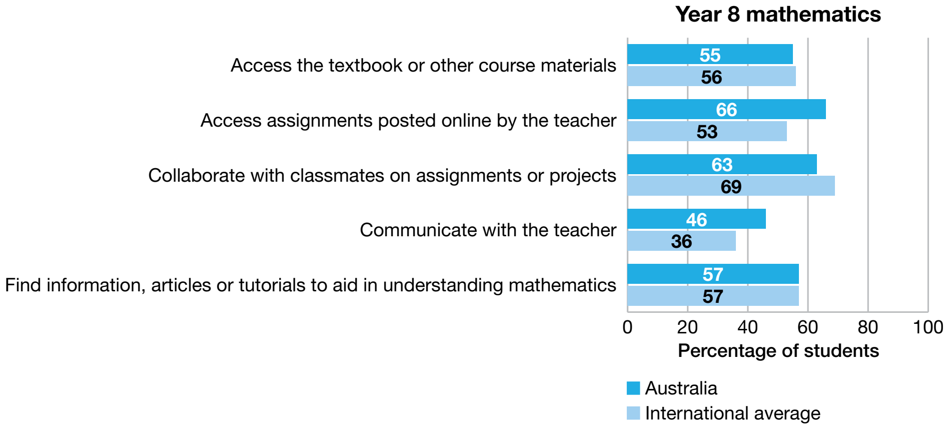


FIGURE 7.6 Percentages of Year 8 students by how they used the internet for mathematics schoolwork, Australia and the international average

Figure 7.6 shows that percentages of Australian Year 8 students who used the internet to *access textbooks or other course materials* or to *find information, articles or tutorials to aid in understanding mathematics* were fairly similar to those of the international average, around 55–57 per cent for both activities (56–57% internationally). However, Australian students were far more likely than students from other countries to use the internet to *access assignments posted online by the teacher* (66% compared to 53%) or to *communicate with the teacher* (46% compared to 36%). Australian Year 8 students were slightly less likely than students from other countries to use the internet to *collaborate with classmates on assignments or projects* (63% compared to 69%).

Time students spend on mathematics homework

Students in Year 8 were asked how often their teacher gives them mathematics homework and how much time they usually spend on it when it is given. Weekly time spent on mathematics homework was then estimated by multiplying the frequency of assignment by the amount of time usually spent on mathematics homework.

Figure 7.7 presents the percentages of Australian Year 8 students according to time spent on mathematics homework per week and their average achievement in mathematics.

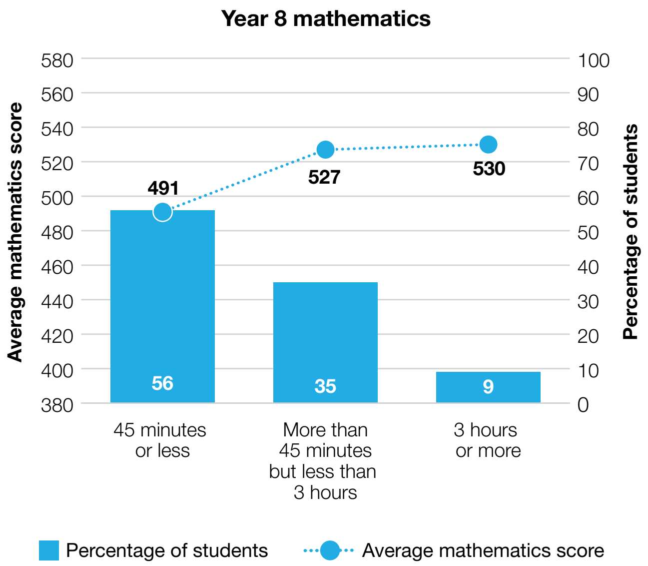


FIGURE 7.7 Time spent on mathematics homework per week and Australian student achievement in mathematics

Figure 7.7 shows that the majority (56%) of Australian Year 8 students spent *45 minutes or less* on mathematics homework each week. Another 35 per cent spent *between 45 minutes and three hours* on mathematics homework each week and nine per cent spent *three hours or more* on mathematics homework. Internationally, 49 per cent of Year 8 students spent *45 minutes or less* on mathematics homework each week, 36 per cent spent *between 45 minutes and three hours* on mathematics homework each week and 15 per cent spent *three hours or more* on mathematics homework.

Figure 7.7 shows that Australian Year 8 students who spent more than 45 minutes a week on mathematics homework had significantly higher average achievement (over 35 score points higher) than those students who spent less than 45 minutes a week on mathematics homework.

Teaching limited by student needs

Teachers of the TIMSS classes were asked their opinion on the extent to which instruction at their school was limited ('limited a lot', 'some' or 'not at all') by the following six student needs:

- students lacking prerequisite knowledge or skills
- students suffering from lack of basic nutrition
- students suffering from not enough sleep
- disruptive students
- uninterested students
- students with mental, emotional or psychological disabilities.

Teachers' responses to these items were combined to create the Teaching Limited by Student Needs scale. Students were then assigned to groups based on their mathematics teacher's scale score.

At Year 4, students with mathematics teachers who felt *not limited* by student needs had a score on the scale of at least 11.0, which corresponds to their teachers feeling 'not at all' limited by three of the six needs and to 'some' extent limited by the other three needs, on average. Students with teachers who felt *very limited* by student needs had a score no higher than 6.9, which corresponds to their teachers reporting feeling limited 'a lot' by three of the six needs and to 'some' extent limited by the other three needs, on average. All other students had teachers who felt *somewhat limited* by student needs.

At Year 8, students with mathematics teachers who felt *not limited* by student needs had a score on the scale of at least 11.4, which corresponds to their teachers feeling 'not at all' limited by three of the six needs and to 'some' extent limited by the other three needs, on average. Students with teachers who felt *very limited* by student needs had a score no higher than 7.4, which corresponds to their teachers reporting feeling limited 'a lot' by three of the six needs and to 'some' extent limited by the other three needs, on average. All other students had teachers who felt *somewhat limited* by student needs.

Figure 7.8 presents the percentages of Australian Year 4 and Year 8 students in each of these categories, along with their average achievement in mathematics.

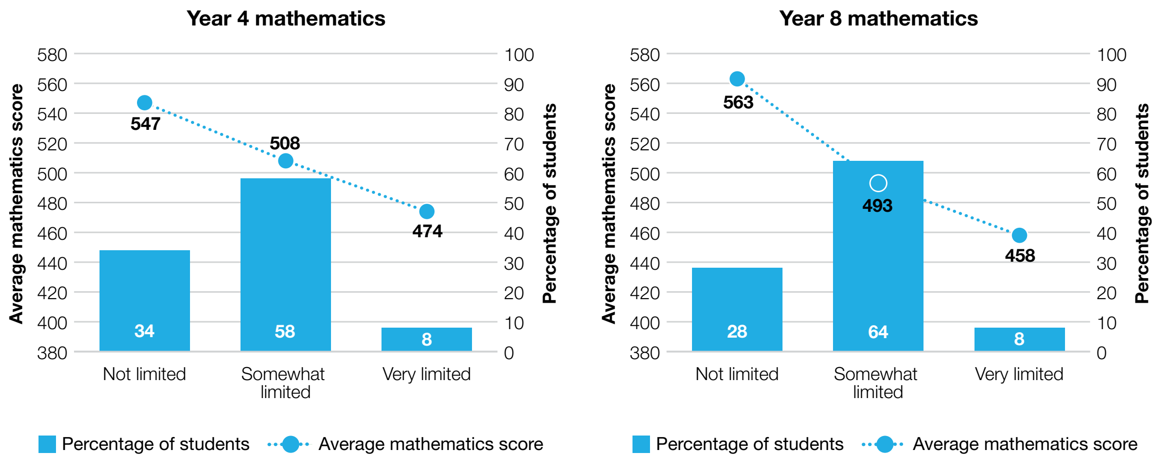


FIGURE 7.8 Teaching limited by student needs and Australian student achievement in mathematics

At Year 4, 34 per cent of Australian students were taught mathematics by teachers who reported that teaching was *not limited* by student needs; 58 per cent were taught mathematics by teachers who reported that teaching was *somewhat limited*; and eight per cent were taught mathematics by teachers who reported that teaching was *very limited* by student needs. These were exactly the same as the percentages seen internationally, on average across countries.

At Year 8, 28 per cent of Australian students were taught mathematics by teachers who reported that teaching was *not limited* by student needs; 64 per cent were taught mathematics by teachers who reported that teaching was *somewhat limited*; and eight per cent were taught mathematics by teachers who reported that teaching was *very limited* by student needs. In comparison, internationally, on average, 27 per cent of students were taught mathematics by teachers who reported that teaching was *not limited* by student needs; 62 per cent were taught mathematics by teachers who reported that teaching was *somewhat limited*; and 11 per cent were taught mathematics by teachers who reported that teaching was *very limited* by student needs.

As can be seen in Figure 7.8, there was a clear relationship between the achievement of Australian students and teachers' reports that mathematics teaching was limited by student needs – fewer limitations being associated with higher achievement. The relationship appears stronger at Year 8 than at Year 4. At Year 4, Australian students who were taught mathematics by teachers reporting that teaching was *not limited* by student needs scored over 70 score points higher than those who were taught mathematics by teachers reporting that teaching was *very limited* by student needs. In comparison, Australian Year 8 students who were taught mathematics by teachers reporting that teaching was *not limited* by student needs scored over 100 score points higher than those who were taught mathematics by teachers reporting that teaching was *very limited* by student needs. Internationally, on average, the gap was over 40 score points at Year 4 and over 60 score points at Year 8.

Frequency of student absences

Students were asked how often they were absent from school ('never or almost never', 'once a month', 'once every two weeks' or 'once a week or more').

Figure 7.9 presents the percentages of Australian Year 4 and Year 8 students according to how often they were absent from school, along with their average achievement in mathematics.

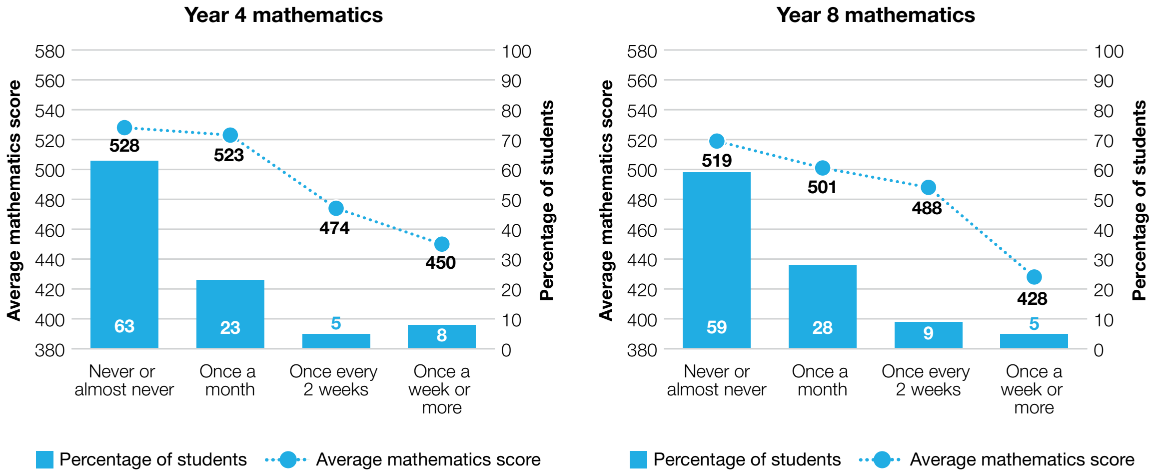


FIGURE 7.9 Frequency of student absences and Australian student achievement in mathematics

Figure 7.9 shows that 63 per cent of Australian Year 4 students were *never or almost never* absent from school, 23 per cent were absent *once a month*, five per cent were absent *once every two weeks* and eight per cent were absent *once a week or more*. In comparison, internationally, 67 per cent of Year 4 students were *never or almost never* absent from school, 18 per cent were absent *once a month*, five per cent were absent *once every two weeks* and 10 per cent were absent *once a week or more*.

At Year 8, 59 per cent of Australian students were *never or almost never* absent from school, 28 per cent were absent *once a month*, nine per cent were absent *once every two weeks* and five per cent were absent *once a week or more*. In comparison, internationally, 61 per cent of Year 8 students were *never or almost never* absent from school, 23 per cent were absent *once a month*, eight per cent were absent *once every two weeks* and eight per cent were absent *once a week or more*.

As can be seen in Figure 7.9, there was a clear relationship between the achievement of Australian students and the frequency of student absences – fewer absences being associated with higher achievement. The relationship appears slightly stronger at Year 8 than at Year 4. At Year 4, Australian students who were *never or almost never* absent scored over 75 score points higher than those who were absent *once a week or more*. In comparison, Australian Year 8 students who were *never or almost never* absent scored over 90 score points higher than those who were absent *once a week or more*. Internationally, on average, the gap was over 60 score points at Year 4 and over 90 score points at Year 8.

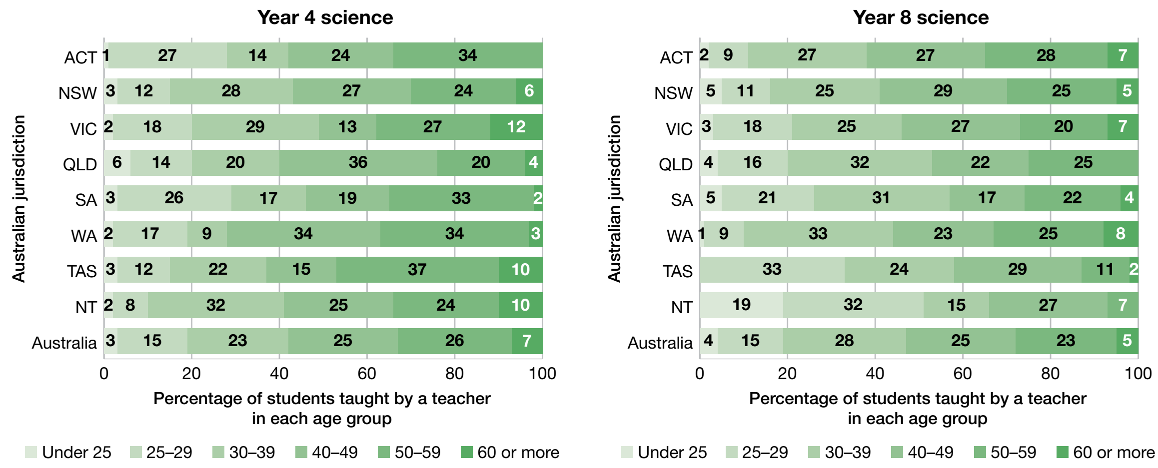
Teaching science

Teachers

Age and gender

Figure 7.10 shows the percentages of Australian Year 4 and Year 8 students according to the age of their science teacher. Across Australia as a whole, the majority of Year 4 students (51%) were taught science by a teacher in their forties or fifties, with another 38 per cent being taught science by a teacher aged between 25 and 39 years. Only three per cent of students had a science teacher under 25 years old and seven per cent had a teacher over 60 years old. At Year 8, the majority of students (68%) were taught science by a teacher aged between 25 and 49 years, with another 23 per cent being taught science by a teacher aged in their fifties. Only four per cent of students had a science teacher under 25 years old and five per cent had a teacher over 60 years old.

There was some variation across the states and territories in the age of the teaching force – for example, at Year 4, 47 per cent of students in Tasmania were being taught science by a teacher over the age of 50, whereas only 24 per cent of students in Queensland had science teachers in this age group. At Year 8, no students in Tasmania were being taught science by a teacher under the age of 25, whereas 19 per cent of Year 8 students in the Northern Territory had science teachers in this age group.



Note: Due to rounding, totals may not add to 100%.

FIGURE 7.10 Percentages of Australian Year 4 and Year 8 students by the age of their science teachers, by jurisdiction

Figure 7.11 shows the percentages of Year 4 and Year 8 students taught science by female or male teachers. On average across Australia, 83 per cent of Year 4 students and 56 per cent of Year 8 students were taught science by a female teacher.

At Year 4, there was little variation across the jurisdictions, with between 79 and 89 per cent of Year 4 students being taught science by a female teacher in most of the jurisdictions. However, the ACT was an exception, with only 65 per cent of students being taught science by a female teacher and 35 per cent by a male science teacher.

At Year 8, the percentage of students being taught science by a female teacher was much lower than at Year 4, although it was still higher than 50 per cent in most jurisdictions. The exception was South Australia, where only 43 per cent of Year 8 students were taught science by a female teacher.

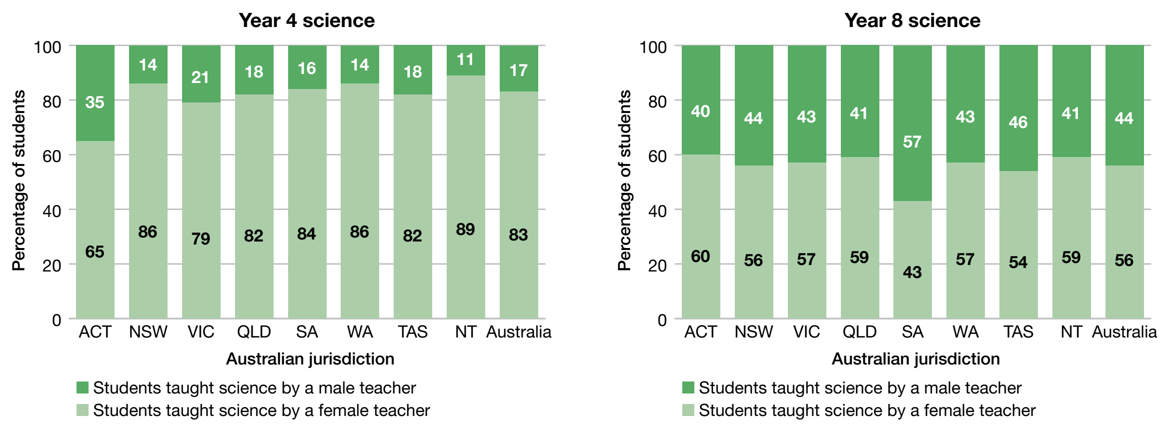


FIGURE 7.11 Percentages of Australian Year 4 and Year 8 students by the sex of their science teachers, by jurisdiction

Qualifications

Table 7.5 shows the percentages of Year 4 and Year 8 students according to the highest education level of their science teacher. The table shows Australian results and the international average.

TABLE 7.5 Year 4 and Year 8 science teachers' formal education, Australia and the international average

	Percentage of students by science teachers' educational level							
	Completed postgraduate degree		Completed bachelor's degree or equivalent but not a postgraduate degree*		Completed post-secondary education but not a bachelor's degree		No further than upper secondary education	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4							
Australia	12	2.7	81	3.3	7	1.9	0	0.0
International average	28	0.4	57	0.4	11	0.3	4	0.2
	Year 8							
Australia	19	2.2	81	2.2	1	0.3	0	0.0
International average	28	0.4	64	0.5	7	0.3	2	0.2

Note: Due to rounding, totals may not add to 100%.

*This category includes teachers who completed a graduate diploma of education following completion of an undergraduate degree.

At Year 4, 81 per cent of Australian students were taught science by a teacher who had completed a bachelor's degree or equivalent, while an additional 12 per cent had a science teacher who had completed a postgraduate university degree (i.e. doctorate, master's or other postgraduate degree). In comparison, on average across countries, 57 per cent of Year 4 students were taught science by a teacher who had completed a bachelor's degree or equivalent, and 28 per cent were taught science by a teacher who had completed a postgraduate university degree.

At Year 8, 81 per cent of Australian students were taught science by a teacher who had completed a bachelor's degree or equivalent, while an additional 19 per cent had a science teacher who had completed a postgraduate university degree. In comparison, on average across countries, 64 per cent of Year 8 students were taught science by a teacher who had completed a bachelor's degree or equivalent, and 28 per cent were taught science by a teacher who had completed a postgraduate university degree.

TIMSS reports not only on teachers' level of education, but also on the major(s) or specialisation(s) that teachers have undertaken during their tertiary studies. Figure 7.12 shows the percentages of Australian Year 4 and Year 8 students according to the type of major or specialisation of their science teachers.

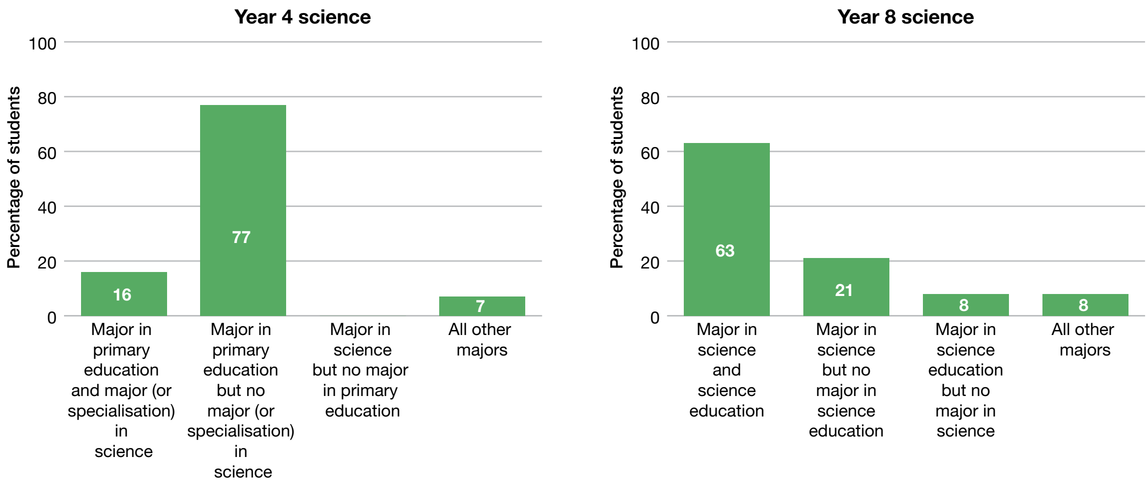


FIGURE 7.12 Percentages of Australian Year 4 and Year 8 students by the type of major of science teachers

At Year 4, 77 per cent of Australian students had science teachers that majored in primary education with no major or specialisation in science. Sixteen per cent had science teachers that majored in both science and primary education and seven per cent had science teachers that majored in neither science nor primary education. There were no significant differences in terms of average science achievement according to type of major.

In comparison, on average across countries, 49 per cent of Year 4 students had science teachers that majored in primary education with no major or specialisation in science. Twenty-three per cent had science teachers that majored both in science and in primary education, 15 per cent had science teachers that majored in science but not in primary education, nine per cent had science teachers that majored neither in science nor in primary education and five per cent had science teachers that had no formal education beyond upper secondary school.

At Year 8, 63 per cent of Australian students had science teachers that majored in science as well as science education. Twenty-one per cent had science teachers that majored in science but not in science education, eight per cent had science teachers that majored in science education but not in science and eight per cent had science teachers that majored neither in science nor in science education. This means that less than 10 per cent of Australian Year 8 students were being taught science by a teacher teaching out of field. However, there were no significant differences in terms of average science achievement according to type of major attained by science teachers.

In comparison, on average across countries, 32 per cent of Year 8 students had science teachers that majored in science as well as in science education. Another 47 per cent had science teachers that majored in science but not in science education, 11 per cent had science teachers that majored in science education but not in science, seven per cent had science teachers that majored neither in science nor in science education and two per cent had science teachers that had no formal education beyond upper secondary school.

Years of experience

Table 7.6 shows the percentages of students according to the experience of their science teacher. The table shows Australian results and the international average.

TABLE 7.6 Year 4 and Year 8 science teachers' years of experience, Australia and the international average

	Percentage of students by science teachers' years of experience								Average years of experience as a teacher	
	20 years or more		At least 10 but less than 20 years		At least 5 but less than 10 years		Less than 5 years			
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	Number of years	SE
	Year 4									
Australia	35	4.0	26	4.0	21	2.7	18	2.8	15	0.8
International average	39	0.5	30	0.5	17	0.4	14	0.4	17	0.1
	Year 8									
Australia	26	2.5	29	2.8	25	2.8	20	2.1	13	0.5
International average	32	0.5	30	0.5	20	0.4	18	0.4	15	0.1

Note: Due to rounding, totals may not add to 100%.

At Year 4, 35 per cent of students were taught by a science teacher who had 20 years of experience; 26 per cent were taught by a science teacher who had at least 10 but less than 20 years' experience; 21 per cent were taught by a science teacher who had at least five but less than 10 years' experience; and 18 per cent of students were taught by a science teacher who had less than five years of experience. On average, Australian Year 4 science teachers had 15 years of experience, compared to the international average of 17 years.

At Year 8, 26 per cent of students were taught by a science teacher who had 20 years of experience; 29 per cent were taught by a science teacher who had at least 10 but less than 20 years' experience; 25 per cent were taught by a science teacher who had at least five but less than 10 years' experience; and 20 per cent of students were taught by a science teacher who had less than five years of experience. On average, Australian Year 8 science teachers had 13 years of experience, compared to the international average of 15 years.

Within Australia there were no significant differences in average science achievement according to the years of experience of science teachers at both Year 4 and Year 8. However, internationally, there appear to be small but statistically significant differences in favour of more experienced teachers at Year 4 but not at Year 8.

Professional development

Many education systems, including Australia's, require registered teachers to participate in ongoing professional development – supplementary to their initial qualifications – to ensure that students benefit from up-to-date instruction methods and information.

Figure 7.13 presents the percentages of Year 4 and Year 8 students whose teachers reported participating in various forms of professional development in the past two years.

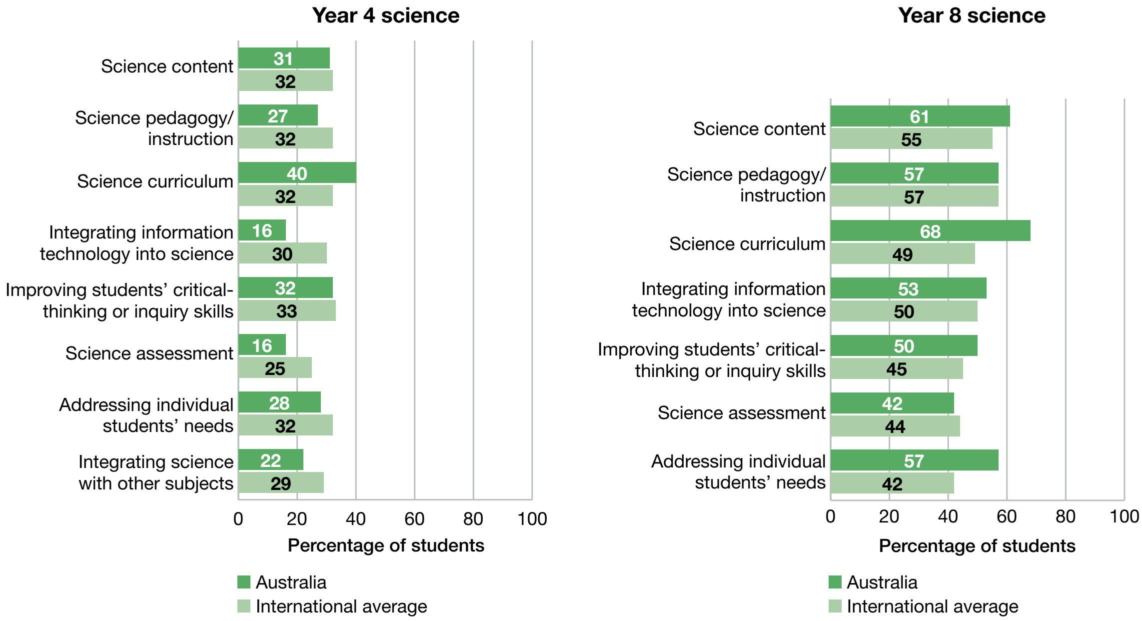


FIGURE 7.13 Percentages of Year 4 and Year 8 students by science teachers' area of professional development, Australia and the international average

At Year 4 in Australia, a lower emphasis seems to have been placed on professional development in science than in mathematics. The proportions of students whose science teacher attended professional development in any one of the topics listed in Figure 7.13 ranged from 16 to 40 per cent, whereas in mathematics the proportions ranged from 38 to 70 per cent. For science, the most popular topic was science curriculum (possibly due to the introduction of the Australian Curriculum), with 40 per cent of students being taught science by a teacher who attended professional development in this topic in the past two years. The next most popular topics were improving students' critical-thinking or inquiry skills (32%) and science content (31%), followed by addressing individual students' needs (28%), science pedagogy/instruction (27%) and integrating science with other subjects (22%). The least popular topics were integrating information technology into science and science assessment, with 16 per cent of students taught science by a teacher who attended professional development in these topics in the past two years. Internationally, there was not a great deal of variation in the proportions of students whose science teacher attended professional development in any one of the topics listed (the reported range was between 25 and 33%). Therefore, the main differences between Australia and the international average were in the categories of integrating information technology into science and science assessment.

At Year 8 in Australia, there was also an emphasis on professional development in science curriculum, given that 68 per cent of students had a science teacher who attended professional development in this area. The next most popular topics were science content (61%), followed by addressing individual students' needs and science pedagogy/instruction (both 57%), integrating information technology into science (53%) and improving students' critical-thinking or inquiry skills (50%). The least popular topic was science assessment, with 42 per cent of students being taught science by a teacher who attended professional development in this topic in the past two years. Internationally, the percentage of students who had a science teacher who attended professional development in any particular topic was slightly lower than in Australia, but the pattern of popularity was similar. Two exceptions were science curriculum, which had a greater emphasis in Australia than internationally (possibly due to the introduction of the Australian Curriculum), and addressing individual students' needs, which garnered more interest from Australian teachers than from teachers working in other countries.

Instructional time

Based on teachers' reports of weekly instructional time for science and principals' reports of how many days the school is open for instruction (weekly and yearly), an estimation was made of the average hours per year for science instruction. In Australia, the average time spent on Year 4 science instruction was 57 hours per year. Internationally, the average was 76 hours per year, with least time spent being 32 hours per year in Ireland and the most 125 hours per year in Qatar. In the United States, an average of 100 hours per year was devoted to science instruction, in Singapore the average was 85, while Canada reported 81 hours, England 61, New Zealand 43 and Northern Ireland 38 hours per year of science instruction at Year 4.

At Year 8, in Australia, the average time spent on science instruction was 126 hours per year. Internationally, the average was 144 hours per year, with the least time spent being 71 hours per year in Italy and the most 311 hours per year in Malta.[1] In the United States, an average of 144 hours per year was devoted to science instruction, in New Zealand the average was 133, while Singapore reported 106 hours, Hong Kong 102, England and Canada 97 and Ireland 90 hours per year of science instruction at Year 8.

Coverage of TIMSS topics

Teachers were asked if the students in the TIMSS class had been taught each of the TIMSS topics mostly before or during the year of assessment. Table 7.7 shows the TIMSS topics for science at both Year 4 and Year 8.

1 A number of participating countries teach science as separate subjects (biology, chemistry, physics etc.) in Year 8. All of these countries, except Sweden, have a higher average hours per year of instruction time than countries that teach science as an integrated subject (such as Australia). Of the countries teaching science as an integrated subject, Qatar has the highest average hours per year of instruction time at 155 hours per year. The international average is based on all countries, regardless of whether science is taught as separate subjects or as an integrated subject.

TABLE 7.7 The TIMSS science topics at Year 4 and Year 8

Year 4	Year 8
Life science a) Characteristics of living things and the major groups of living things (e.g. mammals, birds, insects, flowering plants) b) Major body structures and their functions in humans, other animals and plants c) Life cycles of common plants and animals (e.g. humans, butterflies, frogs, flowering plants) d) Understanding that some characteristics are inherited and some are the result of the environment e) How physical features and behaviours help living things survive in their environments f) Relationships in communities and ecosystems (e.g. simple food chains, predator/prey relationships, human impacts on the environment) g) Human health (transmission and prevention of diseases, symptoms of health and illness, importance of a healthy diet and exercise) ***Physical science*** a) States of matter (solid, liquid, gas) and properties of the states of matter (volume, shape); how the state of matter changes by heating or cooling b) Classifying materials based on physical properties (e.g. weight/mass, volume, conducting heat, conducting electricity, magnetic attraction) c) Mixtures and how to separate a mixture into its components (e.g. sifting, filtering, evaporation, using a magnet) d) Chemical changes in everyday life (e.g. decaying, burning, rusting, cooking) e) Common sources of energy (e.g. the Sun, electricity, wind) and uses of energy (heating and cooling homes, providing light) f) Light and sound in everyday life (e.g. understanding shadows and reflection, understanding that vibrating objects make sound) g) Electricity and simple circuits (e.g. identifying materials that are conductors, recognising that electricity can be changed to light or sound, knowing that a circuit must be complete to work correctly) h) Properties of magnets (e.g. knowing that like poles repel and opposite poles attract, recognising that magnets can attract some objects) i) Forces that cause objects to move (e.g. gravity, pushing/pulling) ***Earth science*** a) Common features of the Earth's landscape (e.g. mountains, plains, deserts, rivers, oceans) and their relationship to human use (farming, irrigation, land development) b) Where water is found on the Earth and how it moves in and out of the air (e.g. evaporation, rainfall, cloud formation, dew formation) c) Understanding that weather can change from day to day, from season to season and by geographic location d) Understanding what fossils are and what they can tell us about past conditions on Earth e) Objects in the solar system (the Sun, the Earth, the Moon and other planets) and their movements (the Earth and other planets revolve around the Sun, the Moon revolves around the Earth) f) Understanding how day and night result from the Earth's rotation on its axis and how the Earth's rotation results in changing shadows throughout the day g) Understanding how seasons are related to the Earth's annual movement around the Sun	***Biology*** a) Differences among major taxonomic groups of organisms (plants, animals, fungi, mammals, birds, reptiles, fish, amphibians) b) Major organs and organ systems in humans and other organisms (structure/function, life processes that maintain stable bodily conditions) c) Cells, their structure and functions, including respiration and photosynthesis as cellular processes d) Life cycles, sexual reproduction and heredity (passing on of traits, inherited versus acquired/learnt characteristics) e) Role of variation and adaptation in survival/extinction of species in a changing environment (including fossil evidence for changes in life on Earth over time) f) Interdependence of populations of organisms in an ecosystem (e.g. energy flow, food webs, competition, predation) and factors affecting population size in an ecosystem g) Human health (causes of infectious diseases, methods of infection, prevention, immunity) and the importance of diet and exercise in maintaining health ***Chemistry*** a) Classification, composition and particulate structure of matter (elements, compounds, mixtures, molecules, atoms, protons, neutrons, electrons) b) Physical and chemical properties of matter c) Mixtures and solutions (solvent, solute, concentration/dilution, effect of temperature on solubility) d) Properties and uses of common acids and bases e) Chemical change (transformation of reactants, evidence of chemical change, conservation of matter, common oxidation reactions – combustion, rusting, tarnishing) f) The role of electrons in chemical bonds ***Physics*** a) Physical states and changes in matter (explanations of properties in terms of movement and distance between particles; phase change, thermal expansion and changes in volume and/or pressure) b) Energy forms, transformations, heat and temperature c) Basic properties/behaviours of light (reflection, refraction, light and colour, simple ray diagrams) and sound (transmission through media, loudness, pitch, amplitude, frequency) d) Electric circuits (flow of current; types of circuits – parallel/series) and properties and uses of permanent magnets and electromagnets e) Forces and motion (types of forces, basic description of motion, effects of density and pressure) ***Earth science*** a) Earth's structure and physical features (Earth's crust, mantle and core; composition and relative distribution of water, and composition of air) b) Earth's processes, cycles and history (rock cycle; water cycle; weather versus climate; major geological events; formation of fossils and fossil fuels) c) Earth's resources, their use and conservation (e.g. renewable/non-renewable resources, human use of land/soil, water resources) d) Earth in the solar system and the universe (phenomena on Earth – day/night, tides, phases of Moon, eclipses, seasons; physical features of Earth compared to other bodies)

Figure 7.14 shows the percentages of Year 4 and Year 8 students that had been taught the TIMSS topics, on average, for each content domain. The figure shows Australian results and the international average.

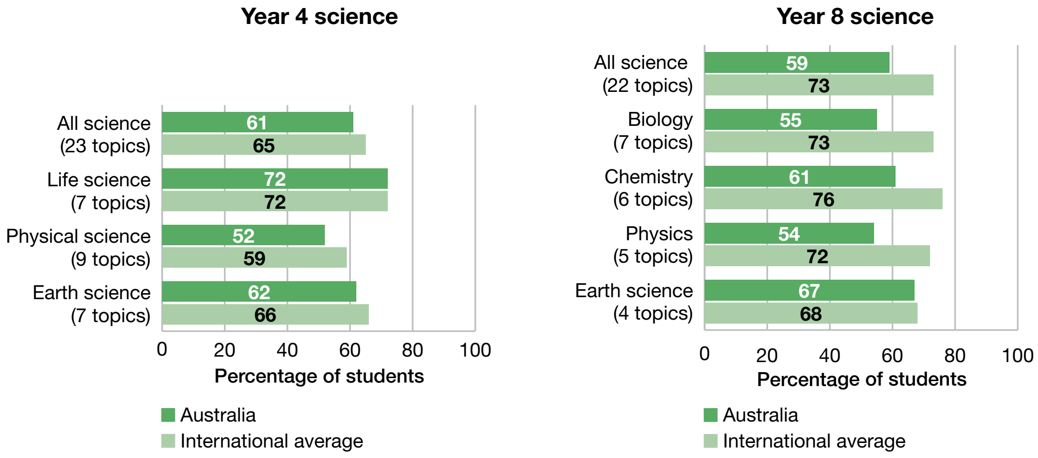


FIGURE 7.14 Percentages of Year 4 and Year 8 students taught the TIMSS science topics, Australia and the international average

According to Figure 7.14, 61 per cent of Australian Year 4 students had been taught all of the TIMSS science topics before or during Year 4. Across the domains, this proportion ranges from 52 per cent for *physical science* to 72 per cent for *life science*. Internationally, the percentage of Year 4 students that had been taught the TIMSS topics was the same or higher than for Australia in each domain.

At Year 8, 59 per cent of Australian students had been taught all of the TIMSS science topics before or during Year 8. Across the domains, this proportion ranges from 54 per cent for *physics* to 67 per cent for *Earth science.* Internationally, the percentage of Year 8 students that had been taught the TIMSS topics was quite substantially higher than for Australia in each domain except *Earth science*.

Emphasis on science investigation

Teachers were asked how often ('every or almost every lesson', 'about half the lessons', 'some lessons' or 'never') they asked their students to do the following eight science investigation activities:

- observe natural phenomena and describe what they see
- watch you demonstrate an experiment or investigation
- design or plan experiments or investigations
- conduct experiments or investigations
- present data from experiments or investigations
- interpret data from experiments or investigations
- use evidence from experiments or investigations to support conclusions
- do field work outside of class.

Teachers' responses to these items were combined to create the Emphasise Science Investigation scale. Students were then assigned to groups based on their science teacher's scale score.

At both Year 4 and Year 8, students with teachers who emphasised science investigation in *about half the lessons or more* had a score on the scale of at least 11.3, which corresponds to their teachers using all eight activities in 'about half the lessons', on average. All other students had teachers who emphasised science investigation in *less than half the lessons*.

Figure 7.15 presents the percentages of Australian Year 4 and Year 8 students in each of these categories, along with their average achievement in science.

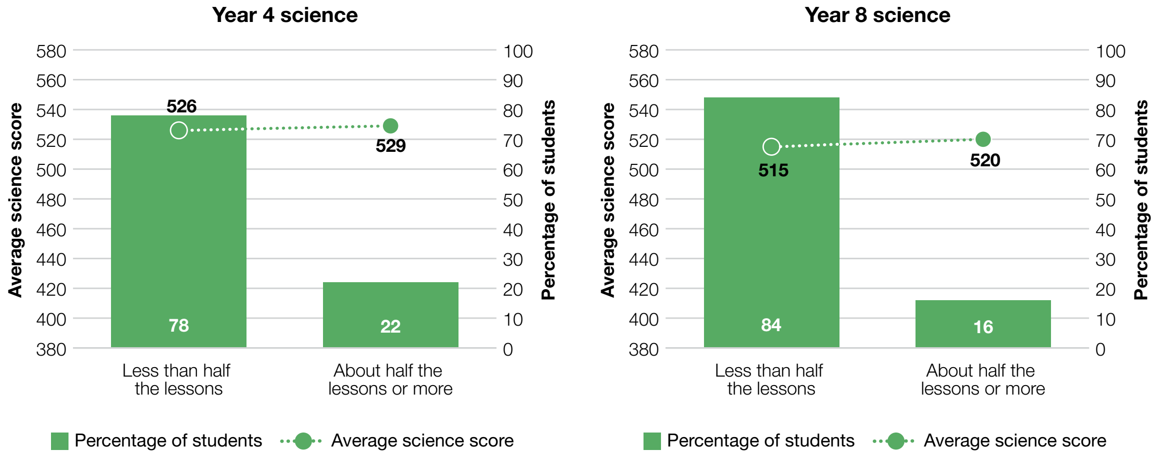


FIGURE 7.15 The Emphasise Science Investigation scale and Australian student achievement in science

At Year 4, 22 per cent of students were taught science by a teacher who emphasised science investigation in *about half the lessons or more*, while 78 per cent were taught science by a teacher who emphasised science investigation in *less than half the lessons.* In comparison, internationally, on average, 27 per cent of students were taught science by a teacher who emphasised science investigation in *about half the lessons or more*, while 73 per cent were taught science by a teacher who emphasised science investigation in *less than half the lessons.*

At Year 8, 16 per cent of students were taught science by a teacher who emphasised science investigation in *about half the lessons or more*, while 84 per cent were taught science by a teacher who emphasised science investigation in *less than half the lessons.* In comparison, internationally, on average, 27 per cent of students were taught science by a teacher who emphasised science investigation in *about half the lessons or more*, while 73 per cent were taught science by a teacher who emphasised science investigation in *less than half the lessons*.

There was no relationship between the degree to which science teachers emphasised science investigation and average science achievement.

Resources for conducting science investigation

School principals were asked whether the school had a science laboratory that is available for use by Year 4 or Year 8 students, and whether teachers have assistance when students are conducting experiments.

Table 7.8 presents the percentages of Australian Year 4 and Year 8 students, along with average achievement in science, according to the availability of science resources in the school.

TABLE 7.8 Resources for conducting science experiments and Year 4 and Year 8 student achievement in science, Australia and the international average

	Schools have a science laboratory								Teachers have assistance when students are conducting experiments							
	Yes				No				Yes				No			
	Percentage of students		Science achievement		Percentage of students		Science achievement		Percentage of students		Science achievement		Percentage of students		Science achievement	
	% of students	SE	Mean	SE	% of students	SE	Mean	SE	% of students	SE	Mean	SE	% of students	SE	Mean	SE
	Year 4															
Australia	13	2.1	521	5.2	87	2.1	524	3.4	13	2.1	529	6.0	87	2.1	523	3.4
International average	38	0.4	511	1.4	62	0.4	504	0.7	32	0.5	507	1.2	68	0.5	507	0.7
	Year 8															
Australia	99	0.9	514	2.9	1	0.9	~	~	69	3.7	515	3.6	31	3.7	511	5.3
International average	85	0.4	489	0.7	15	0.4	450	2.0	58	0.5	489	1.1	42	0.5	481	1.5

At Year 4, only 13 per cent of Australian students attended a school with a science laboratory available for use by Year 4 students. Internationally, 38 per cent of students attended a school with a science laboratory available for use by Year 4 students. Similarly, only 13 per cent of Australian Year 4 students (32% of students internationally) attended a school providing assistance to teachers when students were conducting experiments.

At Year 8, 99 per cent of Australian students attended a school with a science laboratory available for use by Year 8 students. Internationally, 85 per cent of students attended a school with a science laboratory available for use by Year 8 students. However, only 69 per cent of Australian Year 8 students (58% of students internationally) attended a school providing assistance to teachers when students were conducting experiments.

In Australia, there were no differences in average science achievement according to resources available for conducting science experiments.

Computer activities in science

Teachers were asked about their use of computers while teaching science to the TIMSS students. Table 7.9 presents the percentages of students (for Australia and internationally) who had access to computers during science classes and the different types of activities for which computers were used, as reported by teachers.

TABLE 7.9 Computer activities during science lessons and Year 4 and Year 8 student achievement in science, Australia and the international average

	Computers available for students to use in science lessons						Percentage of students whose teachers have them use computers at least monthly									
	Percentage of students		Science achievement													
	Yes		Yes		No		To practise skills and procedures		To look up ideas and information		To do scientific procedures or experiments		To study natural phenomena through simulations		To process and analyse data*	
	% of students	SE	Mean	SE	Mean	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4															
Australia	63	3.3	528	3.3	524	4.2	39	3.2	60	3.4	37	3.3	46	3.5	N/A	
International average	46	0.5	509	0.9	504	0.7	31	0.5	41	0.5	26	0.5	28	0.5	N/A	
	Year 8															
Australia	66	3.0	519	3.0	509	5.1	53	3.3	65	3.0	47	3.5	49	3.2	55	3.1
International average	42	0.5	493	1.0	483	0.8	30	0.5	37	0.5	28	0.5	29	0.5	29	0.5

*This activity was not included at Year 4.

At both Year 4 and Year 8, around 65 per cent of Australian students had computers available for use in science lessons. Internationally, 46 per cent of Year 4 students and 42 per cent of Year 8 students had computers available for use in science lessons. There were only small differences in average science achievement between Australian students who had access to computers during science lessons and those who did not. These differences were not statistically significant.

At Year 4, 60 per cent of Australian students were asked, by their science teacher, to use computers at least monthly to look up ideas and information, while 46 per cent were asked to study natural phenomena through simulations, 39 per cent were asked to practise skills and procedures, and 37 per cent were asked to do scientific procedures or experiments.

At Year 8, 65 per cent of Australian students were asked, by their science teacher, to use computers at least monthly to look up ideas and information, while 55 per cent were asked to process and analyse data, 53 per cent were asked to practise skills and procedures, 49 per cent were asked to study natural phenomena through simulations and 47 per cent were asked to do scientific procedures or experiments.

Use of the internet for schoolwork

The internet is becoming increasingly prominent as a teaching and learning tool. In TIMSS 2015, Year 8 students were asked about the types of tasks for which they used the internet when doing schoolwork. Figure 7.16 presents the percentages of Year 8 students according to how they used the internet for schoolwork. The figure shows Australian results and the international average.

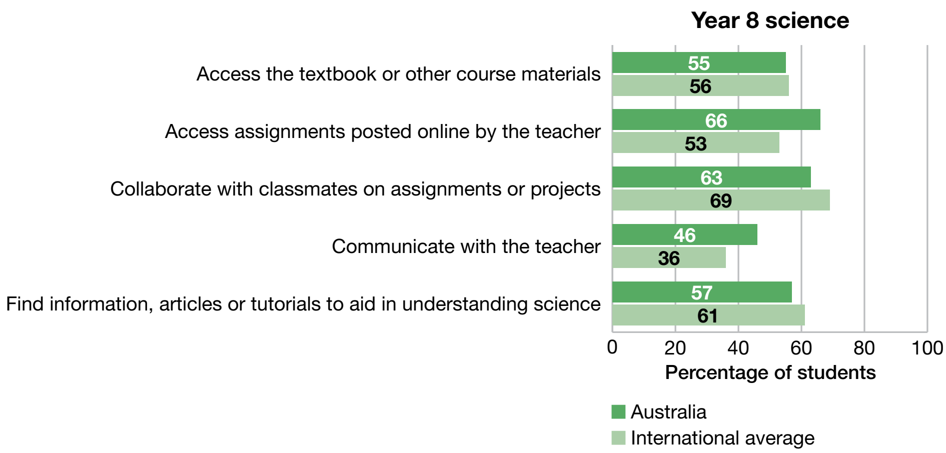


FIGURE 7.16 Percentages of Year 8 students by how they used the internet for science schoolwork, Australia and the international average

Figure 7.16 shows that percentages of Australian Year 8 students who used the internet to *access textbooks or other course materials* or to *find information, articles or tutorials to aid in understanding science* were fairly similar to those of the international average, around 55–57 per cent for both activities (56–61% internationally). However, Australian students were far more likely than students from other countries to use the internet to *access assignments posted online by the teacher* (66% compared to 53%) or to *communicate with the teacher* (46% compared to 36%). Australian Year 8 students were slightly less likely than students from other countries to use the internet to *collaborate with classmates on assignments or projects* (63% compared to 69%).

Time students spend on science homework

Students in Year 8 were asked how often their teacher gives them science homework and how much time they usually spend on it when it is given. Weekly time spent on science homework was then estimated by multiplying the frequency of assignment by the amount of time usually spent on science homework.

Figure 7.17 presents the percentages of Australian Year 8 students according to time spent on science homework per week and their average achievement in science.

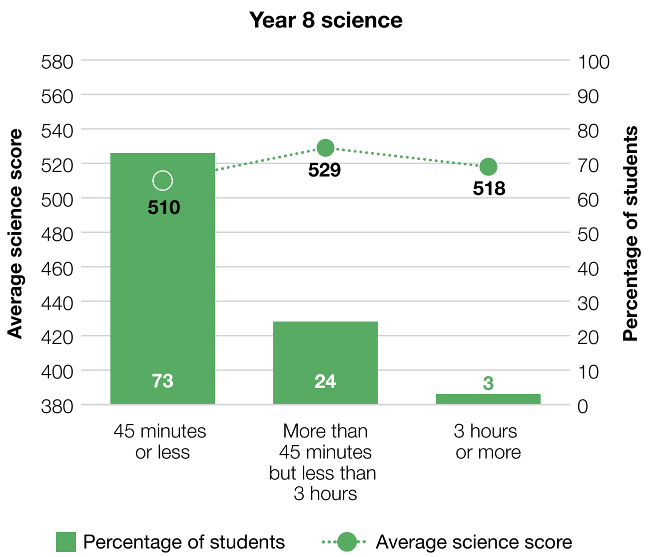


FIGURE 7.17 Time spent on science homework per week and Australian student achievement in science

Figure 7.17 shows that the majority (73%) of Australian Year 8 students spent *45 minutes or less* on science homework each week. Another 24 per cent spent *between 45 minutes and three hours* on science homework each week and three per cent spent *three hours or more* on science homework. Internationally, 67 per cent of Year 8 students spent *45 minutes or less* on science homework each week, 28 per cent spent *between 45 minutes and three hours* on science homework each week and five per cent spent *three hours or more* on science homework.

Figure 7.17 shows that Australian Year 8 students who spent *between 45 minutes and three hours* a week on science homework had higher average achievement (19 score points higher) than those students who spent *45 minutes or less* a week on science homework. However, spending over three hours a week on science homework did not provide an advantage, as students in this group had average science achievement that fell between those who spent *45 minutes or less* and those who spent *between 45 minutes and three hours* a week on science homework. The average score achieved by students who spent *three hours or more* a week on science homework was not significantly different to the average scores achieved by their peers in the two other groups.

Teaching limited by student needs

Teachers of the TIMSS classes were asked their opinion on the extent to which instruction at their school was limited ('limited a lot', 'some' or 'not at all') by the following six student needs:

- students lacking prerequisite knowledge or skills
- students suffering from lack of basic nutrition
- students suffering from not enough sleep
- disruptive students
- uninterested students
- students with mental, emotional or psychological disabilities.

Teachers' responses to these items were combined to create the Teaching Limited by Student Needs scale. Students were then assigned to groups based on their science teacher's scale score.

At Year 4, students with science teachers who felt *not limited* by student needs had a score on the scale of at least 11.0, which corresponds to their teachers feeling 'not at all' limited by three of the six needs and to 'some' extent limited by the other three needs, on average. Students with teachers who felt *very limited* by student needs had a score no higher than 6.9, which corresponds to their teachers reporting feeling limited 'a lot' by three of the six needs and to 'some' extent limited by the other three needs, on average. All other students had teachers who felt *somewhat limited* by student needs.

At Year 8, students with science teachers who felt *not limited* by student needs had a score on the scale of at least 11.4, which corresponds to their teachers feeling 'not at all' limited by three of the six needs and to 'some' extent limited by the other three needs, on average. Students with teachers who felt *very limited* by student needs had a score no higher than 7.4, which corresponds to their teachers reporting feeling limited 'a lot' by three of the six needs and to 'some' extent limited by the other three needs, on average. All other students had teachers who felt *somewhat limited* by student needs.

Figure 7.18 presents the percentages of Australian Year 4 and Year 8 students in each of these categories, along with their average achievement in science.

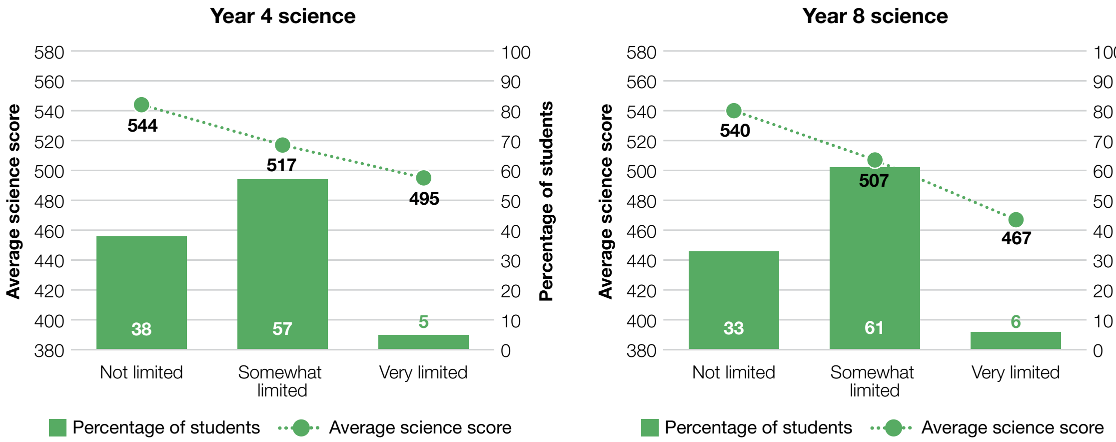


FIGURE 7.18 Teaching limited by student needs and Australian student achievement in science

At Year 4, 38 per cent of Australian students were taught science by teachers who reported that teaching was *not limited* by student needs; 57 per cent were taught science by teachers who reported that teaching was *somewhat limited*; and five per cent were taught science by teachers who reported that teaching was *very limited* by student needs. In comparison, internationally, on average, 37 per cent of students were taught science by teachers who reported that teaching was *not limited* by student needs; 56 per cent were taught science by teachers who reported that teaching was *somewhat limited*; and seven per cent were taught science by teachers who reported that teaching was *very limited* by student needs.

At Year 8, 33 per cent of Australian students were taught science by teachers who reported that teaching was *not limited* by student needs; 61 per cent were taught science by teachers who reported that teaching was *somewhat limited*; and six per cent were taught science by teachers who reported that teaching was *very limited* by student needs. In comparison, internationally, on average, 28 per cent of students were taught science by teachers who reported that teaching was *not limited* by student needs; 62 per cent were taught science by teachers who reported that teaching was *somewhat limited*; and 10 per cent were taught science by teachers who reported that teaching was *very limited* by student needs.

As can be seen in Figure 7.18, there was a clear relationship between the achievement of Australian students and teachers' reports that science teaching was limited by student needs – fewer limitations being associated with higher achievement. The relationship appears slightly stronger at Year 8 than at Year 4. At Year 4, Australian students who were taught science by teachers reporting that teaching was *not limited* by student needs scored 50 score points higher than those who were taught science by teachers reporting that teaching was *very limited* by student needs. In comparison, Australian Year 8 students who were taught science by teachers reporting that teaching was *not limited* by student needs scored over 70 score points higher than those who were taught science by teachers reporting that teaching was *very limited* by student needs. Internationally, on average, the gap was over 40 score points at Year 4 and over 55 score points at Year 8.

Frequency of student absences

Students were asked how often they were absent from school ('never or almost never', 'once a month', 'once every two weeks' or 'once a week or more').

Figure 7.19 presents the percentages of Australian Year 4 and Year 8 students according to how often they were absent from school, along with their average achievement in science.

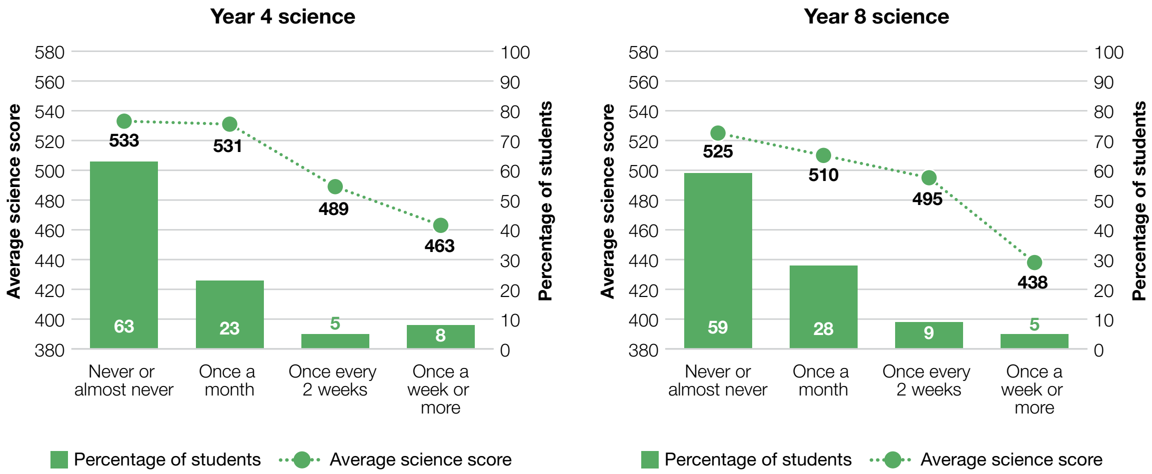


FIGURE 7.19 Frequency of student absences and Australian student achievement in science

Figure 7.19 shows that 63 per cent of Australian Year 4 students were *never or almost never* absent from school, 23 per cent were absent *once a month*, five per cent were absent *once every two weeks* and eight per cent were absent *once a week or more*. In comparison, internationally, 67 per cent of Year 4 students were *never or almost never* absent from school, 18 per cent were absent *once a month*, five per cent were absent *once every two weeks* and nine per cent were absent *once a week or more*.

At Year 8, 59 per cent of Australian students were *never or almost never* absent from school, 28 per cent were absent *once a month*, nine per cent were absent *once every two weeks* and five per cent were absent *once a week or more*. In comparison, internationally, 61 per cent of Year 8 students were *never or almost never* absent from school, 23 per cent were absent *once a month*, eight per cent were absent *once every two weeks* and eight per cent were absent *once a week or more*.

As can be seen in Figure 7.19, there was a clear relationship between the achievement of Australian students and the frequency of student absences – fewer absences being associated with higher achievement. The relationship appears slightly stronger at Year 8 than at Year 4. At Year 4, Australian students who were *never or almost never* absent scored 70 score points higher than those who were absent *once a week or more*. In comparison, Australian Year 8 students who were *never or almost never* absent scored over 85 score points higher than those who were absent *once a week or more.* Internationally, on average, the gap was 60 score points at Year 4 and 95 score points at Year 8.

Chapter 8

Students: Attitudes, engagement and aspirations

Key findings

- In general, students who indicated that they liked mathematics or science, were confident learning it, valued it and felt that they were taught in an engaging way scored higher on average in the assessments than students who did not.
- Australian students generally showed quite negative attitudes towards mathematics, particularly at Year 8. Attitudes towards science were slightly less negative.
- Twenty-seven per cent of Year 4 students in Australia and 50 per cent of Year 8 students reported that they *do not like learning mathematics*, while 12 per cent of Australian Year 4 students and 29 per cent of Year 8 students reported that they *do not like learning science*.
- Twenty-seven per cent of Year 4 students in Australia and 43 per cent of Year 8 students reported that they were *not confident in mathematics*, while 20 per cent of Australian Year 4 students and 45 per cent of Year 8 students reported that they were *not confident in science*.
- Australian Year 8 students tended to value mathematics, with close to 90 per cent valuing or strongly valuing mathematics (similar to the international average). However, levels of valuing science were low, with 68 per cent of Australian Year 8 students valuing or strongly valuing science, compared to the international average of 81 per cent.
- From Year 4 to Year 8 the proportion of students who thought that they were exposed to *very engaging teaching* in either subject declined substantially, from just over 60 per cent at Year 4 to around 35 per cent at Year 8.
- Males liked mathematics and science more than females, they were more confident learning these subjects, and valued them more. However, despite these differences, equal comparisons show that females on the same level of confidence, liking or valuing mathematics or science as males scored at the same level as their male peers.
- The differences between advantaged and disadvantaged students were quite stark. Disadvantaged students liked mathematics and science less, they were less confident and they valued mathematics and science to a lesser extent than did their advantaged peers.

Of concern is that – unlike the achievement parity noted in the analysis of sex differences – whether they liked a subject or not, were confident or not, valued it or not, disadvantaged students had average mathematics or science achievement that was substantially lower than that of advantage students.

- Disadvantaged students were also more likely to report lower levels of *very engaging teaching* in mathematics and science at Year 8 than were advantaged students. When they did experience *very engaging teaching*, both disadvantaged and advantaged students scored substantially higher than those students who faced *less than engaging teaching*; however, there is more of a booster effect for disadvantaged students at Year 8.
- Females held higher ambitions than males, with a greater percentage aiming for university study. Students from an advantaged background were far more likely than those from a disadvantaged background to aspire to university, with the majority of those from a disadvantaged background willing to settle for completion of secondary school.

Students' attitudes towards mathematics and science

Developing positive attitudes towards mathematics and science is an important goal of the curriculum in many countries. To summarise information about progress towards these goals, TIMSS examined students' general attitudes towards mathematics and science, and reports on the value that students place on mathematics and science as a way of improving their lives and their academic self-confidence.

As in the previous two chapters, results are presented in this chapter without standard errors. In Appendix D the same data are presented in tables that show the standard errors.

Students like learning mathematics

TIMSS 2015 collected data on how students feel about mathematics. Students were asked to indicate their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following nine statements:

- I enjoy learning mathematics.
- I wish I did not have to study mathematics (reverse scored).
- Mathematics is boring (reverse scored).
- I learn many interesting things in mathematics.
- I like mathematics.
- I like any schoolwork that involves numbers.
- I like to solve mathematics problems.
- I look forward to mathematics class.
- Mathematics is one of my favourite subjects.

Responses to these statements were combined to create the Students Like Learning Mathematics scale.

At Year 4, students who *very much like learning mathematics* had a score on the scale of at least 10.1, which corresponds to their 'agreeing a lot' with five of the items and 'agreeing a little' with the other four, on average. Students who *do not like learning mathematics* had a score that was no higher than 8.3, corresponding to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the remaining four, on average. All other students *like learning mathematics*.

At Year 8, students who *very much like learning mathematics* had a score on the scale of at least 11.4, which corresponds to their 'agreeing a lot' with five of the items and 'agreeing a little' with the other four, on average. Students who *do not like learning mathematics* had a score that was no higher than 9.4, corresponding to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the remaining four. All other students *like learning mathematics*.

Liking mathematics – Australia and internationally

At Year 4, Australian students had an average scale score of 9.5. This was significantly lower than the 2011 average score. Australian students were among the lowest scorers internationally on this index, showing quite low levels of liking learning mathematics.

Figure 8.1 shows the percentages of Year 4 and Year 8 students in each of the three categories described, and their associated scores in mathematics in each category. The positive relationship between liking mathematics and scoring well in it can clearly be seen for both Year 4 and Year 8 students. Unless otherwise noted in the text, Australian students performed at a level significantly higher than the international average in all achievement analyses undertaken for this chapter.

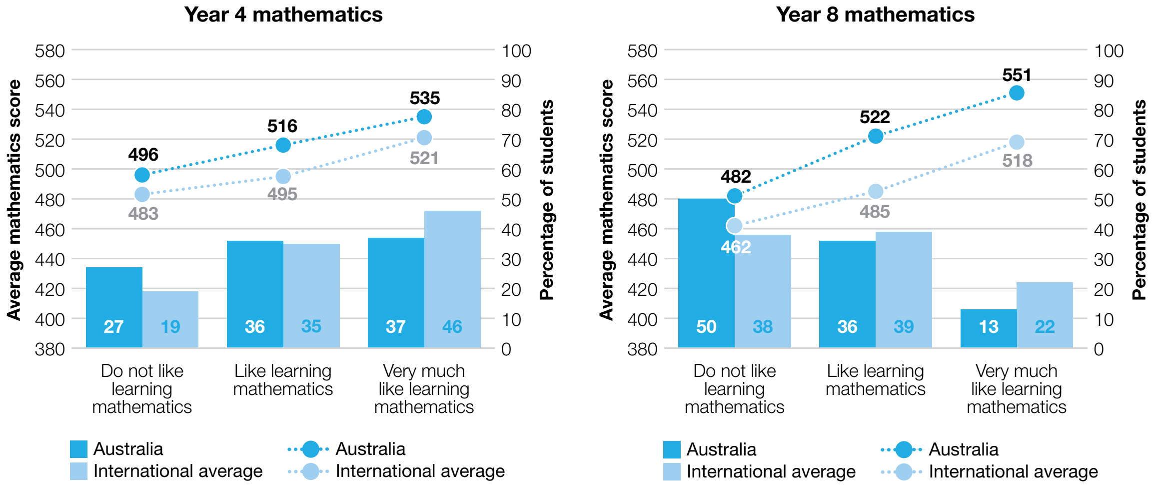


FIGURE 8.1 The Students Like Learning Mathematics scale and student achievement in mathematics, Australia and the international average

Year 4 students were mostly positive about learning mathematics, although not as positive as on average internationally. Thirty-seven per cent of Australian students reported that they *very much like learning mathematics*, and associated with this was a score of 535 score points. Internationally, a significantly higher 46 per cent of Year 4 students were placed in this category, and in Turkey, for comparison, 79 per cent of Year 4 students said that they *very much like learning mathematics*.

More than one-quarter of Australian Year 4 students, however, reported that they *do not like learning mathematics*, and this was significantly higher than the international average of 19 per cent of students.

Over the four years between Year 4 and Year 8, attitudes deteriorated. Australia's average index score at Year 8 was 9.4, which was not statistically different to the score in 2011. Again, most similar countries scored at about the same level as that of Australia, though Singaporean Year 8 students scored a significantly higher 10.1.

Just 13 per cent of Australian Year 8 students said that they *very much like learning mathematics*, with a further 36 per cent in the middle category and 50 per cent saying that they *do not like learning mathematics*. Internationally, 22 per cent of students *very much like learning mathematics* – in Singapore, 24 per cent of students fell into this category, and the highest proportion of students who *very much like learning mathematics* was in Botswana, a low-scoring country, which achieved 50 per cent.

Unfortunately, the stakes are somewhat higher for students at this year level, in that the relationship between liking mathematics and achievement is stronger. At Year 4, the correlation in Australia between liking mathematics and achievement was 0.19, while at Year 8 it was significantly higher at 0.34. Of course, the effect is likely to be reciprocal, in that the less a student enjoys doing mathematics, the less likely they are to put the time and energy into becoming better at it. Students who *very much like learning mathematics* scored, on average, 39 score points more at Year 4 and 69 score points more at Year 8 than those who *did not like learning mathematics*. This was the pattern in all countries.

In terms of the TIMSS benchmarks, students who *very much like learning mathematics* at Year 8 generally scored at the High international benchmark, while those who do not generally scored at the Intermediate international benchmark.

Liking mathematics – males and females

At both Year 4 and Year 8, males scored significantly higher on this index than females, indicating a stronger liking for mathematics. At Year 4, the average scale scores for males and females were 9.7 and 9.3, respectively. The score for males was not significantly different to that of 2011; however, the score for females declined significantly. At Year 8, the scores were 9.6 for males and 9.2 for females, neither of which were significantly different to those of 2011.

Figure 8.2 shows the proportions of male and female students liking mathematics at both TIMSS year levels, along with their associated achievement levels. The pattern for males and females in students' beliefs was the same in each year level, though much amplified at Year 8. At Year 4, 32 per cent of female students, compared to 43 per cent of male students, *very much like learning mathematics*. These proportions fell to just 11 per cent of female students and 16 per cent of male students in Year 8. At both year levels the differences between females and males were significant, and both declines were significant.

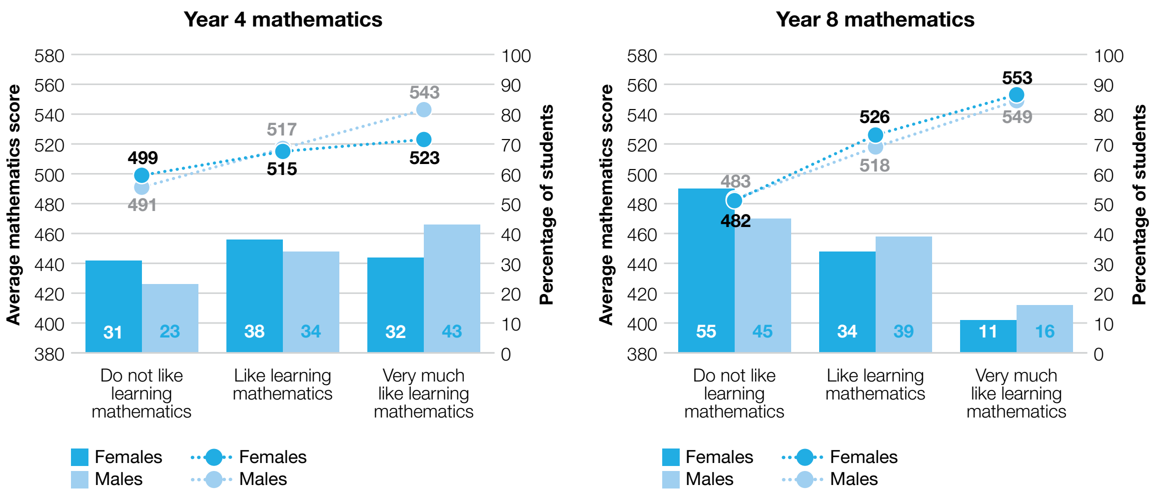


FIGURE 8.2 The Students Like Learning Mathematics scale and Australian student achievement in mathematics, by sex

Already at Year 4 level, 31 per cent of female students and 23 per cent of male students reported that they *do not like learning mathematics*. By Year 8, these proportions had increased to 55 per cent of female students and 45 per cent of male students.

In terms of achievement, a similar pattern was seen for males and females. For both, achievement was highest among those students with higher levels of liking mathematics, and this is more pronounced at Year 8. At Year 4, the difference in achievement between those who *very much like learning mathematics* and those who do not was 25 score points for females and 52 score points for males, and at Year 8 these proportions had increased to 71 score points for females and 66 score points for males. While the difference in achievement at Year 4 between male and female students who *very much like learning mathematics* was significant, it had disappeared at Year 8.

Liking mathematics – socioeconomic differences

In the case of Year 4 students in TIMSS, the proxy measure for socioeconomic background is books in the home, which is categorised as a *few books*, which would represent disadvantaged background, an *average number of books*, representing average socioeconomic background, and *many books*, representing an advantaged background. For Year 8 students, as has been described previously, more data could be collected from the older students and a more detailed scale developed. For the older students, the Home Educational Resources scale was used. This scale, as described in previous chapters, included parents' educational background and the presence of home study supports with books. The three categories used for these analyses were *few resources*, corresponding to disadvantaged background, *some resources*, corresponding to average socioeconomic background, and *many resources*, corresponding to an advantaged background. Past cycles of TIMSS have found achievement in mathematics and science to be strongly correlated with both books in the home and home education resources.

Figure 8.3 illustrates the differences by broad socioeconomic background.

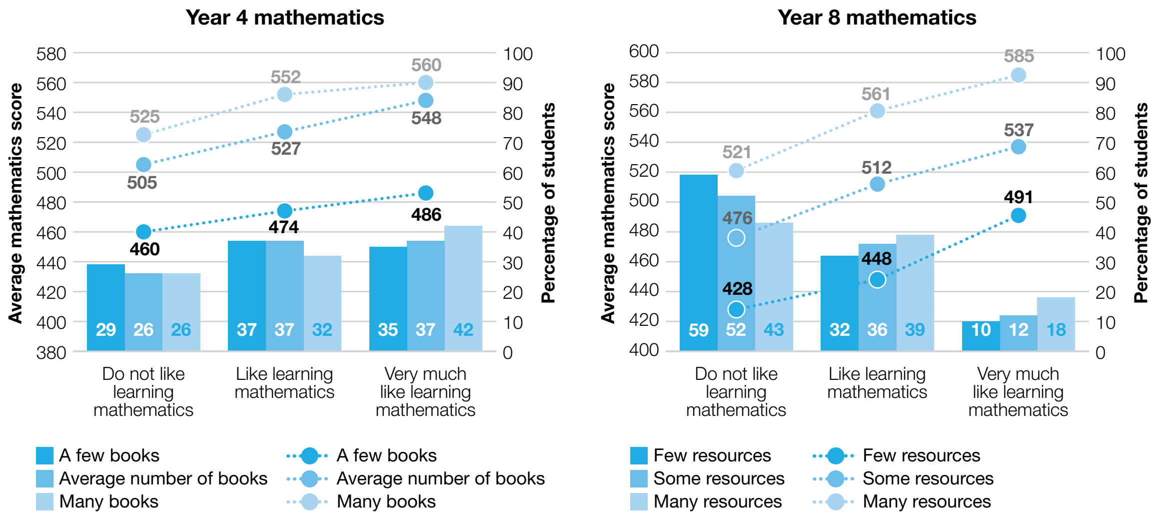


FIGURE 8.3 The Students Like Learning Mathematics scale and Australian student achievement in mathematics, by broad socioeconomic background

At Year 4, there was no difference by socioeconomic background in the proportions of students who reported that they *do not like learning mathematics* – 26 per cent of those in the highest group compared to 29 per cent in the lowest group. Indeed, there was little difference at the other end of the scale, with 35 per cent of those in the disadvantaged group and 42 per cent in the advantaged group reporting that they *very much like learning mathematics*. However, there were strong socioeconomic differences at Year 8, with the proportion of those who *do not like learning mathematics* rising to 59 per cent of students from a disadvantaged and 43 per cent of those from an advantaged background.

Large differences can be seen in the figures, particularly at Year 8 level. Unlike the male–female breakdown, where male and female students who like mathematics at the same level scored equally on the assessment, the socioeconomic data show that students from an advantaged background scored substantially higher than their peers from a disadvantaged background in every category of liking mathematics. At Year 8, the difference between advantaged and disadvantaged students who *very much like learning mathematics* was 94 score points, and for those who *do not like learning mathematics*, the difference was 93 score points.

For students from all socioeconomic backgrounds, there is a definite advantage in liking learning mathematics, particularly at Year 8 level. Those students in the highest level, at Year 4, who *very much like learning mathematics* achieved, on average, 34 score points higher, and at Year 8, 64 score points higher, than those who *do not like learning mathematics*. For disadvantaged students, the differences were 26 score points and 64 score points, respectively.

Students like learning science

As for mathematics, a Students Like Learning Science scale was created, based on students' level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following nine statements about science:

- I enjoy learning science.
- I wish I did not have to study science (reverse scored).
- Science is boring (reverse scored).
- I learn many interesting things in science.
- I like science.
- I like any schoolwork that involves numbers.
- I like to solve science problems.
- I look forward to science class.
- Science is one of my favourite subjects.

At Year 4, students who *very much like learning science* had a score on the scale of at least 9.6, which corresponds to their 'agreeing a lot' with five of the items and 'agreeing a little' with the other four, on average. Students who *do not like learning science* had a score that was no higher than 7.6, corresponding to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the remaining four, on average. All other students *like learning science*.

At Year 8, students who *very much like learning science* had a score on the scale of at least 10.7, which corresponds to their 'agreeing a lot' with five of the items and 'agreeing a little' with the other four, on average. Students who *do not like learning science* had a score that was no higher than 8.3, corresponding to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the remaining four, on average. All other students *like learning science*.

Liking science – Australia and internationally

At Year 4, Australian students had an average scale score of 10.0 in science, not significantly different to the average score in 2011. Many comparable countries such as New Zealand, Ireland, Germany, Canada and the United States, as well as high performers Singapore and Hong Kong, scored similarly to Australia, while the highest-scoring countries were generally lower performers such as Turkey and Portugal. At Year 8, Australian students had an average scale score of 9.6 – significantly higher than the score in 2011, but still one of the lowest scale scores internationally (similar to that for mathematics).

At Year 4, 54 per cent of students said that they *very much like learning science*, a proportion similar to that of the international average and to the 56 per cent of students in this category reported by Singapore. However, as with mathematics, this degree of liking science declined significantly over the subsequent four years, with a significantly lower 28 per cent of Australian students very much liking science at Year 8. The international average was 37 per cent, and Singapore had a similar proportion – 38 per cent – saying that they *very much like learning science* at Year 8. Botswana had the highest percentage (57%) of students in this category.

As can be seen in Figure 8.4, the patterns were similar to those of mathematics, although science does enjoy higher levels of liking at both Year 4 and Year 8.

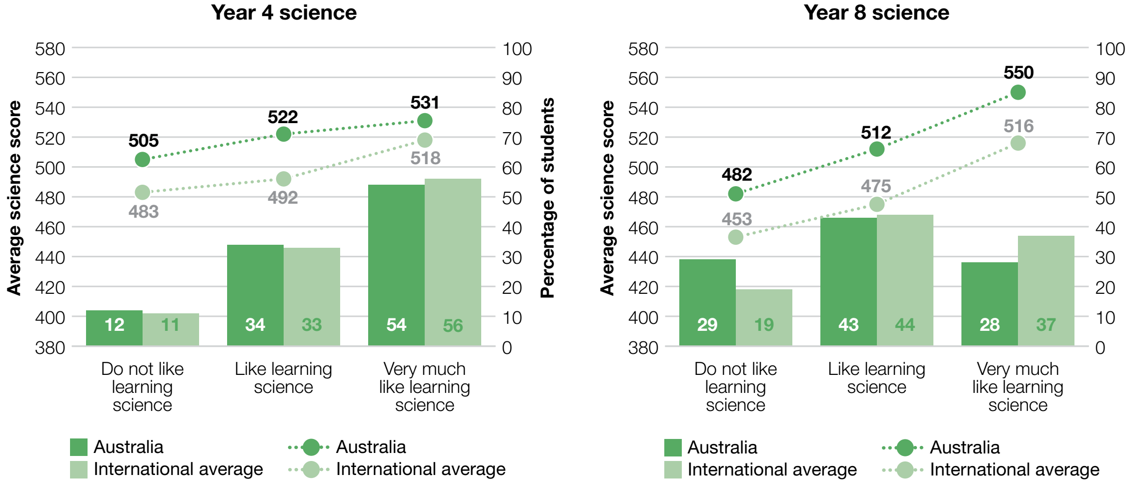


FIGURE 8.4 The Students Like Learning Science scale and student achievement in science, Australia and the international average

Only 12 per cent of Australian students at Year 4 level said that they *do not like learning science*, and while this proportion increased to 29 per cent of students at Year 8 it was much lower than the 50 per cent of Year 8 students who reported not liking learning mathematics. In Singapore, the 11 per cent who *do not like learning science* at Year 4 increased slightly to 15 per cent at Year 8.

While the correlation between achievement and liking science in Australia was quite weak at Year 4 (0.10) and the score difference between those who *very much like learning science* and those who don't was 26 score points, at Year 8 level it was moderate (0.34) and the score difference was 68 score points.

Liking science – males and females

At Year 4, there were no sex differences in liking science. Year 4 males scored an average 10.1 on the liking science index, while females scored 10.0. Neither were significantly different to the 2011 scores. At Year 8, males scored an average of 9.8, which was significantly higher than the 9.4 scored by females. While the scale score for both males and females had increased since 2011, the difference was significant only for males.

Figure 8.5 shows the proportions of male and female students liking science at both TIMSS year levels, along with their associated achievement levels. The sex pattern in students' beliefs was the same for each year level, though much exacerbated at Year 8. At Year 4, 53 per cent of female students and 55 per cent of male students *very much like learning science*, but these proportions fell to 24 per cent of female students and 31 per cent of male students in Year 8. At both year levels the declines were significant, and the difference in proportions at Year 8 was significant.

At Year 4 level, just 11 per cent of female students and 13 per cent of male students said that they *do not like learning science*. By Year 8, these proportions had increased to 32 per cent of female students and 26 per cent of male students.

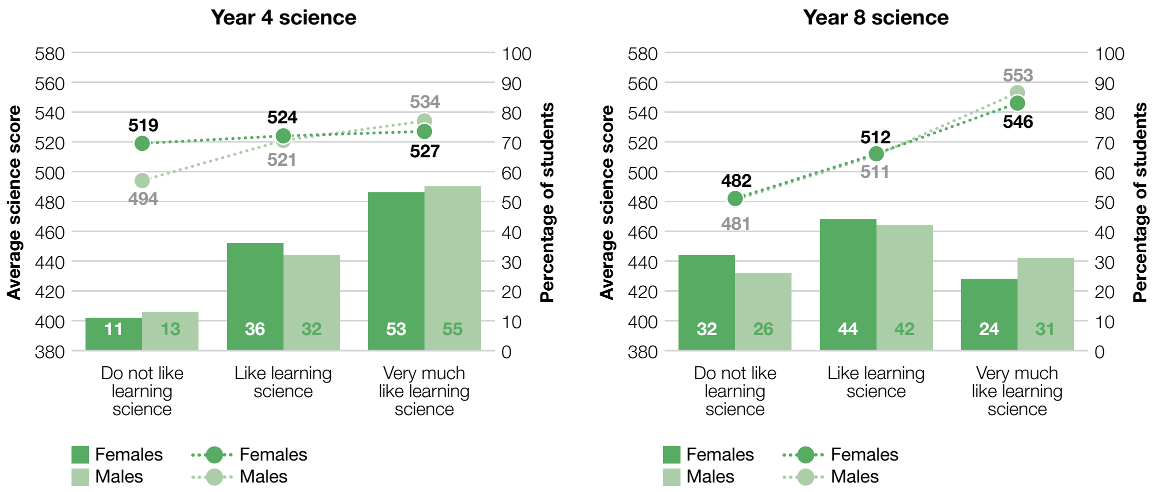


FIGURE 8.5 The Students Like Learning Science scale and Australian student achievement in science, by sex

In terms of achievement, a similar pattern was seen for males and females. For both, achievement was highest among those students who reported higher levels of liking science, and this was more pronounced at Year 8. At Year 4, the difference in achievement between those who *very much like learning science* and those who do not was only eight score points for females and 40 score points for males, and at Year 8 the difference had increased to 64 score points for females and 72 score points for males. The gap in achievement at Year 4 among those students who *do not like learning science* was not significant.

Liking science – socioeconomic differences

Figure 8.6 illustrates the differences in science achievement by broad socioeconomic background. As with mathematics, at Year 4 there was no difference in the proportions of students, by socioeconomic background, who reported that they *do not like learning science* – 12 per cent of advantaged students compared to 14 per cent of disadvantaged students. Indeed, there was little difference at the other end of the scale, with 51 per cent of disadvantaged and 59 per cent of advantaged students reporting that they *very much like learning science*. However, there were strong socioeconomic differences at Year 8, with the proportion not liking science rising to 39 per cent of students from a disadvantaged and 21 per cent from an advantaged background.

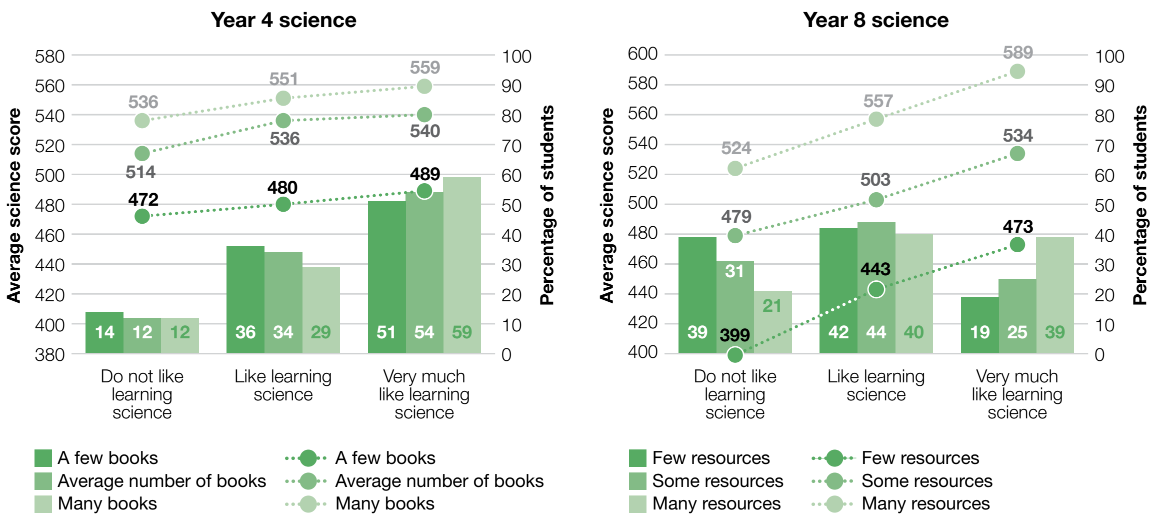


FIGURE 8.6 The Students Like Learning Science scale and Australian student achievement in science, by broad socioeconomic background

Chapter 8

The differences in achievement at the same level of liking science between advantaged and disadvantaged students at Year 8 were 116 score points for students who *very much like learning science* and 125 score points for those who *do not like learning science*.

For students from all socioeconomic backgrounds, there is a definite advantage in liking learning science, particularly at Year 8 level. Advantaged students, at Year 4, who *very much like learning science* scored, on average, 23 score points higher, and at Year 8, 65 score points higher, than those who *do not like learning science*. For disadvantaged students, the differences were 17 score points and 73 score points, respectively.

Students' self-confidence in mathematics

TIMSS 2015 collected data on students' beliefs about their abilities in mathematics. Students were asked to indicate their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following nine statements:

- I usually do well in mathematics.
- Mathematics is harder [Year 8: more difficult] for me than for many of my classmates (reverse scored).
- I am just not good at mathematics [Year 4]/Mathematics is not one of my strengths [Year 8] (reverse scored).
- I learn things quickly in mathematics.
- Mathematics makes me nervous (reverse scored).
- I am good at working out difficult mathematics problems.
- My teacher tells me I am good at mathematics.
- Mathematics is harder for me than any other subject.
- Mathematics makes me confused (reverse scored).

Responses to these statements were combined to create the Students' Confidence in Mathematics scale.

At Year 4, students who were *very confident in mathematics* had a scale score of at least 10.6, which corresponds to their 'agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four, on average. Students who were *not confident in mathematics* scored no higher than 8.5 on the scale, which corresponds to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four, on average. All other students were classified as *confident in mathematics*.

At Year 8, students who were *very confident in mathematics* had a scale score of at least 12.1, which corresponds to their 'agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four, on average. Students who were *not confident in mathematics* scored no higher than 9.5 on the scale, which corresponds to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four, on average. All other students were classified as *confident in mathematics*.

Self-confidence in mathematics – Australia and internationally

At Year 4, Australian students had an average scale score of 9.7 on the confidence in mathematics scale. This score is significantly lower than the average score recorded in 2011, and indicates that Australian students were less confident in 2015 than in 2011. Students in a number of similar countries, such as the United States, Ireland and England, scored significantly higher than Australian Year 4 students, while students in Singapore scored significantly lower. Self-confidence is often found to be inversely related to achievement in many Asian countries.

Figure 8.7 shows the percentages of Year 4 and Year 8 students in each of the three categories of confidence, and their associated scores in mathematics in each category.

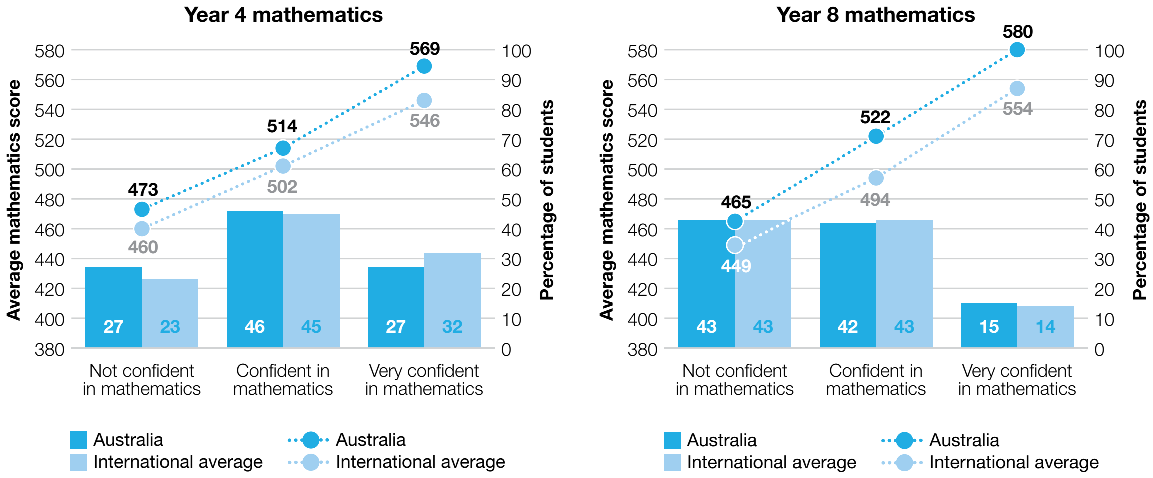


FIGURE 8.7 The Students' Confidence in Mathematics scale and student achievement in mathematics, Australia and the international average

Year 4 students were reasonably confident about learning mathematics, although not as confident as on average internationally. Twenty-seven per cent of Australian students reported that they were *very confident in mathematics*, and associated with this was a score of 569 score points. Internationally, a significantly higher 32 per cent of Year 4 students reported a high degree of confidence in mathematics, and in Serbia, the country with the highest proportion in this category, 45 per cent of Year 4 students said that they were *very confident in mathematics*.

More than one-quarter of Australian Year 4 students, however, reported that they were *not confident in mathematics*, and this was significantly higher than the international average of 23 per cent of students.

Over the four years between Year 4 and Year 8, confidence declined. Australia's average index score at Year 8 was 10.0, which was not statistically different to the score in 2011. Again, many similar countries scored at about the same level as that of Australia, though Singaporean Year 8 students scored a significantly lower 9.7.

Just 15 per cent of Australian Year 8 students said that they were *very confident in mathematics*, with a further 42 per cent in the middle category and 43 per cent reporting that they were *not confident in mathematics*. Internationally, 14 per cent of students were *very confident in mathematics* – in Singapore, 13 per cent of students reported being very confident, and the highest proportion of students in this category was in Canada, in which 26 per cent of Year 8 students were *very confident in mathematics*.

At both year levels, the relationship between self-confidence in mathematics and achievement was strong. At Year 4, the correlation in Australia between confidence in mathematics and achievement was 0.44, while at Year 8 it was significantly higher at 0.51. Of course, the effect is likely to be reciprocal, in that the more confident a student is of performing well in mathematics, the more likely they are to put the time and energy into practising it. Students who were *very confident in mathematics* scored, on average, 96 score points more at Year 4 and 115 score points more at Year 8 than those who were not. This was the pattern in all countries. In terms of the TIMSS benchmarks, Australian students who were *very confident in mathematics* at Year 8 generally scored at the top end of the High international benchmark, while those who reported a low degree of confidence generally scored at the Low international benchmark.

Self-confidence in mathematics – males and females

At both year levels, males were significantly more confident than females in mathematics. At Year 4, males scored an average 10.0 on the confidence in mathematics index, females 9.3, and at Year 8 males scored an average 10.4, females an average 9.6. The score for females at Year 4 and for both males and females at Year 8 declined significantly since 2011.

Figure 8.8 shows the percentages of students in each category of the Students' Confidence in Mathematics scale, and the average mathematics achievement of students at each level, for male and female Australian students.

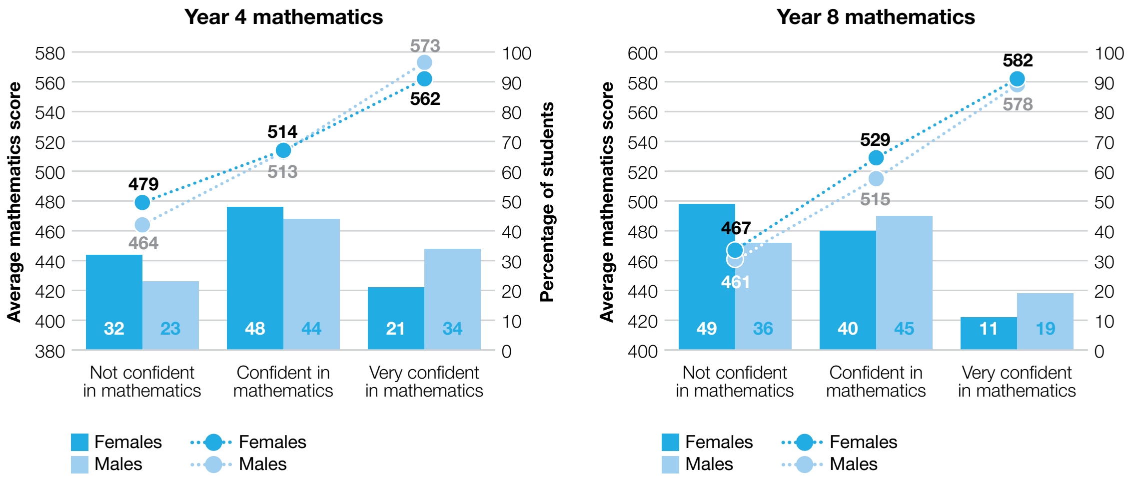


FIGURE 8.8 The Students' Confidence in Mathematics scale and Australian student achievement in mathematics, by sex

Across Year 4 and Year 8, there were substantial and significant differences in the level of confidence reported by male and female students. At Year 4, 21 per cent of females and 34 per cent of males reported that they were *very confident in mathematics*. At Year 8, these proportions dropped to just 11 per cent of females and 19 per cent of males. At the other end of the scale, 32 per cent of females and 23 per cent of males in Year 4 reported that they were *not confident in mathematics*, with the proportions rising to 49 per cent of females and 36 per cent of males at Year 8.

As has already been described, there is a strong benefit to being confident in mathematics – the scores for students who reported high levels of confidence were significantly higher than for those with moderate confidence, and the latter, in turn, scored significantly higher than their peers who reported low levels of confidence. What is positive is that at neither year level was there a difference in this relationship by sex. For all levels of confidence there were no sex differences in achievement.

Self-confidence in mathematics – socioeconomic differences

Figure 8.9 presents the differences in the proportions of students at the different confidence levels in mathematics, along with associated mathematics achievement by broad socioeconomic background.

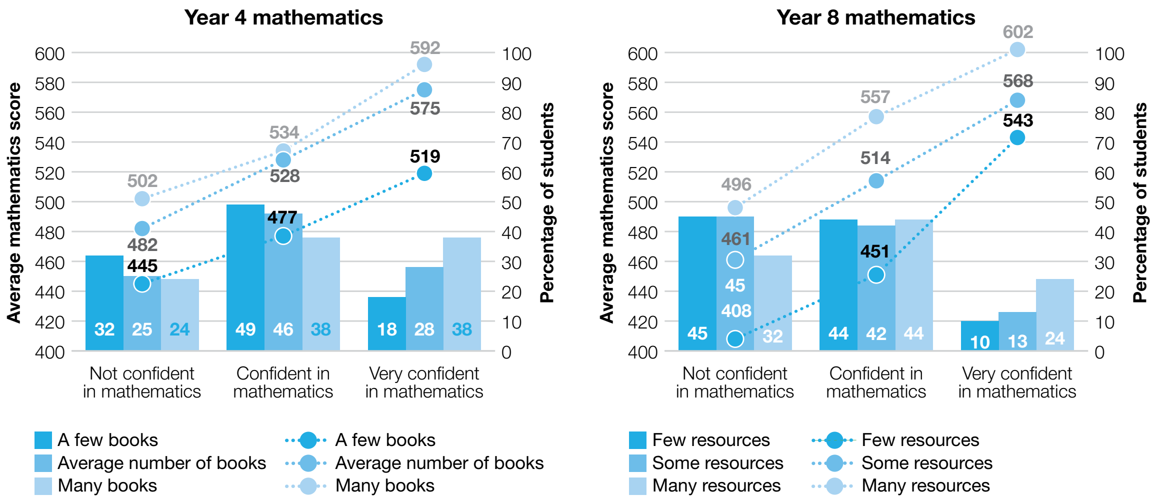


FIGURE 8.9 The Students' Confidence in Mathematics scale and Australian student achievement in mathematics, by broad socioeconomic background

At Year 4, students from a disadvantaged background exhibited the lowest levels of self-confidence in mathematics, with 32 per cent reporting that they were *not confident in mathematics*, compared to 25 per cent of students in the average socioeconomic background category and 24 per cent of those from an advantaged background. However, in Year 8, 45 per cent of those in the disadvantaged group, 45 per cent in the middle group and 32 per cent of advantaged students reported that they were *not confident in mathematics*.

The differences in achievement between socioeconomic groups are quite large. The difference in scores at Year 8 between disadvantaged and advantaged students was 87 score points for those students who were *very confident in mathematics* and 60 score points for those who were *not confident in mathematics*. All differences between disadvantaged and advantaged students were statistically significant.

As can be seen, for students from all socioeconomic backgrounds, those who show more confidence in mathematics tend to achieve at a higher level. Students from an advantaged background, at Year 4, who were *very confident in mathematics* scored, on average, 90 score points higher, and at Year 8, 107 score points higher, than those who were *not confident in mathematics*. For students at the lowest level of resources, the differences were 74 score points and 135 score points, respectively.

Students' self-confidence in science

As for mathematics, a Students' Confidence in Science scale was created, based on students' level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following statements about science:

- I usually do well in science.
- Science is harder [Year 8: more difficult] for me than for many of my classmates (reverse scored).
- I am just not good at science [Year 4]/Science is not one of my strengths [Year 8] (reverse scored).
- I am good at working out difficult science problems (Year 8 only).
- I learn things quickly in science.
- My teacher tells me I am good at science.
- Science is harder for me than any other subject.
- Science makes me confused (reverse scored).

At Year 4, students who were *very confident in science* had a scale score of at least 10.2, which corresponds to their 'agreeing a lot' with four of the statements and 'agreeing a little' with the other three, on average. Students who were *not confident in science* had a score no higher than 8.2, which corresponds to their 'disagreeing a little' with four of the seven statements and 'agreeing a little' with the remaining three, on average. All other students were assigned to the *confident in science* category.

At Year 8, students who were *very confident in science* had a scale score of at least 11.5, which corresponds to their 'agreeing a lot' with four of the eight statements and 'agreeing a little' with the other four, on average. Students who were *not confident in science* had a score no higher than 9.2, which corresponds to their 'disagreeing a little' with four of the eight statements and 'agreeing a little' with the remaining four. All other students were assigned to the *confident in science* category.

Self-confidence in science – Australia and internationally

At Year 4, Australian students had an average scale score of 9.7 on the self-confidence in science index, significantly lower than the average score in 2011, indicating that students assessed in 2015 were less confident in science than those assessed in 2011. Students in a number of similar countries, such as Ireland and England, scored significantly higher than Australian Year 4 students, while students in New Zealand and in Singapore scored significantly lower.

Figure 8.10 shows the percentages of Year 4 and Year 8 students in each of the three categories of confidence in science, and their associated scores in science in each category.

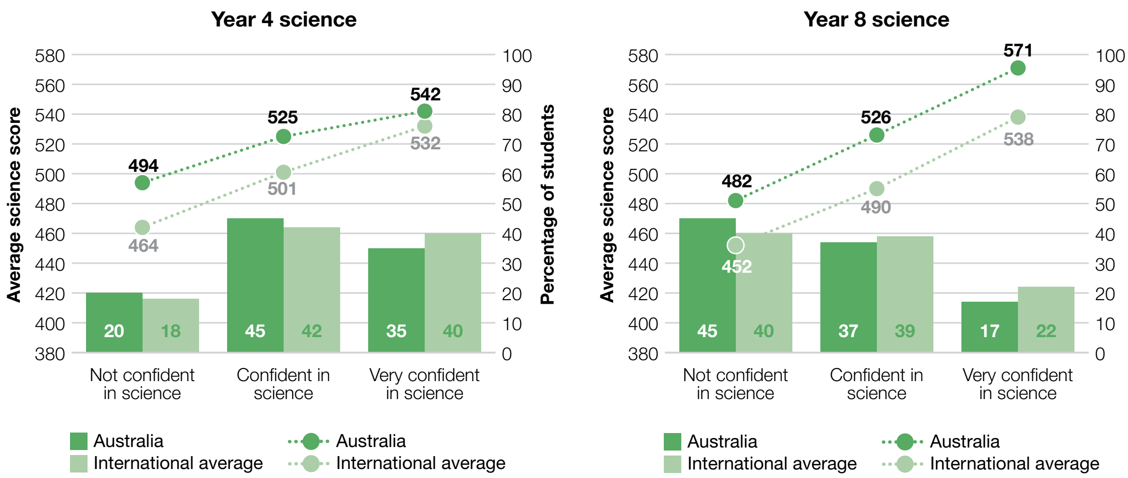


FIGURE 8.10 The Students' Confidence in Science scale and student achievement in science, Australia and the international average

Year 4 students were reasonably confident about learning science – more so than they were about learning mathematics – but, in line with their placement on the mathematics index, they were not as confident in science as on average internationally. Thirty-five per cent of Australian students reported that they were *very confident in science*, and associated with this was a score of 542 score points. Internationally, a significantly higher 40 per cent of Year 4 students were *very confident in science*, and in Turkey, the country with the highest proportion in this category, 61 per cent of Year 4 students reported being *very confident in science*.

Twenty per cent of Australian Year 4 students reported that they were *not confident in science*, and this was similar to the international average of 18 per cent of students.

Over the four years between Year 4 and Year 8, confidence declined. Australia's average index score at Year 8 was 9.7, which was not statistically different to the score in 2011. Again, many similar countries scored at about the same level as Australia's, and Singaporean Year 8 students also scored 9.7.

Just 17 per cent of Australian Year 8 students said that they were *very confident in science*, with a further 37 per cent in the middle category and 45 per cent reporting that they were *not confident in science*. Internationally, 22 per cent of students were *very confident in science*, and in Singapore this level of confidence was reported by 17 per cent of students. Kuwait had the highest proportion of Year 8 students in this category – 34 per cent said that they were *very confident in science*.

As was found for other variables, the relationship between self-confidence in science and achievement was stronger at Year 8 than at Year 4. At Year 4, the correlation in Australia between confidence in science and achievement was 0.20, while at Year 8 it was significantly higher at 0.39. Of course, the effect is likely to be reciprocal, in that the more confident a student is of performing well in science, the more likely they are to put the time and energy into practising it. Students who were *very confident in science* scored, on average, 48 score points more at Year 4 and 89 score points more at Year 8 than those who were not. This was the pattern in all countries. In terms of the TIMSS benchmarks, Australian students who were *very confident in science* at Year 8 generally scored at the High international benchmark, while those who were not generally scored at the Intermediate international benchmark.

Self-confidence in science – males and females

At Year 4, there were no sex differences in science confidence. At Year 8, however, males were significantly more confident in science than females. At Year 4, males scored an average 9.7 on the confidence in science index, females 9.6, and at Year 8 males scored an average 10.0, females an average 9.4. The scores for both males and females at Year 4 declined significantly since 2011.

Figure 8.11 shows the percentages of students in each category of the Students' Confidence in Science scale, and the average science achievement of students, at each level, for male and female Australian students.

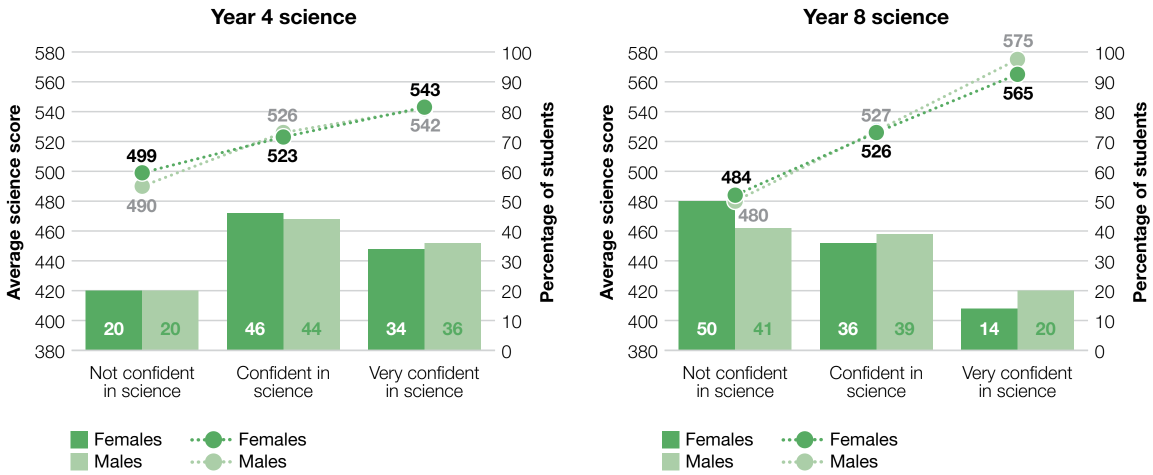


FIGURE 8.11 The Students' Confidence in Science scale and Australian student achievement in science, by sex

Across Year 4 and Year 8, there were substantial and significant differences in the level of confidence of male and female students. At Year 4, 34 per cent of females and 36 per cent of males reported that they were *very confident in science*. At Year 8, these proportions dropped to just 14 per cent of females and 20 per cent of males. At the other end of the scale, 20 per cent of females and 20 per cent of males in Year 4 reported being *not confident in science*, rising to 50 per cent of females and 41 per cent of males at Year 8.

The scores for students who reported high levels of confidence in science were significantly higher than for those with moderate confidence, and were significantly higher than for those who reported low levels of confidence. This was particularly the case at Year 8, where male and female students who were *very confident* achieved scores of 575 score points and 565 score points, respectively, compared to 480 score points and 484 score points for males and females, respectively, who were *not confident in science*. What is positive is that at neither year level was there a difference in this relationship by sex.

Self-confidence in science – socioeconomic differences

Figure 8.12 presents the differences in the proportions of students at the different confidence levels in science, along with associated science achievement by broad socioeconomic background.

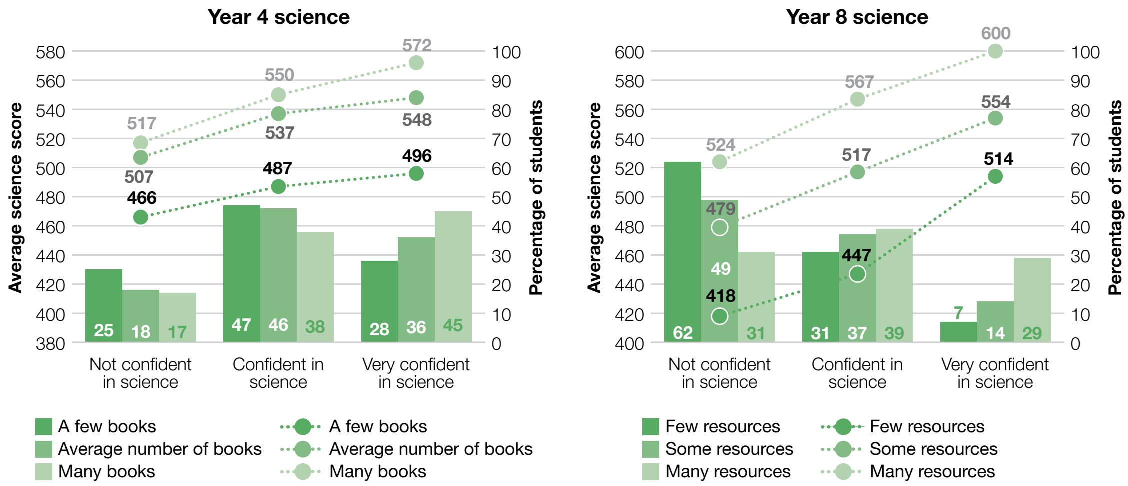


FIGURE 8.12 The Students' Confidence in Science scale and Australian student achievement in science, by broad socioeconomic background

At Year 4, there was not a lot of difference in the proportions of students not confident in science, when looked at by categories of socioeconomic background. Twenty-five per cent of those from a disadvantaged background, compared with 18 per cent of those in the middle and 17 per cent of advantaged students, said that they were *not confident in science*.

However, at Year 8, 62 per cent of disadvantaged students, compared with 49 per cent of those in the middle group and 31 per cent of advantaged students, reported that they were *not confident in science*.

The differences between socioeconomic groups were substantial. The difference in scores at Year 8 between disadvantaged and advantaged students was 85 score points for those students who were *very confident in science* and 106 score points for those who were *not confident in science*.

As can be seen, for students from all socioeconomic backgrounds, those who show more confidence in science tended to achieve at a higher level. Students from an advantaged background, at Year 4, who were *very confident in science* scored, on average, 55 score points higher, and at Year 8, 76 score points higher, than those who were *not confident in science*. For those at the lowest level of resources, the differences were 30 score points and 96 score points, respectively.

Students' valuing of mathematics

TIMSS 2015 collected data on the value that students attached to mathematics. Year 8 students were asked to indicate their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following nine statements:

- I think learning mathematics will help me in my daily life.
- I need mathematics to learn other school subjects.
- I need to do well in mathematics to get into the university of my choice.
- I need to do well in mathematics to get the job I want.
- I would like a job that involves using mathematics.
- It is important to learn about mathematics to get ahead in the world.
- Learning mathematics will give me more job opportunities when I am an adult.
- My parents think that it is important that I do well in mathematics.
- It is important to do well in mathematics.

Responses to these statements were combined to create the Students Value Mathematics scale.

Students who *strongly value mathematics* had a score on the scale of at least 10.3, which corresponds to their 'agreeing a lot' with five of the nine statements and 'agreeing a little' with the other four, on average. Students who *do not value mathematics*, in contrast, had a score no higher than 7.7, which corresponds to their 'disagreeing a little' with five of the statements and 'agreeing a little' with the other four, on average. All other students were assigned to the *value mathematics* group.

Valuing mathematics – Australia and internationally

Australian students had an average scale score of 9.9 on the students value mathematics index, placing them in the group that valued mathematics, but not highly. Students in a number of similar countries, such as Canada and England, scored significantly higher than Australian students; students in New Zealand and the United States scored about the same; and students in Singapore scored significantly lower.

Figure 8.13 shows the percentages of Year 8 students in each of the three categories of valuing mathematics, and their associated scores in mathematics in each category.

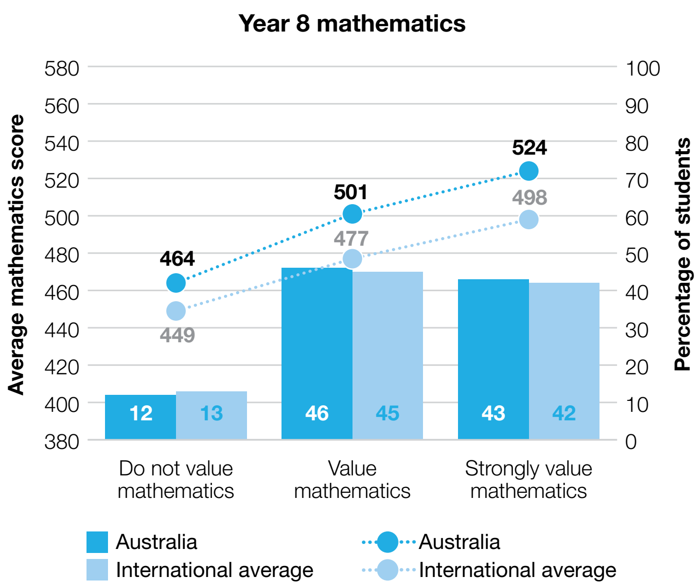


FIGURE 8.13 The Students Value Mathematics scale and student achievement in mathematics, Australia and the international average

The results of Australian students placed them very near the international average. Forty-three per cent of Australian students reported that they *strongly value mathematics*, and associated with this was a score of 524 score points. Internationally, 42 per cent of Year 8 students *strongly value mathematics*, and in South Africa, the country with the highest proportion in this category, 72 per cent of Year 8 students *strongly value mathematics*.

Just 12 per cent of Australian Year 8 students reported that they *do not value mathematics*, and this was similar to the international average of 13 per cent of students.

The relationship between valuing mathematics and achievement was moderate, at 0.23. Australian students who *strongly value mathematics* scored, on average, 60 score points higher than students who *do not value mathematics*.

Valuing mathematics – males and females

Australian males valued mathematics to a greater extent than females. The average scale score for males was 10.1 and for females 9.6. Neither score differed significantly from the 2011 results.

Figure 8.14 shows the percentages of Year 8 students in each category of the Students Value Mathematics scale, along with the average mathematics achievement of students at each level, for male and female Australian students.

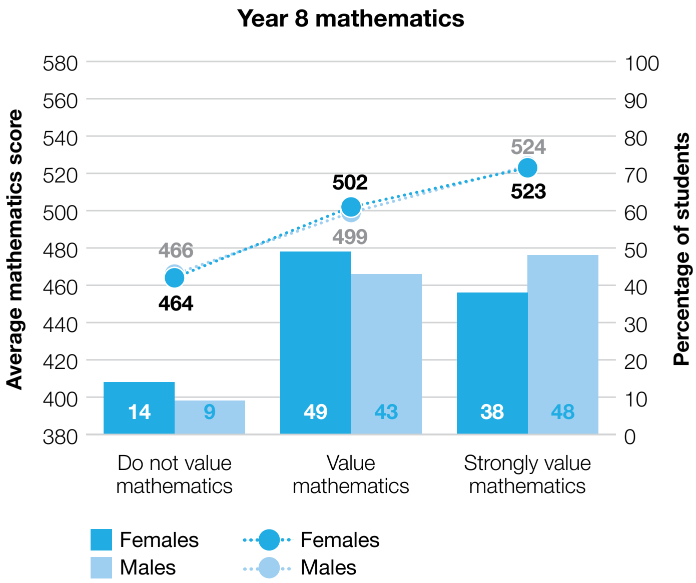


FIGURE 8.14 The Students Value Mathematics scale and Australian student achievement in mathematics, by sex

There are some fairly substantial and significant differences in the value assigned to mathematics by male and female students. Thirty-eight per cent of female students, compared to 48 per cent of male students, said that they *strongly value mathematics*, while 14 per cent of females and nine per cent of males reported that they *do not value mathematics*.

A similar relationship between valuing of mathematics and mathematics achievement is evident for males and females, with higher scores recorded by those who *strongly value mathematics* and lower scores recorded by those who *do not value mathematics*. There were no significant differences between the average scores of male and female students in each of the scale categories.

Valuing mathematics – socioeconomic differences

Figure 8.15 shows Year 8 students' levels of valuing of mathematics and associated mathematics achievement by broad socioeconomic background.

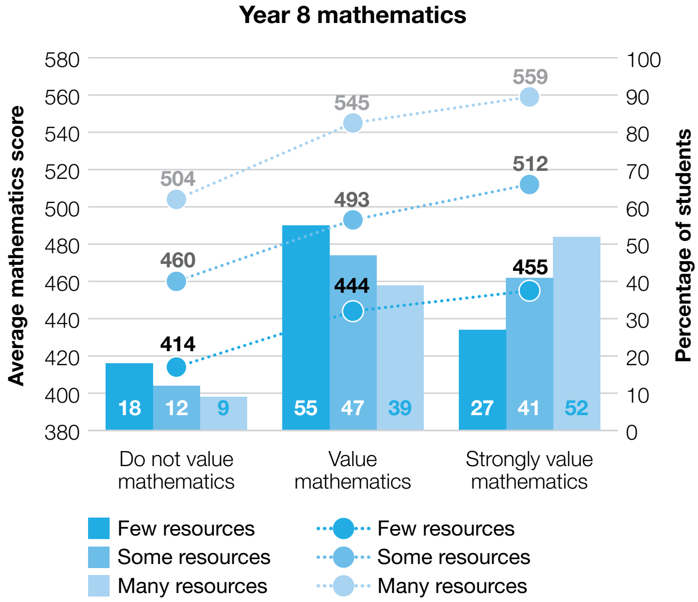


FIGURE 8.15 The Students Value Mathematics scale and Australian student achievement in mathematics, by broad socioeconomic background

Valuing of mathematics certainly seems to be associated with level of socioeconomic background – just 27 per cent of students from a disadvantaged background said that they *strongly value mathematics*, whereas 52 per cent of those from an advantaged background were assigned to this category. The reverse was also seen, with 18 per cent of students from a disadvantaged background – compared to nine per cent of advantaged students – reporting that they *do not value mathematics*.

The differences between socioeconomic groups are again substantial. The difference in scores at Year 8 between disadvantaged and advantaged students was 104 score points for those students who value mathematics to a high degree and 90 score points for those who assigned no value to this subject. All differences were statistically significant.

Students from the highest socioeconomic background who *strongly value mathematics* scored, on average, 55 score points higher than those who *do not value mathematics*. For those at the lowest level of resources, the difference was 41 score points.

Students' valuing of science

As for mathematics, the Students Value Science scale was created, based on students' level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with each of the following nine statements about science:

- I think learning science will help me in my daily life.
- I need science to learn other school subjects.
- I need to do well in science to get into the university of my choice.
- I need to do well in science to get the job I want.
- I would like a job that involves using science.
- It is important to learn about science to get ahead in the world.
- Learning science will give me more job opportunities when I am an adult.
- My parents think that it is important that I do well in science.
- It is important to do well in science.

For general or integrated science (as is taught in Australia), students who *strongly value science* had a score on the scale of at least 10.7, which corresponds to their 'agreeing a lot' with five of the nine statements and 'agreeing a little' with the remaining four, on average. Students who *do not value science* had a score no higher than 8.4, corresponding to their 'disagreeing a little' with five of the nine statements and 'agreeing a little' with the other four, on average. All other students were assigned to the *value science* category.

Valuing science – Australia and internationally

Australian students had an average scale score of 9.4 on the students value science index, significantly higher than the score in 2011, placing them in the group that valued science, but not highly. Students in a number of similar countries, such as Singapore, the United States, Canada, England and New Zealand scored significantly higher than Australian students. Australia was one of the lower-performing countries on this index.

Figure 8.16 shows the percentages of Year 8 students in each of the three categories of valuing science, and their associated scores in science in each category.

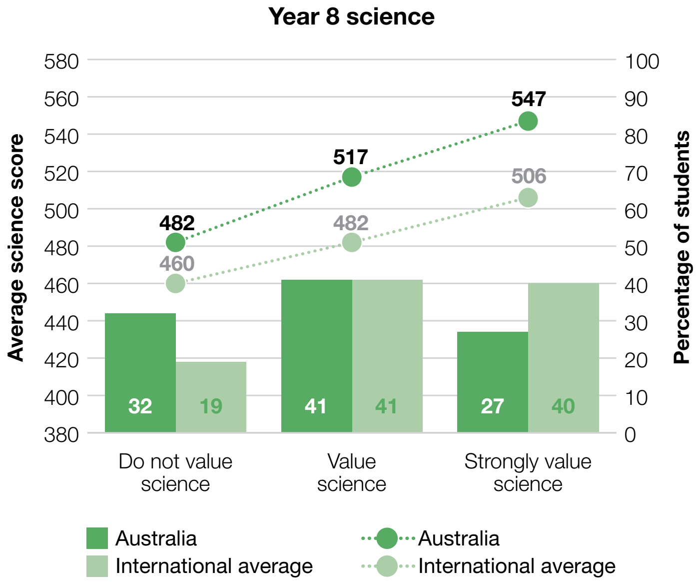


FIGURE 8.16 The Students Value Science scale and student achievement in science, Australia and the international average

Australian students were well below the average internationally, as is evident from the index score. Just 27 per cent of Australian students reported that they *strongly value science*, and associated with this was a score of 547 score points. Internationally, 40 per cent of Year 8 students *strongly value science*, and in Botswana, the country with the highest proportion in this category, 73 per cent of Year 8 students *strongly value science*.

Thirty-two per cent of Australian Year 8 students reported that they *do not value science*, a proportion significantly larger than the international average of 19 per cent of students.

The relationship between valuing science and achievement was moderate at 0.32, but this was stronger than the corresponding relationship for mathematics. Australian students who *strongly value science* scored, on average, 65 score points higher than students who *do not value science*.

Valuing science – males and females

Australian males valued science to a greater extent than females, with males scoring an average of 9.5 and females 9.3. These were both significantly higher than the scores in 2011.

Figure 8.17 shows the percentages of students in each category of the Students Value Science scale, and the average science achievement of students at each level, for male and female Australian students.

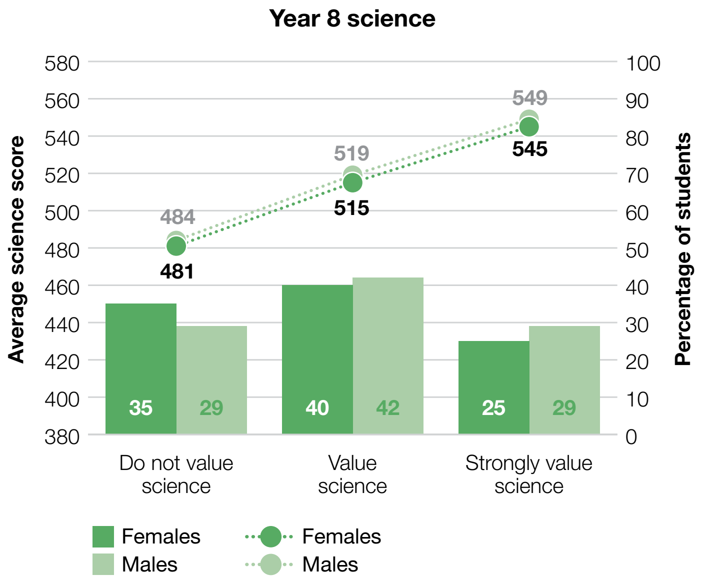


FIGURE 8.17 The Students Value Science scale and Australian student achievement in science, by sex

The sex differences in valuing of science were not of the same magnitude as those for mathematics. Unfortunately, however, this was because the levels of valuing science were much lower than the corresponding mathematics levels. Twenty-five per cent of female students and 29 per cent of male students said that they *strongly value science*, while 35 per cent of females and 29 per cent of males reported not valuing it at all.

A similar relationship between valuing of science and science achievement is evident for males and females, with higher scores recorded by those who *strongly value science* and the lowest by those who *do not value science*. There were no significant differences between the average scores of male and female students in each of the scale categories.

Valuing science – socioeconomic differences

Figure 8.18 shows the level of valuing of science and associated science achievement by broad socioeconomic background.

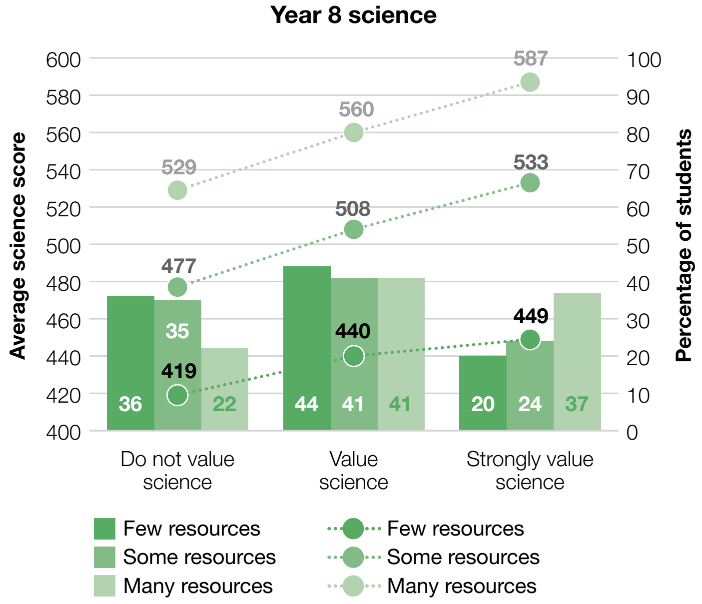


FIGURE 8.18 The Students Value Science scale and Australian student achievement in science, by broad socioeconomic background

Valuing of science certainly seems to be associated with level of socioeconomic background (though this association was more apparent for mathematics) – with just 20 per cent of students from a disadvantaged background compared to 37 per cent of those from an advantaged background strongly valuing science. The reverse was also seen, with 36 per cent of students from a disadvantaged compared to 22 per cent from an advantaged background reporting that they *do not value science*.

The differences between socioeconomic groups were very large. The difference in scores at Year 8 between disadvantaged and advantaged students was 138 score points for students who *strongly value science* and 110 score points for those who *do not value science*. All differences were statistically significant.

Students from an advantaged background who placed a strong value on science scored, on average, 58 score points higher than those who assigned no value to science. For disadvantaged students, the difference was 30 score points.

Students' views on engaging teaching

TIMSS 2015 also collected some data from students about how they perceived the teaching in their classrooms. Students are more likely to be engaged and interested in mathematics and science at school if they understand what is being asked of them, if they feel that the work is challenging and interesting, and if they hold the view that their teacher engages in good teaching practices.

Students' views on engaging teaching in mathematics lessons

The Students' Views on Engaging Teaching in Mathematics Lessons scale summarises students' responses to 10 statements designed to capture their views on whether they experienced engaging teaching in mathematics lessons. Students indicated their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') with the following statements about their mathematics lessons:

- I know what my teacher expects me to do.
- My teacher is easy to understand.
- I am interested in what my teacher says.
- My teacher gives me interesting things to do.
- My teacher has clear answers to my questions.

- My teacher is good at explaining mathematics.
- My teacher lets me show what I have learnt.
- My teacher does a variety of things to help us learn.
- My teacher tells me how to do better when I make a mistake.
- My teacher listens to what I have to say.

Student responses to these items were combined to create the scale, and students were assigned to one of three groups based on their scale score.

At Year 4, students who experienced *very engaging teaching* in mathematics lessons had a score of at least 9.0, which is the point on the scale corresponding to 'agreeing a lot' with five of the 10 statements and 'agreeing a little' with the remaining five, on average. Students who experienced *less than engaging teaching* in mathematics lessons had a score no higher than 7.0, which corresponds to their 'disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five, on average. All other students were assigned to the *engaging teaching* category.

At Year 8, students who considered themselves exposed to *very engaging teaching* in mathematics lessons had a score of at least 10.4, which is the point on the scale corresponding to 'agreeing a lot' with five of the 10 statements and 'agreeing a little' with the remaining five, on average. Students who experienced *less than engaging teaching* in mathematics lessons had a score no higher than 8.2, which corresponds to their 'disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five, on average. All other students were assigned to the *engaging teaching* category.

Engaging teaching in mathematics – Australia and internationally

At Year 4, Australian students had an average scale score of 9.7. At Year 8, the average scale score was 9.5. Many countries scored at a higher level than that of Australia – for example, Bulgaria scored 11.2 at Year 4 and Canada 10.2 at Year 8.

Figure 8.19 shows the percentages of Year 4 and Year 8 students in each of the three categories described, and their associated scores in mathematics in each category. The positive relationship between perceptions of engaging teaching and scoring well in mathematics can clearly be seen in this figure.

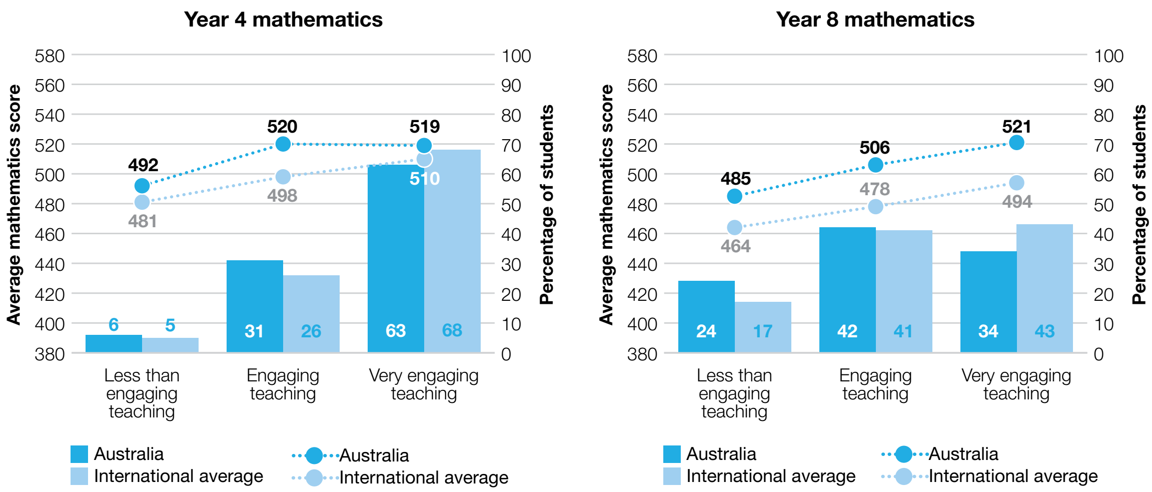


FIGURE 8.19 The Students' Views on Engaging Teaching in Mathematics Lessons scale and student achievement in mathematics, Australia and the international average

Year 4 students were mostly positive about their teaching in mathematics, although not as positive as on average internationally. Sixty-three per cent of Australian students reported that they experienced *very engaging teaching* in mathematics, and associated with this was a score of 519 score points.

Internationally, 68 per cent of Year 4 students reported *very engaging teaching* in mathematics, and in Portugal, for comparison, 88 per cent of Year 4 students reported *very engaging teaching* in mathematics.

Just six per cent of Australian Year 4 students reported *less than engaging teaching* in mathematics, and this was similar to the international average of five per cent of students.

In line with every student-attitude scale reported, over the four years between Year 4 and Year 8, Australian students' perceptions of the quality of teaching deteriorated.

Thirty-four per cent of Australian Year 8 students said that they experienced *very engaging teaching* in mathematics, with a further 42 per cent in the middle category and one-quarter saying that they had experienced *less than engaging teaching* in mathematics. Internationally, 43 per cent of students said that they experienced *very engaging teaching* in mathematics, rising to a maximum of 68 per cent in Jordan.

The relationship between perceptions of engaging teaching in mathematics and achievement is quite weak. At Year 4, the correlation in Australia was close to zero at 0.02, while at Year 8 it was higher at 0.17 but still weak. Students who found teaching to be *very engaging* in mathematics scored, on average, 27 score points more at Year 4 and 36 score points more at Year 8 than those who did not.

Engaging teaching in mathematics – males and females

There were no sex differences on this index at Year 4 or Year 8, indicating that perceptions of teaching in mathematics were the same for males and females.

Figure 8.20 shows the proportions of male and female students in each of the three categories described, along with their associated scores in mathematics in each category.

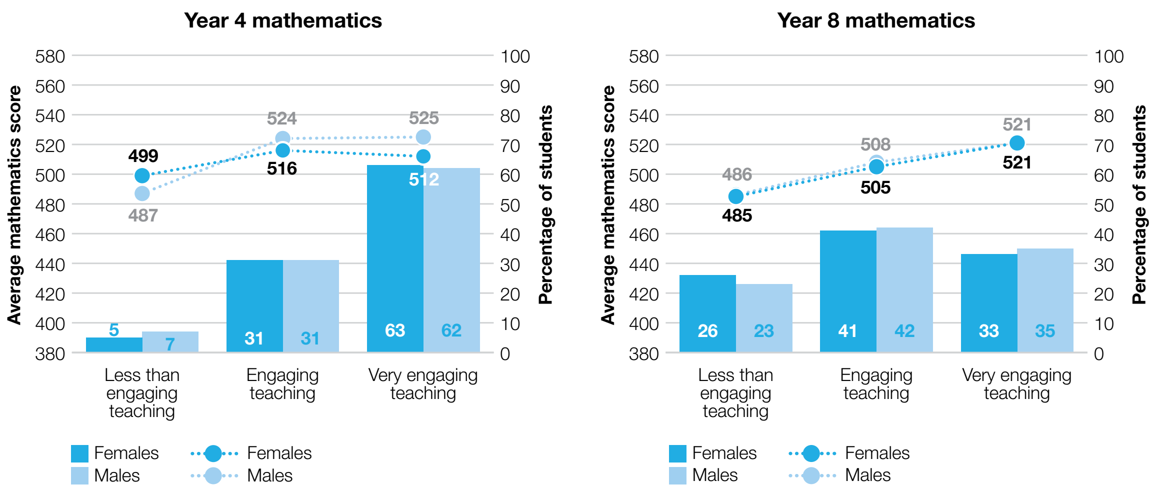


FIGURE 8.20 The Students' Views on Engaging Teaching in Mathematics Lessons scale and Australian student achievement in mathematics, by sex

The sex pattern in students' beliefs was the same for each year level. At Year 4, 63 per cent of female and 62 per cent of male students reported that they experienced *very engaging teaching* in mathematics. By Year 8, this proportion had fallen to 33 per cent of female students and 35 per cent of male students. Both declines were significant.

At Year 4, just five per cent of female students and seven per cent of male students said that they found lessons *less than engaging*, but by Year 8 these proportions had increased to 26 per cent of female students and 23 per cent of male students.

At Year 8, and for Year 4 males, achievement was highest among students who perceived themselves to be recipients of *very engaging teaching*. While for Year 4 females the difference in achievement was not significant, the gap between those who reported *very engaging teaching* and those who reported *less than engaging teaching* was 38 score points for Year 4 males, 36 score points for Year 8 females and 34 score points for Year 8 males.

Engaging teaching in mathematics – socioeconomic differences

Figure 8.21 illustrates the differences in perceptions of engaging teaching by broad socio-economic background.

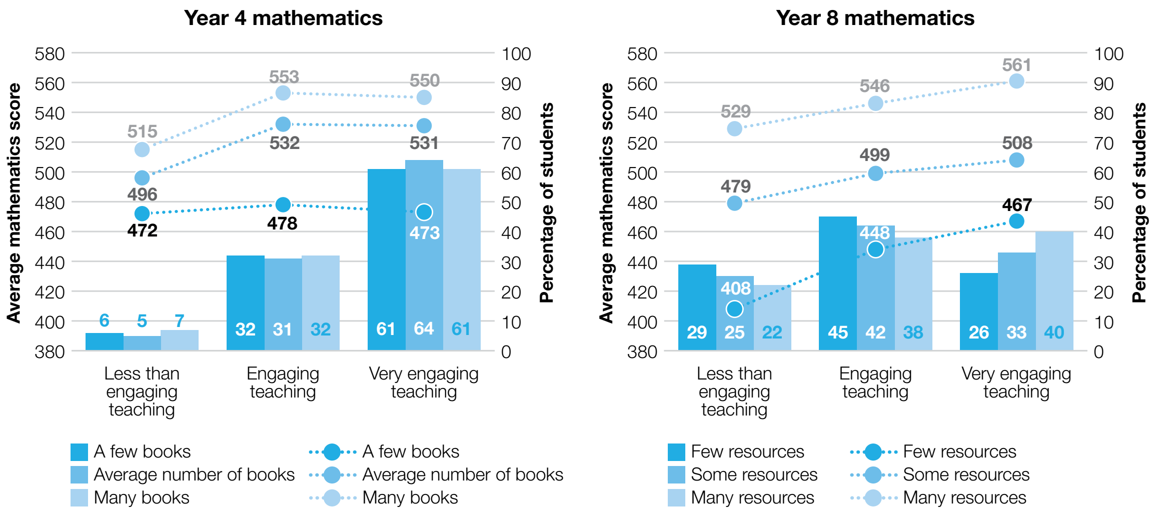


FIGURE 8.21 The Students' Views on Engaging Teaching in Mathematics Lessons scale and Australian student achievement in mathematics, by broad socioeconomic background

At Year 4, there were no differences in the proportions of students who reported *very engaging teaching* in mathematics by socioeconomic background – 61 per cent of students in both the highest group and the lowest group. Indeed, there was little difference at the other end of the scale, with six per cent of those in the lowest socioeconomic group and seven per cent of those in the highest reporting that they experienced *less than engaging teaching*.

However, there were strong socioeconomic differences at Year 8, with the proportions of students reporting *very engaging teaching* in mathematics falling to 26 per cent of students from a disadvantaged and 40 per cent from an advantaged background.

Once again, the differences between socioeconomic groups are substantial. The difference in scores at Year 8 between disadvantaged and advantaged students was 94 score points for those students who found mathematics teaching *very engaging* and 121 score points for those who did not. All differences between disadvantaged and advantaged students were statistically significant.

Advantaged students, at Year 4, who reported *very engaging teaching* in mathematics scored, on average, 34 score points higher, and at Year 8, 32 score points higher, than advantaged recipients of *less than engaging teaching* in mathematics. For disadvantaged students, the differences were one score point and 59 score points, respectively.

Students' views on engaging teaching in science lessons

The Students' Views on Engaging Teaching in Science Lessons scale summarises students' responses to 10 statements designed to capture their views on whether they experienced engaging teaching in science lessons. Students indicated their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') to the following statements about their science lessons:

- I know what my teacher expects me to do.
- My teacher is easy to understand.
- I am interested in what my teacher says.

- My teacher gives me interesting things to do.
- My teacher has clear answers to my questions.
- My teacher is good at explaining science.
- My teacher lets me show what I have learnt.
- My teacher does a variety of things to help us learn.
- My teacher tells me how to do better when I make a mistake.
- My teacher listens to what I have to say.

At Year 4, students who experienced *very engaging teaching* in science lessons had a score of at least 9.0, which is the point on the scale corresponding to 'agreeing a lot' with five of the 10 statements and 'agreeing a little' with the remaining five, on average. Students who experienced *less than engaging teaching* in science lessons had a score no higher than 7.0, which corresponds to their 'disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five, on average. All other students were assigned to the *engaging teaching* category.

At Year 8, students who experienced *very engaging teaching* in science lessons had a score of at least 10.2, which is the point on the scale corresponding to 'agreeing a lot' with five of the 10 statements and 'agreeing a little' with the remaining five, on average. Students who experienced *less than engaging teaching* in science lessons had a score no higher than 8.1, which corresponds to their 'disagreeing a little' with five of the 10 statements and 'agreeing a little' with the other five, on average. All other students were assigned to the *engaging teaching* category.

Engaging teaching in science – Australia and internationally

At Year 4, Australian students had an average scale score of 9.7, and at Year 8 an average score of 9.6. Again, Australian students were among the lower scorers internationally on this index, reporting levels of engaging teaching in science that were lower than those indicated in many other countries.

Figure 8.22 shows the percentages of Year 4 and Year 8 students in each of the three categories described, and their associated scores in science in each category. There is a positive relationship between reporting *very engaging teaching* in science and achievement at Year 8; at Year 4, however, there appears to be no such relationship. Perhaps at Year 4 there is not enough discrimination between categories – a very large proportion of Year 4 students reported *very engaging teaching*.

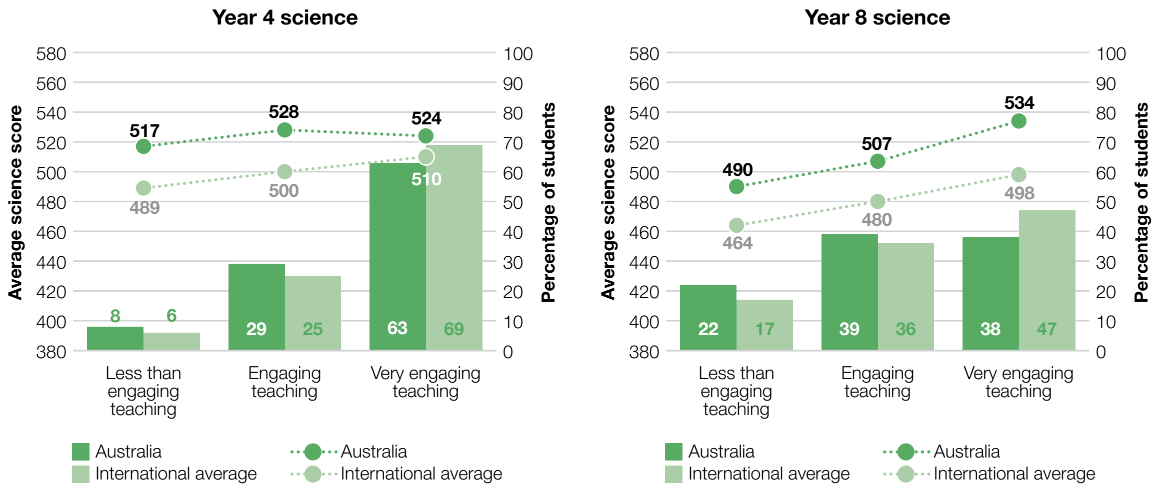


FIGURE 8.22 The Students' Views on Engaging Teaching in Science Lessons scale and student achievement in science, Australia and the international average

Year 4 students were mostly positive about learning science, although not as positive as on average internationally. Sixty-three per cent of Australian students reported that they experienced

Chapter 8

very engaging teaching in science, and associated with this was a score of 524 score points. Internationally, 69 per cent of Year 4 students reported *very engaging teaching* in science, and in Portugal, for comparison, 88 per cent of Year 4 students reported *very engaging teaching* in science, as in mathematics. Only eight per cent of Australian students reported *less than engaging teaching* in science, similar to the international average of six per cent.

At Year 8, Australia's average index score was 9.6. Many countries scored higher than this; Australian students' perceptions of the level of engagement with teaching in science were lower than in many other countries.

Thirty-eight per cent of Australian Year 8 students said that teaching in science was *very engaging*, with a further 39 per cent in the middle category and 22 per cent in the group whose science teaching was *less than engaging*. Internationally, 47 per cent of students found teaching in science *very engaging*, and the highest proportion of students in this category was in Jordan, a low-scoring country, which achieved 71 per cent.

As with mathematics, there was no relationship (a correlation of −0.02) between perceptions of engagement in the classroom and science achievement at Year 4 and a moderate correlation of 0.22 at Year 8. At Year 8, if not at Year 4, there was a positive relationship between perception and achievement – students who felt themselves to be the beneficiaries of *very engaging teaching* in science scored, on average, 44 score points more than students who experienced *less than engaging teaching*.

Engaging teaching in science – males and females

There were no sex differences in perceptions of engaging teaching in science at Year 4. However, at Year 8, males reported higher levels of engaging teaching in science than females, on average. At Year 4, both males and females scored an average 9.7 on the index, and at Year 8 males scored an average 9.7, females an average 9.5.

Figure 8.23 shows the proportions of male and female students in each of the three categories described, along with their associated scores in science in each category.

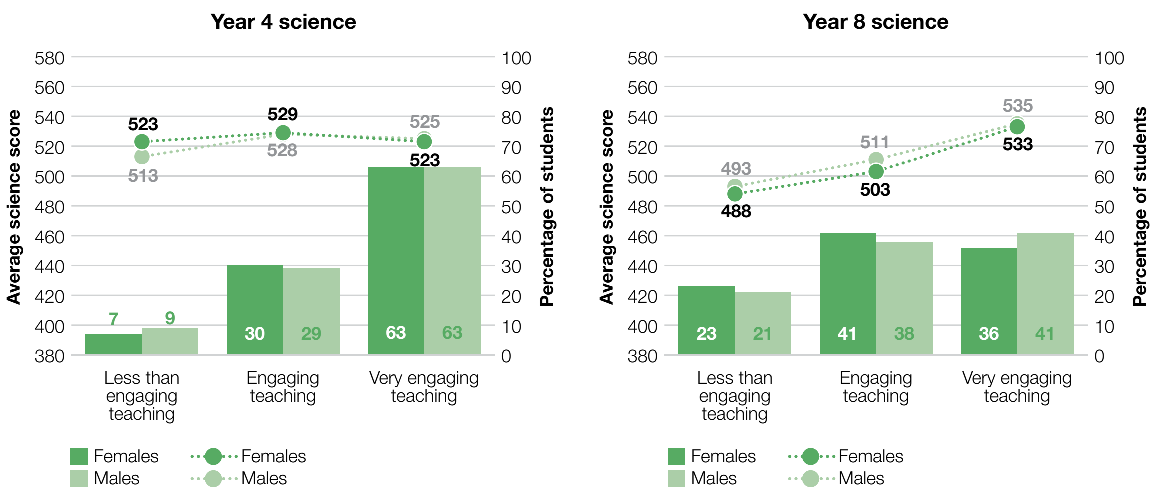


FIGURE 8.23 The Students' Views on Engaging Teaching in Science Lessons scale and Australian student achievement in science, by sex

The sex pattern in students' beliefs was the same for each year level, though more pronounced at Year 8. At Year 4, 63 per cent of both male and female students reported *very engaging teaching* in science – a proportion that fell to 36 per cent of female students and 41 per cent of male students in Year 8. At Year 4, just seven per cent of female students and nine per cent of male students reported *less than engaging teaching* in science. By Year 8, this had increased to 23 per cent of female students and 21 per cent of male students.

In terms of achievement, a similar pattern was seen for males and females, particularly at Year 8. For both sexes, those who reported *very engaging teaching* scored around 45 score points higher than those who reported *less than engaging teaching*. At Year 4, there were no significant differences in achievement across the groups.

Engaging teaching in science – socioeconomic differences

Figure 8.24 illustrates the differences in perceptions about engaging teaching in science by broad socioeconomic background.

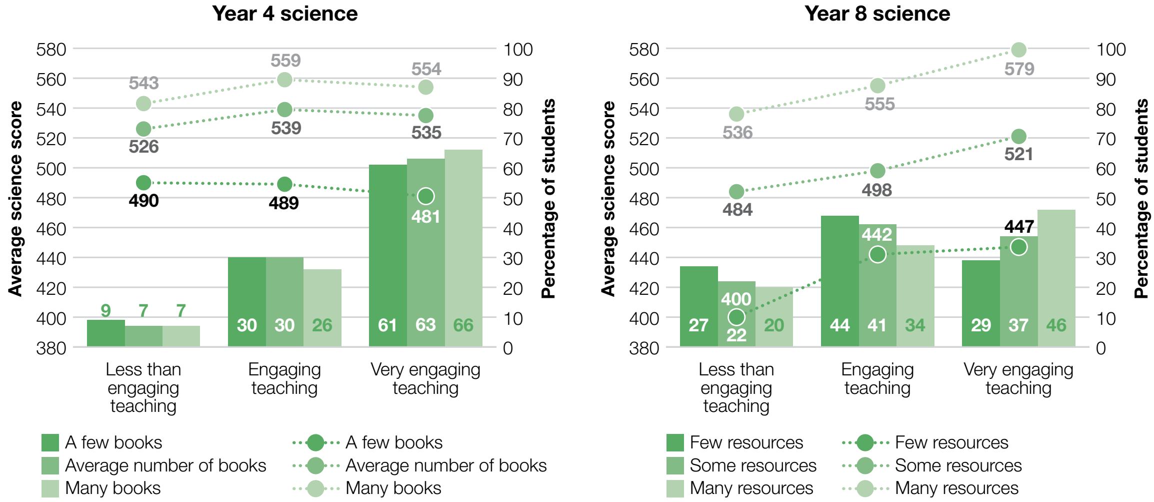


FIGURE 8.24 The Students' Views on Engaging Teaching in Science Lessons scale and Australian student achievement in science, by broad socioeconomic background

At Year 4, there were no differences in the proportions of students who reported *very engaging teaching* in science by socioeconomic background – 61 per cent of students in the lowest group and 66 per cent in the highest group. There was little difference at the other end of the scale, with nine per cent of those in the lowest socioeconomic group and seven per cent of those in the highest reporting that they experienced *less than engaging teaching*.

However, there were moderate socioeconomic differences at Year 8, with the proportion of students reporting *very engaging teaching* in science falling to 29 per cent of students from a disadvantaged and 46 per cent of students from an advantaged background.

The differences between socioeconomic groups are again substantial. The difference in scores at Year 8 between disadvantaged and advantaged students was 133 score points for those students who found science teaching to be *very engaging* and 136 score points for those who did not. All differences between disadvantaged and advantaged students were statistically significant.

At Year 8, students with the highest level of resources who reported *very engaging teaching* in science scored, on average, 43 score points higher than those who reported *less than engaging teaching*, while for students at the lowest level of resources, the difference was 47 score points. At Year 4, there were no significant differences in achievement across the groups.

Students' educational aspirations

Table 8.1 shows the percentage of Australian Year 8 students according to the highest education level that they thought they would achieve, as well as the average mathematics and science achievement for each response group.

Fifty per cent of Australian students expected to attend university. This is a substantial increase from 2011, when 34 per cent expressed the same expectation. Twenty per cent expected to earn a postgraduate qualification (including doctorate, master's or other postgraduate degree or diploma).

A further 25 per cent of students expected to gain some form of post-school qualification (such as an apprenticeship, traineeship or TAFE qualification), but not to attend university. This is significantly lower than the 30 per cent who expressed the same expectation in 2011.

Sex differences

There were substantial sex differences evident. Overall, female students were more ambitious than male students, with 57 per cent expecting to attend university compared to 43 per cent of males. The proportion of females expecting to gain an undergraduate degree was significantly higher than the proportion of males harbouring such ambitions.

More males than females expressed lower ambitions – gaining a TAFE or other post-secondary qualification, or simply completing secondary school.

Socioeconomic differences

The differences by socioeconomic background are interesting. Seventy-five per cent of students from an advantaged background expected to attend university, compared to 28 per cent of those from a disadvantaged background. On the other hand, 52 per cent of disadvantaged students planned simply to complete upper secondary school, or less, and 20 per cent considered TAFE or other post-secondary courses – in comparison, 10 per cent of students from an advantaged background intended only to complete secondary school and 15 per cent considered TAFE.

TABLE 8.1 Australian Year 8 students' educational aspirations and achievement in mathematics and science

	Postgraduate degree						University but not postgraduate degree						Post-secondary but not university						Upper secondary education or less					
	% of students	SE	Average mathematics achievement		Average science achievement		% of students	SE	Average mathematics achievement		Average science achievement		% of students	SE	Average mathematics achievement		Average science achievement		% of students	SE	Average mathematics achievement		Average science achievement	
			Mean	SE	Mean	SE			Mean	SE	Mean	SE			Mean	SE	Mean	SE			Mean	SE	Mean	SE
Australia	20	0.8	555	4.2	558	3.4	30	0.9	536	2.9	541	2.8	25	0.9	492	2.4	502	2.4	25	0.8	454	4.1	463	3.8
Females	22	1.1	549	5.7	550	4.8	35	1.1	531	3.2	536	3.2	21	0.9	486	2.7	494	2.8	22	1.2	445	5.2	452	4.9
Males	18	1.0	563	5.5	568	4.8	25	1.2	542	4.0	550	3.8	30	1.3	497	3.3	508	3.2	27	1.1	461	4.2	471	4.0
Few resources	12	4.6	535	44.0	492	28.7	16	2.8	497	13.5	480	14.7	20	2.3	436	12.0	430	11.3	52	4.6	409	10.9	406	10.6
Some resources	16	0.8	540	5.4	540	4.6	28	0.9	526	3.0	530	2.8	29	1.0	492	2.6	500	2.4	28	0.9	455	3.8	464	3.6
Many resources	35	1.5	579	3.6	588	3.7	40	1.6	557	3.9	571	3.2	15	1.4	512	5.7	529	5.8	10	0.8	481	9.1	504	10.0

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Appendix

A

TIMSS methods and procedures

To assist readers to understand the scope and operations of TIMSS, a brief account of some of its procedures is provided in this appendix. A thorough account is available in *Methods and Procedures in TIMSS 2015* (http://timssandpirls.bc.edu/publications/timss/2015-methods.html). As most of the operational procedures have both international and national components, this appendix will provide details specific to Australia, where appropriate.

Operationalisation of TIMSS

Procedures for administering the test were determined by the TIMSS International Study Center so that data from all students from all schools in all countries could be considered equivalent. These were operationalised by National Centres in each country, such as ACER in Australia. School Coordinators, nominated by the principal of each participating school, assisted the National Centre with the management of TIMSS within the school, including administering the school and teacher questionnaires. The actual test and student questionnaires were administered by a Test Administrator, who, in most cases, was a teacher from the school. The Test Administrator followed strict guidelines and was required to complete a report about any situation that constituted a deviation from these guidelines. A National Quality Control Observer (employed by the National Centre) visited 10 per cent of schools to observe the test administration. An International Quality Control Observer (employed by the IEA) visited a further 15 schools at each year level as well as examining the operations of the National Centre.

Detailed information about the operations of TIMSS 2015 is available in *Methods and Procedures in TIMSS 2015* (http://timssandpirls.bc.edu/publications/timss/2015-methods.html).

Sampling

The TIMSS 2015 assessment was administered to carefully drawn random samples of students from the target population in each country. Because the accuracy of the TIMSS results depends on the quality of the national samples, the TIMSS sampling experts worked with participating countries on all phases of sampling to ensure efficient sampling design and implementation.

National Centre staff were trained in how to select the school and student samples, and in how to use the sampling software provided by the IEA Data Processing Center. Staff from Statistics Canada reviewed the national sampling plans, sampling data, sampling frames and sample selections. The sampling documentation was used by the TIMSS International Study Center (in consultation with Statistics Canada and the sampling referee) to evaluate the quality of the samples.

Internationally, the target populations of students are defined as follows:

- fourth grade: all students enrolled in the grade that represents four years of schooling counting from the first year of Level 1 of the International Standard Classification of Education (ISCED), providing the mean age at the time of testing is at least 9.5 years
- eighth grade: all students enrolled in the grade that represents eight years of schooling counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 13.5 years.

All students enrolled in the target grade, regardless of their age, belong to the international target population and should be eligible to participate in TIMSS. Where the national target population differs from the international target population, this was annotated in the international reports. In Australia, the target populations are Year 4 students and Year 8 students.

Within the target population, countries could define a population that excluded a small percentage (no more than 5%) of certain kinds of schools or students that would be very difficult or resource intensive to test (e.g. schools for students with special needs or schools that were very small or located in remote rural areas). In Australia, school-level exclusions included very small schools (less than five students in the target year level), non-mainstream schools (such as schools for students with special needs) and very remote schools. Within-school exclusions consisted of students with intellectual disabilities, students with functional disabilities and non-native language speakers (with less than one year of exposure to English). Table A.1 provides the rates of exclusion in Australia.

TABLE A.1 Rates of exclusion from the Australian national target population for TIMSS 2015

	School-level exclusions	Within-school exclusions	Overall exclusions
Year 4	2.1%	2.1%	4.2%
Year 8	1.3%	2.2%	3.5%

The basic design of the sample used in TIMSS 2015 was a two-stage stratified cluster design. The first stage consisted of a sampling of schools, and the second stage of a sampling of intact classrooms from the target year level in the sampled schools. Schools were selected with probability proportional to size, and classrooms with equal probabilities. Most countries sampled 150 schools and one or two intact classrooms from each school. This approach was designed to yield a representative sample of at least 4500 students in each country. For information about this approach to sampling, please refer to Chapter 3 of *Methods and Procedures in TIMSS 2015* (http://timssandpirls.bc.edu/publications/timss/2015-methods/chapter-3.html).

In Australia, a larger sample of schools and students participated in TIMSS to produce reliable estimates representative of:

- **Each of the Australian jurisdictions**

  In order for comparisons to be made between jurisdictions, it was necessary to oversample the smaller jurisdictions, since a random sample proportionate to jurisdiction populations would not yield enough students in the smaller jurisdictions to give a result of sufficient precision.

- **Indigenous students**

  A sufficiently large sample of Australia's Indigenous students was required so that valid and reliable separate analyses could be conducted.

At the school level, in Australia, the planned sample was 290 schools at each year level. In order to produce the representative sample, this sample was stratified in the following manner:

- explicit stratification (where a separate sample was drawn for each stratum) – by jurisdiction
- implicit stratification (where the schools were sorted according to the stratification variables within each of the explicit strata) – by geographic location (metropolitan, provincial, remote), school type (Catholic, government, independent) and socioeconomic index (low socioeconomic status, high socioeconomic status).

Table A.2 shows the designed school sample and the distribution of schools across the jurisdictions. Following sampling, some schools were withdrawn from the sample, either because they were ineligible (lacking students from the target population) or because all of their students fell into an exclusion category. In addition, some schools were replaced – by schools that had been identified as suitable replacements during the sampling process – as they were unable to participate for reasons other than ineligibility or exclusion. Where a school was withdrawn too late for replacement, they were recorded as a 'refusal'. Table A.2 summarises these changes to the sample.

TABLE A.2 Allocation of school sample in Australia for TIMSS 2015

Jurisdiction	Total sampled schools	Ineligible schools	Participating schools			Refusal schools	Excluded schools
			Original schools	1st replacements	2nd replacements		
ACT	30	0	30	0	0	0	0
NSW	45	0	45	0	0	0	0
VIC	45	0	43	1	1	0	0
QLD	45	1	43	0	0	1	0
SA	40	0	39	0	0	1	0
WA	40	0	40	0	0	0	0
TAS	30	0	30	0	0	0	0
NT	15	0	15	0	0	0	0
Australia	*290*	*1*	*285*	*1*	*1*	*2*	*0*
Year 8							
ACT	30	2	28	0	0	0	0
NSW	45	0	45	0	0	0	0
VIC	45	0	45	0	0	0	0
QLD	45	0	44	0	0	1	0
SA	40	0	40	0	0	0	0
WA	40	0	40	0	0	0	0
TAS	30	0	30	0	0	0	0
NT	15	1	13	0	0	1	0
Australia	*290*	*3*	*285*	*0*	*0*	*2*	*0*

Following school sampling, class sampling was undertaken. The usual process was for each school to have only one mathematics classroom sampled. However, in cases where the classes were small (such as composite classes), at least two classes were sampled in order to allow the total number of students more closely to approximate the average class size. Where schools used streaming or tracking to allocate students to classes, two classes were sampled in order to balance out the academic abilities of selected students. In addition, in Australia, any student in the target year that identified as Indigenous was selected to participate in TIMSS 2015.

Within-school exclusions of students were allowed where disability or language barriers prevented the students' full participation in TIMSS 2015. These exclusions were either of full classes (where any such class comprised students with special needs) or of individual students within sampled classes.

Table A.3 shows the student sample sizes achieved, as well as the numbers of excluded, absent and withdrawn students (withdrawn students were students that had left the school between the sampling of the class and the assessment date).

TABLE A.3 Student sample sizes in Australia for TIMSS 2015

	Number of sampled students in participating schools	Number of students withdrawn from class/ school	Number of students excluded	Number of eligible students	Number of students absent	Number of students assessed
Year 4	6705	149	129	6427	370	6057
Year 8	11,968	312	88	11,568	1230	10,338

To ensure accurate and unbiased data, the TIMSS & PIRLS International Study Center set minimum participation rates of 85 per cent of sampled schools and 85 per cent of sampled students (or a combined school and student participation rate of 75%). Non-participating sampled schools could be replaced by replacement schools that had been matched according to strata and size. However, countries that achieved these requirements only by the use of replacement schools are annotated in the international reports. Countries with less than 50 per cent of sampled schools participating are segregated in the international reports. Table A.4 shows that Australia achieved the minimum participation rate for both Population 1 (Year 4) and Population 2 (Year 8).

TABLE A.4 TIMSS 2015 participation rates (weighted) for Australia

	School participation		Class participation	Student participation	Overall participation	
	Before replacement	After replacement			Before replacement	After replacement
Year 4	98%	99%	100%	95%	94%	94%
Year 8	99%	99%	99%	91%	90%	90%

The structure of the TIMSS assessment

TIMSS 2015 reports student outcomes by both major content domain and subdomain, as well as by cognitive domain. A consequence of these assessment goals is that there are many more questions on the assessment than can be answered by a student in the amount of testing time available. Accordingly, TIMSS 2015 uses a matrix-sampling approach that involves packaging the entire assessment pool of mathematics and science questions into a set of 14 student-achievement booklets, with each student completing just one booklet. Each question, or item, appears in two booklets, providing a mechanism for linking together the student responses from the various booklets. Booklets are distributed among students in participating classrooms so that the groups of students completing each booklet are approximately equivalent in terms of student ability. Using item response theory (IRT) scaling techniques, a comprehensive picture of the achievement of the entire student population is assembled from the combined responses of individual students to the booklets they are assigned. This approach reduces to manageable proportions what would otherwise be an impossible student burden (albeit at the cost of greater complexity in booklet assembly, data collection and data analysis).

To facilitate the process of creating the student achievement booklets, TIMSS groups the assessment items into a series of item blocks, with approximately 12 to 18 items in each block. TIMSS 2015 developed 28 blocks in total, 14 containing mathematics items and 14 containing science items. Student booklets were assembled from various combinations of these item blocks. Following the 2011 assessment, eight of the 14 mathematics blocks and eight of the 14 science blocks were secured for use in measuring trends in 2015. The remaining 12 blocks were released into the public domain for use in publications, research and teaching, to be replaced by newly developed items in the TIMSS 2015 assessment. Accordingly, the 28 blocks in the TIMSS 2015 assessment comprised 16 blocks of trend items (eight mathematics and eight science) and 12 blocks of new items developed for 2015.

In choosing how to distribute assessment blocks across student achievement booklets, the major goal was to maximise coverage of the framework while ensuring that every student responded to sufficient items to provide reliable measurement of trends in both mathematics and science. A further goal was to ensure that trends in the mathematics and science content areas could be measured reliably. To enable linking among booklets while keeping the number of booklets to a minimum, each block appeared in two booklets. Countries participating in TIMSS aim for a sample of at least 4500 students to ensure that there are enough respondents for each item. The 14 student booklets are distributed among the students in each sampled class according to a predetermined order, so that approximately equal proportions of students respond to each booklet.

Question types and scoring the responses

Students' knowledge and understanding of mathematics and science are assessed through a range of questions in each subject. Two question formats are used in the TIMSS assessment – multiple-choice and constructed-response. At least half of the total number of score points that can be accrued in the assessment will come from multiple-choice questions. Each multiple-choice question is worth one score point.

Multiple-choice questions

Multiple-choice questions provide four response options, of which only one is correct. These questions can be used to assess any of the behaviours in the cognitive domains. However, as they do not allow for students' explanations or supporting statements, multiple-choice questions may be less suitable for assessing students' ability to make more complex interpretations or evaluations.

It is important that linguistic features of the questions be developmentally appropriate. Therefore, the questions are written clearly and concisely. The response options are also written succinctly in order to minimise the reading load of each question. The options that are incorrect are written to be plausible, but are not intended to deceive. For students who may be unfamiliar with this test question format, the instructions given at the beginning of the test include a sample multiple-choice item that illustrates how to select and mark an answer.

Constructed-response questions

For this type of test item, students are required to construct a written response, rather than select a response from a set of options. Constructed-response questions are particularly well suited for assessing aspects of knowledge and skill that require students to explain phenomena or interpret data based on their background learning and experience.

Constructed-response questions require scoring by trained scorers. The scoring guide for each constructed-response question describes the essential features of appropriate and complete responses. The guides point to evidence of the type of behaviour that a given question is designed to assess. They describe evidence of partially correct and completely correct responses. In addition, sample student responses at each level of understanding provide important guidance to those who will be rating the students' responses. In scoring students' responses to constructed-response questions, the focus is solely on students' achievement with respect to the topic being assessed, not on their ability to write well. However, students need to communicate their response in a manner that will be clear to scorers.

For more information about the items and their development, please refer to Chapter 1 of *Methods and Procedures in TIMSS 2015* (http://timss.bc.edu/publications/timss/2015-methods/chapter-1.html).

Translation and adaptation of materials

Experts in translation procedures ensured that translated materials were as equivalent in meaning and level of complexity as possible. Translation of the assessment booklets, questionnaires and manuals involved development and implementation of extensive and rigorous processes. Materials from the TIMSS International Study Center were provided to countries in both English and Arabic. Countries whose principal language is neither English nor Arabic were required to translate the assessment materials. These translations were then reviewed for accuracy by a team of expert translators. For more information about the translation processes, please refer to Chapter 7 of *Methods and Procedures in TIMSS 2015* (http://timssandpirls.bc.edu/publications/timss/2015-methods/chapter-7.html).

In Australia, while a full translation was not necessary, adaptation of the materials from American English to Australian English was required and was undertaken in accordance with the TIMSS translation-verification process. The assessment materials, along with all questionnaires, manuals and items of documentation, were adapted to suit local linguistic usages and educational circumstances.

Trends in achievement by country

TABLE B.1 Mean scores for Year 4 mathematics achievement, 1995–2015, by country

	2015		2011		2007		2003		1995	
Country	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	517	3.1	516	3.0	516	3.5	499	3.9	495	3.5
Bahrain	451	1.6	436	3.2						
Belgium (Flemish)	546	2.1	549	1.9			551	1.8		
Chile	459	2.4	462	2.3						
Chinese Taipei	597	1.9	591	2.0	576	1.8	564	1.8		
Croatia	502	1.8	490	1.9						
Cyprus	523	2.7					510	2.4	475	3.2
Czech Republic	528	2.2	511	2.5	486	2.7			541	3.0
Denmark	539	2.7	537	2.6	523	2.5				
England	546	2.8	542	3.5	541	3.0	531	3.7	484	3.3
Finland	535	2.0	545	2.4						
Georgia	463	3.6	450	3.7	438	4.3				
Germany	522	2.0	528	2.2	525	2.1				
Hong Kong	615	2.9	602	3.4	607	3.5	575	3.1	557	4.0
Hungary	529	3.2	515	3.4	510	3.5	529	3.2	521	3.5
Iran	431	3.2	431	3.5	402	4.0	389	4.2	387	4.9
Ireland	547	2.1	527	2.6					523	3.5
Italy	507	2.6	508	2.6	507	3.1	503	3.7		
Japan	593	2.0	585	1.7	568	2.1	565	1.6	567	1.9
Kazakhstan	544	4.5	501	4.5						
Korea	608	2.2	605	1.9					581	1.8
Kuwait	327	3.2	342	3.6						
Lithuania	536	2.7	534	2.4	530	2.4	534	2.7		
Morocco	377	3.4	335	4.0						
Netherlands	530	1.7	540	1.6	535	2.1	540	2.2	549	3.0
New Zealand	491	2.3	486	2.6	492	2.4	493	2.2	469	4.4
Northern Ireland	570	2.9	562	2.8						
Norway (4)	493	2.3	495	2.8	473	2.6	451	2.2	476	3.0
Oman	425	2.5	385	2.9						
Portugal	541	2.2	532	3.3					442	4.0
Qatar	439	3.4	413	3.4						
Russian Federation	564	3.4	542	3.7	544	4.9	532	4.8		
Saudi Arabia	383	4.1	410	5.2						
Serbia	518	3.5	516	3.0						
Singapore	618	3.8	606	3.2	599	3.8	594	5.6	590	4.5
Slovak Republic	498	2.5	507	3.7	496	4.5				
Slovenia	520	1.9	513	2.1	502	1.8	479	2.5	462	3.2
Spain	505	2.5	482	2.8						
Sweden	519	2.8	504	2.1	503	2.6				
Turkey	483	3.1	469	4.7						
United Arab Emirates	452	2.4	434	2.0						
United States	539	2.3	541	1.9	529	2.5	518	2.4	518	2.9

Note: Trend results (including TIMSS 2015 in this table) for Kuwait do not include data about private schools. Trend results (including TIMSS 2015 in this table) for Lithuania do not include data about students taught in Polish or Russian. Since Bulgaria, Canada, France, Indonesia, Jordan, Poland and South Africa do not have trend results, they are not included in this table.

TABLE B.2 Mean scores for Year 8 mathematics achievement, 1995–2015, by country

	2015		2011		2007		2003		1999		1995	
Country	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	505	3.1	505	5.2	496	3.8	505	4.7			509	3.7
Bahrain	454	1.4	409	1.9	398	1.6	401	1.7				
Botswana (9)	391	2.0	397	2.5								
Chile	427	3.2	416	2.7			387	3.3	392	4.4		
Chinese Taipei	599	2.4	609	3.2	598	4.6	585	4.6	585	4.2		
Egypt	392	4.1			391	3.6	406	3.5				
England	518	4.2	507	5.6	513	4.9	498	4.6	496	4.2	498	3.0
Georgia	453	3.4	431	3.7	410	5.8						
Hong Kong	594	4.6	586	3.9	572	5.9	586	3.4	582	4.3	569	6.1
Hungary	514	3.8	505	3.5	517	3.5	529	3.3	532	3.6	527	3.2
Iran	436	4.6	415	4.3	403	4.1	411	2.4	422	3.4	418	3.9
Ireland	523	2.7									519	4.9
Israel	511	4.1	516	4.1								
Italy	494	2.5	498	2.3	480	3.1	484	3.2	479	3.9		
Japan	586	2.3	570	2.6	570	2.4	570	2.1	579	1.7	581	1.6
Jordan	386	3.2	406	3.9	427	4.2	424	4.1	428	3.7		
Kazakhstan	528	5.3	487	4.2								
Korea	606	2.6	613	2.9	597	2.6	589	2.2	587	2.0	581	2.0
Kuwait	375	3.5			354	2.4						
Lebanon	442	3.6	449	3.9	449	4.1	433	3.1				
Lithuania	512	2.9	502	2.5	506	2.5	502	2.5	482	4.3	472	4.1
Malaysia	465	3.6	440	5.5	474	5.1	508	4.1	519	4.5		
Malta	494	1.0			488	1.2						
Morocco	384	2.3	371	2.0								
New Zealand	493	3.4	488	5.4			494	5.5	491	5.3	501	4.7
Norway (8)	487	2.0	475	2.5	469	2.0	461	2.5			498	2.2
Oman	403	2.4	366	2.9	372	3.4						
Qatar	437	3.0	410	3.1								
Russian Federation	538	4.7	539	3.6	512	4.0	508	3.8	526	5.8	524	5.2
Saudi Arabia	368	4.6	394	4.7								
Singapore	621	3.2	611	3.8	593	3.8	605	3.6	604	6.3	609	4.0
Slovenia	516	2.1	505	2.2	501	2.2	493	2.2			494	2.9
South Africa (9)	372	4.5	352	2.5								
Sweden	501	2.8	484	1.9	491	2.3	499	2.7			540	4.3
Thailand	431	4.8	427	4.4	441	5.0			467	5.1		
Turkey	458	4.7	452	4.0								
United Arab Emirates	465	2.0	456	2.1								
United States	518	3.1	509	2.7	508	2.9	504	3.4	502	3.9	492	4.9

Note: Trend results (including TIMSS 2015 in this table) for Kuwait do not include data about private schools. Trend results (including TIMSS 2015 in this table) for Lithuania do not include data about students taught in Polish or Russian. Since Canada does not have trend results, it is not included in this table.

TABLE B.3 Mean scores for Year 4 science achievement, 1995–2015, by country

	2015		2011		2007		2003		1995	
Country	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Australia	524	2.9	516	2.9	527	3.3	521	4.3	521	3.7
Bahrain	459	2.6	449	3.5						
Belgium (Flemish)	512	2.3	509	2.0			518	1.9		
Chile	478	2.7	480	2.5						
Chinese Taipei	555	1.8	552	2.2	557	2.0	551	1.8		
Croatia	533	2.1	516	2.2						
Cyprus	481	2.6					480	2.4	450	3.4
Czech Republic	534	2.4	536	2.5	515	3.0			532	3.1
Denmark	527	2.1	528	2.8	517	2.9				
England	536	2.4	529	3.0	542	2.8	540	3.5	528	3.2
Finland	554	2.3	570	2.6						
Georgia	451	3.7	455	3.9	418	4.6				
Germany	528	2.4	528	2.9	528	2.4				
Hong Kong	557	2.9	535	3.7	554	3.5	542	3.0	508	3.4
Hungary	542	3.3	534	3.7	536	3.4	530	2.8	508	3.4
Iran	421	4.0	453	3.8	436	4.4	414	4.2	380	4.6
Ireland	529	2.4	516	3.3					515	3.5
Italy	516	2.6	524	2.7	535	3.2	516	3.8		
Japan	569	1.8	559	1.9	548	2.1	543	1.5	553	1.7
Kazakhstan	550	4.4	495	5.1						
Korea	589	2.0	587	2.1					576	2.1
Kuwait	315	5.1	347	4.8						
Lithuania	530	2.7	515	2.4	514	2.4	512	2.6		
Morocco	352	4.7	264	4.4						
Netherlands	517	2.7	531	2.2	523	2.6	525	2.0	530	3.2
New Zealand	506	2.7	497	2.4	504	2.7	520	2.4	505	5.4
Northern Ireland	520	2.2	517	2.5						
Norway (4)	493	2.2	494	2.5	477	3.5	466	2.6	504	3.7
Oman	431	3.1	377	4.3						
Portugal	508	2.2	522	3.8					452	4.1
Qatar	436	4.1	394	4.3						
Russian Federation	567	3.2	552	3.4	546	5.0	526	5.3		
Saudi Arabia	390	4.9	429	5.5						
Serbia	525	3.7	516	3.1						
Singapore	590	3.7	583	3.4	587	4.1	565	5.5	523	4.8
Slovak Republic	520	2.6	532	3.7	526	4.8				
Slovenia	543	2.4	520	2.6	518	1.9	490	2.6	464	3.1
Spain	518	2.6	505	3.1						
Sweden	540	3.6	533	2.8	525	2.9				
Turkey	483	3.3	463	4.7						
United Arab Emirates	451	2.8	428	2.5						
United States	546	2.2	544	2.1	539	2.7	536	2.5	542	3.4

Note: Trend results (including TIMSS 2015 in this table) for Kuwait do not include data about private schools. Trend results (including TIMSS 2015 in this table) for Lithuania do not include data about students taught in Polish or Russian. Since Bulgaria, Canada, France, Indonesia and Poland do not have trend results, they are not included in this table.

TABLE B.4 Mean scores for Year 8 science achievement, 1995–2015, by country

	2015		2011		2007		2003		1999		1995	
Country	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Australia	512	2.7	519	4.7	515	3.6	527	3.9			514	3.9
Bahrain	466	2.2	452	1.9	467	1.7	438	1.7				
Botswana (9)	392	2.7	404	3.6								
Chile	454	3.1	461	2.5			413	2.8	420	3.8		
Chinese Taipei	569	2.1	564	2.3	561	3.6	571	3.5	569	4.2		
Egypt	371	4.3			408	3.6	421	3.9				
England	537	3.8	533	4.9	542	4.4	544	4.0	538	4.8	533	3.5
Georgia	443	3.1	420	3.0	421	4.6						
Hong Kong	546	3.9	535	3.4	530	5.0	556	3.0	530	3.5	510	5.9
Hungary	527	3.4	522	3.1	539	2.9	543	2.8	552	3.6	537	3.2
Iran	456	4.0	474	4.0	459	3.7	453	2.4	448	3.8	463	3.7
Ireland	530	2.8									518	5.1
Israel	507	3.9	516	4.0								
Italy	499	2.4	501	2.4	495	2.9	491	3.1	493	4.0		
Japan	571	1.8	558	2.4	554	1.8	552	1.9	550	2.1	554	1.8
Jordan	426	3.4	449	4.1	482	4.0	475	3.7	450	3.8		
Kazakhstan	533	4.4	490	4.2								
Korea	556	2.2	560	2.0	553	2.0	558	1.6	549	2.7	546	2.1
Kuwait	394	4.8			418	2.8						
Lebanon	398	5.3	406	5.0	414	6.0	393	4.2				
Lithuania	522	3.0	514	2.5	519	2.6	519	2.2	488	4.1	464	4.0
Malaysia	471	4.1	426	6.2	471	6.0	510	3.6	492	4.3		
Malta	481	1.6			457	1.2						
Morocco	393	2.5	376	2.2								
New Zealand	513	3.1	512	4.6			520	5.0	510	5.1	511	4.9
Norway (8)	489	2.4	494	2.6	487	2.2	494	2.2			514	2.4
Oman	455	2.7	420	3.2	423	2.9						
Qatar	457	3.0	419	3.2								
Russian Federation	544	4.2	542	3.3	530	3.7	514	3.6	529	6.4	523	4.4
Saudi Arabia	396	4.5	436	3.8								
Singapore	597	3.2	590	4.3	567	4.4	578	4.2	568	8.0	580	5.6
Slovenia	551	2.4	543	2.6	538	2.2	520	1.9			514	2.8
South Africa (9)	358	5.6	332	3.6								
Sweden	522	3.4	509	2.6	511	2.5	524	2.7			553	4.3
Thailand	456	4.2	451	4.0	471	4.3			482	3.9		
Turkey	493	4.0	483	3.4								
United Arab Emirates	477	2.3	465	2.4								
United States	530	2.8	525	2.4	520	2.9	527	3.2	515	4.4	513	5.5

Note: Trend results (including TIMSS 2015 in this table) for Kuwait do not include data about private schools. Trend results (including TIMSS 2015 in this table) for Lithuania do not include data about students taught in Polish or Russian. Since Canada does not have trend results, it is not included in this table.

Appendix

C

Trends in achievement by jurisdiction

TABLE C.1 Mean scores for Year 4 mathematics achievement, 1995–2015, by jurisdiction

	2015		2011		2007		2003		1995	
Jurisdiction	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
ACT	544	7.9	545	5.7	513	8.7	523	13.1	527	7.3
NSW	519	7.5	525	6.0	534	6.2	510	9.4	496	6.8
VIC	525	5.5	531	5.7	532	8.1	508	6.5	507	7.8
QLD	511	5.6	499	5.6	485	6.8	484	7.1	484	8.0
SA	510	7.9	502	5.4	493	9.1	485	8.2	485	7.7
WA	512	9.1	499	6.3	493	5.8	472	7.6	483	8.0
TAS	513	9.6	517	8.0	510	5.8	497	13.8	486	8.3
NT	467	13.3	489	12.6	484	9.7	479	14.0	491	9.5

TABLE C.2 Mean scores for Year 8 mathematics achievement, 1995–2015, by jurisdiction

	2015		2011		2007		2003		1995	
Jurisdiction	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
ACT	549	7.0	547	5.2	527	8.7	547	9.8	557	5.7
NSW	524	6.4	522	5.6	538	5.9	526	10.5	522	5.9
VIC	527	4.9	529	5.1	544	8.2	528	6.4	529	9.9
QLD	523	5.2	501	6.1	501	6.2	513	7.5	503	7.2
SA	524	7.1	506	5.3	512	10.1	515	8.9	519	7.5
WA	516	7.5	502	5.8	512	5.4	502	7.1	527	6.2
TAS	525	9.4	518	7.1	533	6.0	517	11.1	523	9.1
NT	480	12.7	491	13.2	503	10.0	503	13.4	512	10.3

TABLE C.3 Mean scores for Year 4 science achievement, 1995–2015, by jurisdiction

	2015		2011		2007		2003		1995	
Jurisdiction	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
ACT	516	4.5	532	10.4	518	22.3	507	10.2	528	11.7
NSW	503	6.9	518	11.2	500	9.8	530	12.2	512	8.7
VIC	516	5.1	504	8.0	503	8.0	495	6.8	500	6.4
QLD	498	5.7	497	8.3	491	4.9	490	6.1	506	8.4
SA	498	9.1	489	6.1	490	6.5	501	11.7	513	5.6
WA	508	6.0	493	10.6	485	8.3	487	7.5	527	6.7
TAS	493	8.4	475	7.2	485	7.0	477	13.0	496	11.6
NT	452	10.0	462	14.9	483	13.8	449	13.3	470	19.9

TABLE C.4 Mean scores for Year 8 science achievement, 1995–2015, by jurisdiction

	2015		2011		2007		2003		1995	
Jurisdiction	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
ACT	528	4.6	551	9.0	538	19.6	538	8.5	542	12.1
NSW	511	6.1	532	10.3	521	9.3	547	9.9	518	9.2
VIC	518	4.1	513	7.0	513	7.6	516	5.2	500	7.6
QLD	507	5.6	516	7.3	513	4.5	516	5.8	507	7.2
SA	507	8.3	506	5.0	512	6.3	524	10.6	524	5.5
WA	518	5.7	514	9.6	506	8.3	520	6.7	534	6.7
TAS	503	8.0	496	6.7	507	7.2	504	11.9	514	11.8
NT	463	11.9	481	14.4	502	10.9	482	12.1	487	19.6

Appendix

Data tables with standard errors

D

Data tables with standard errors for Chapter 6

Please note that, due to rounding, totals may not add to 100 per cent.

TABLE D.1 Socioeconomic composition of schools and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	More affluent – schools where more than 25% of the student body comes from economically affluent homes and not more than 25% from economically disadvantaged homes				Neither more affluent nor more disadvantaged				More disadvantaged – schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% from economically affluent homes			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4											
Australia	35	3.5	551	4.5	34	3.7	519	4.2	31	3.6	479	5.6
International average	37	0.5	527	0.8	35	0.5	505	0.8	29	0.5	483	1.1
	Year 8											
Australia	30	3.6	545	4.8	39	4.1	504	4.2	30	3.6	474	6.3
International average	31	0.5	513	1.4	34	0.6	486	1.2	36	0.5	457	1.3

TABLE D.2 Socioeconomic composition of schools and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	More affluent – schools where more than 25% of the student body comes from economically affluent homes and not more than 25% from economically disadvantaged homes				Neither more affluent nor more disadvantaged				More disadvantaged – schools where more than 25% of the student body comes from economically disadvantaged homes and not more than 25% from economically affluent homes			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4											
Australia	35	3.5	552	3.8	34	3.7	525	4.1	31	3.6	490	5.0
International average	38	0.5	526	0.9	35	0.6	507	0.9	27	0.5	483	1.3
	Year 8											
Australia	30	3.6	548	3.6	39	4.1	512	4.0	30	3.6	481	5.4
International average	31	0.5	517	1.4	34	0.6	491	1.2	36	0.5	462	1.3

TABLE D.3 Language background of schools' populations and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	School has more than 90% of students with language of test as their native language				School has 51–90% of students with language of test as their native language				School has 50% or less of students with language of test as their native language			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4											
Australia	62	3.1	517	4.6	22	2.7	530	8.0	16	2.4	502	8.3
International average	66	0.4	506	0.6	17	0.4	502	1.6	16	0.3	486	1.9
	Year 8											
Australia	62	4.0	506	3.8	27	3.5	513	8.1	11	2.1	497	12.7
International average	64	0.4	478	1.0	14	0.4	483	1.9	22	0.3	475	2.6

TABLE D.4 Language background of schools' populations and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	School has more than 90% of students with language of test as their native language				School has 51–90% of students with language of test as their native language				School has 50% or less of students with language of test as their native language			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4											
Australia	62	3.1	526	4.2	22	2.7	533	6.3	16	2.4	502	7.1
International average	67	0.5	508	0.6	18	0.4	501	1.6	15	0.3	478	2.1
	Year 8											
Australia	62	4.0	515	3.5	27	3.5	517	7.1	11	2.1	493	10.3
International average	64	0.4	485	1.2	14	0.4	491	2.1	22	0.3	477	2.5

TABLE D.5 Schools Where Students Enter the Primary Grades with Literacy and Numeracy Skills scale and Year 4 student achievement in mathematics and science, Australia and the international average

Year 4	Schools where more than 75% enter with skills				Schools where 25–75% enter with skills				Schools where less than 25% enter with skills				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4 mathematics													
Australia	9	1.9	536	9.8	41	3.8	537	4.9	50	3.9	498	5.0	8.8	0.14
International average	21	0.4	516	1.5	54	0.5	504	0.7	24	0.4	474	1.5		
	Year 4 science													
Australia	9	1.9	538	8.1	41	3.8	541	4.3	50	3.9	507	4.3	8.8	0.14
International average	22	0.4	519	1.4	54	0.5	507	0.8	24	0.4	479	1.7		

TABLE D.6 The Mathematics Resource Shortages scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Not affected				Affected				Affected a lot				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Year 4														
Australia	44	3.8	526	4.7	55	3.7	512	5.3	1	0.5	~ ~	~	11.1	0.15
International average	27	0.5	519	1.5	69	0.5	502	0.5	4	0.2	466	3.1		
Year 8														
Australia	51	3.5	520	3.3	48	3.4	493	5.2	1	0.7	~ ~	~	11.3	0.11
International average	27	0.5	506	1.8	66	0.5	476	0.7	6	0.3	448	2.9		

TABLE D.7 The Science Resource Shortages scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Not affected				Affected				Affected a lot				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Year 4														
Australia	30	3.5	531	4.9	69	3.4	521	4.3	1	0.5	~ ~		10.7	0.14
International average	25	0.5	517	1.7	69	0.5	504	0.6	5	0.2	483	3.1		
Year 8														
Australia	53	3.6	524	3.1	46	3.5	501	4.8	1	0.8	~ ~	~	11.5	0.12
International average	27	0.5	509	1.8	65	0.5	480	0.7	7	0.3	465	2.6		

TABLE D.8 The Problem with School Conditions and Resources scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Hardly any problems				Minor problems				Moderate to severe problems				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	53	3.8	518	5.5	38	3.4	518	4.6	8	1.9	519	6.5	10.6	0.12
International average	37	0.5	512	0.8	43	0.5	505	0.7	20	0.4	499	1.1		
	Year 8													
Australia	50	3.3	519	3.8	44	3.5	496	4.9	6	1.4	500	13.9	10.9	0.10
International average	34	0.5	493	1.2	44	0.6	481	0.9	22	0.5	470	1.5		

TABLE D.9 The Problem with School Conditions and Resources scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Hardly any problems				Minor problems				Moderate to severe problems				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	54	4.1	526	4.8	37	3.7	523	4.9	8	1.9	527	6.1	10.6	0.13
International average	38	0.5	512	0.9	43	0.5	506	0.7	19	0.4	500	1.2		
	Year 8													
Australia	50	2.5	524	3.2	40	3.0	508	5.7	10	2.0	503	8.0	10.8	0.10
International average	34	0.5	500	1.2	43	0.5	486	0.9	23	0.5	475	1.3		

TABLE D.10 Students' Sense of School Belonging scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	High sense of school belonging				Sense of school belonging				Little sense of school belonging				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	62	1.2	524	3.7	33	1.0	511	3.2	5	0.4	483	7.3	9.8	0.05
International average	66	0.2	511	0.5	30	0.2	501	0.7	4	0.1	487	1.4		
	Year 8													
Australia	41	1.1	528	3.4	48	0.9	499	2.8	11	0.5	460	5.0	9.8	0.05
International average	44	0.2	492	0.7	47	0.2	479	0.6	9	0.1	458	1.0		

TABLE D.11 Students' Sense of School Belonging scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	High sense of school belonging				Sense of school belonging				Little sense of school belonging				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	62	1.2	529	3.3	33	1.0	520	3.6	5	0.4	493	6.0	9.8	0.05
International average	66	0.2	511	0.5	30	0.2	501	0.7	4	0.1	487	1.4		
	Year 8													
Australia	41	1.1	535	2.9	48	0.9	506	2.3	11	0.5	465	5.1	9.8	0.05
International average	44	0.2	498	0.6	47	0.2	483	0.6	9	0.1	459	1.0		

TABLE D.12 The School Emphasis on Academic Success scale (principals' reports) and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	12	2.8	555	8.7	53	4.1	525	4.2	34	3.4	492	5.5	10.4	0.16
International average	7	0.3	527	2.4	54	0.5	512	0.6	39	0.5	490	0.8		
	Year 8													
Australia	14	2.3	557	7.4	42	3.5	512	5.1	44	3.0	486	4.6	10.5	0.11
International average	7	0.3	531	3.2	48	0.6	494	0.9	45	0.5	462	0.8		

TABLE D.13 The School Emphasis on Academic Success scale (principals' reports) and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	12	2.8	556	7.1	53	4.1	530	3.5	34	3.4	503	5.3	10.4	0.16
International average	7	0.3	525	2.2	55	0.6	514	0.6	38	0.5	491	0.9		
	Year 8													
Australia	14	2.3	556	5.8	42	3.5	519	4.6	44	3.0	495	4.1	10.5	0.11
International average	7	0.3	533	3.0	48	0.6	499	1.0	45	0.5	466	0.9		

TABLE D.14 The School Emphasis on Academic Success scale (teachers' reports) and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	9	2.2	555	7.7	63	4.1	526	3.5	28	4.0	488	5.8	10.4	0.13
International average	7	0.3	515	2.2	56	0.5	513	0.6	36	0.5	488	0.8		
	Year 8													
Australia	8	1.7	543	10.5	48	3.1	523	4.2	44	2.9	484	4.0	10.2	0.15
International average	5	0.2	515	3.6	46	0.5	495	0.9	49	0.5	464	0.8		

TABLE D.15 The School Emphasis on Academic Success scale (teachers' reports) and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	12	2.5	552	5.6	64	3.7	527	4.2	24	3.2	504	4.6	10.4	0.12
International average	8	0.3	522	2.4	56	0.5	514	0.6	36	0.5	491	0.9		
	Year 8													
Australia	6	1.4	548	10.9	45	3.1	526	4.5	49	3.2	501	3.3	9.9	0.14
International average	5	0.2	520	3.5	46	0.5	499	0.9	49	0.5	471	0.8		

TABLE D.16 Teacher Job Satisfaction scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very satisfied				Satisfied				Less than satisfied				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	52	3.9	522	4.1	45	3.9	514	5.8	3	1.0	507	9.5	10.2	0.14
International average	52	0.5	508	0.6	42	0.5	503	0.8	6	0.2	501	2.0		
	Year 8													
Australia	50	3.6	514	4.2	39	3.4	504	5.6	11	2.1	496	8.1	9.9	0.15
International average	50	0.6	486	0.8	43	0.6	478	1.0	7	0.3	480	2.4		

TABLE D.17 The Teacher Job Satisfaction scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very satisfied				Satisfied				Less than satisfied				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	54	3.4	526	4.8	43	3.3	525	3.5	3	0.9	508	10.7	10.3	0.12
International average	52	0.5	509	0.7	42	0.5	504	0.8	6	0.3	502	2.4		
	Year 8													
Australia	44	3.0	524	4.3	41	2.8	508	3.9	15	2.4	513	5.9	9.6	0.14
International average	49	0.5	492	0.8	42	0.5	483	1.0	9	0.3	478	2.2		

TABLE D.18 The Challenges Facing Teachers scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Few challenges				Some challenges				Many challenges				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	24	2.6	522	7.6	67	2.5	515	4.0	8	1.9	529	7.8	9.4	0.11
International average	41	0.5	504	0.8	51	0.5	501	0.7	8	0.3	497	1.6		
	Year 8													
Australia	29	2.9	514	6.1	58	3.3	505	3.7	13	2.1	508	8.0	9.2	0.13
International average	45	0.6	480	1.0	49	0.6	476	0.9	5	0.3	481	2.8		

TABLE D.19 The Challenges Facing Teachers scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Few challenges				Some challenges				Many challenges				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	26	2.9	532	5.8	67	2.8	522	3.8	7	1.7	526	4.9	9.4	0.11
International average	43	0.5	506	0.8	49	0.5	503	0.7	8	0.3	497	1.9		
	Year 8													
Australia	31	2.5	519	5.3	57	3.2	512	3.7	12	2.4	521	8.0	9.4	0.11
International average	45	0.5	487	1.0	49	0.5	481	0.9	6	0.3	473	2.7		

TABLE D.20 The School Discipline Problems scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Hardly any problems				Minor problems				Moderate to severe problems				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	64	3.4	530	3.5	30	3.4	506	5.4	6	3.1	446	5.9	10.2	0.12
International average	60	0.5	512	0.7	31	0.5	497	0.9	10	0.3	468	2.3		
	Year 8													
Australia	48	3.2	528	4.7	51	3.2	487	4.4	1	0.6	~	~	10.6	0.09
International average	43	0.6	495	1.1	45	0.6	473	0.9	11	0.4	439	2.4		

TABLE D.21 The School Discipline Problems scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Hardly any problems				Minor problems				Moderate to severe problems				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	64	3.4	534	2.9	30	3.4	516	4.7	6	3.1	462	6.3	10.2	0.12
International average	61	0.5	513	0.7	30	0.5	498	1.0	9	0.3	471	2.5		
	Year 8													
Australia	48	3.2	531	4.4	51	3.2	497	3.9	1	0.6	~	~	10.6	0.09
International average	43	0.6	501	1.2	45	0.6	478	0.9	11	0.4	446	2.2		

TABLE D.22 The Safe and Orderly School scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very safe and orderly				Safe and orderly				Less than safe and orderly				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	75	2.8	529	4.1	23	2.9	490	5.8	2	0.8	~~	~	11.4	0.13
International average	56	0.5	511	0.6	40	0.5	497	0.8	4	0.2	464	2.9		
	Year 8													
Australia	60	3.0	523	3.6	33	2.7	492	4.5	7	1.6	445	10.1	11.0	0.16
International average	46	0.5	493	0.9	46	0.6	474	0.9	8	0.3	453	2.5		

TABLE D.23 The Safe and Orderly School scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very safe and orderly				Safe and orderly				Less than safe and orderly				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	77	2.7	533	3.6	21	2.7	502	5.6	2	0.6	~~	~	11.4	0.15
International average	57	0.5	513	0.6	39	0.5	498	0.8	4	0.2	469	2.8		
	Year 8													
Australia	56	3.2	529	3.3	38	3.3	501	4.2	6	1.5	482	13.1	10.8	0.14
International average	45	0.5	499	0.9	47	0.5	478	0.9	8	0.3	457	2.4		

TABLE D.24 The Student Bullying scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Almost never				About monthly				About weekly				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	45	1.3	529	3.7	36	1.1	518	2.9	20	1.1	490	5.5	9.4	0.05
International average	56	0.2	514	0.5	29	0.1	505	0.5	16	0.1	478	0.8		
	Year 8													
Australia	57	1.0	514	3.2	34	0.8	500	3.2	9	0.4	476	5.1	9.7	0.04
International average	63	0.2	488	0.6	29	0.1	478	0.7	8	0.1	434	1.2		

TABLE D.25 The Student Bullying scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Almost never				About monthly				About weekly				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	45	1.3	533	3.3	36	1.1	525	2.9	20	1.1	502	5.3	9.4	0.05
International average	57	0.2	515	0.5	28	0.1	506	0.6	15	0.1	481	0.9		
	Year 8													
Australia	57	1.0	521	2.9	34	0.8	507	2.9	9	0.4	483	4.4	9.7	0.04
International average	63	0.2	495	0.6	29	0.1	484	0.7	8	0.1	433	1.4		

Data tables with standard errors for Chapter 7

Please note that, due to rounding, totals may not add to 100 per cent.

TABLE D.26 Percentages of Australian Year 4 and Year 8 students by the age of their mathematics teachers, by jurisdiction

Mathematics	Under 25		25–29		30–39		40–49		50–59		60 or more	
	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE
Year 4												
ACT			31	10.8	15	6.8	22	6.2	29	9.5	4	2.9
NSW	3	2.5	10	4.5	19	4.6	36	9.4	26	8.1	7	3.7
VIC	2	2.2	19	6.3	27	7.3	13	5.0	27	7.0	11	5.4
QLD	10	4.5	14	5.5	19	6.0	34	7.0	19	4.6	4	2.7
SA	3	2.7	21	5.8	21	6.3	23	5.4	27	5.7	6	3.6
WA	5	3.2	19	5.4	9	4.5	23	5.8	38	6.5	5	1.8
TAS	3	3.5	12	6.2	20	6.5	16	7.5	38	8.4	10	5.9
NT	2	2.0	5	4.5	33	14.2	32	12.5	24	13.2	4	3.6
Australia	5	1.4	15	2.6	20	2.5	27	3.9	27	3.6	7	1.9
Year 8												
ACT			20	8.5	19	6.3	33	9.3	14	4.0	15	5.0
NSW	5	1.3	5	2.5	21	5.9	30	5.5	30	5.4	9	4.1
VIC	5	3.2	13	5.0	26	6.2	22	6.9	28	7.3	6	3.6
QLD	6	3.5	18	4.6	30	6.5	18	5.8	29	7.5	0	0.1
SA	8	4.5	10	4.9	19	5.7	27	6.8	25	7.8	11	5.2
WA	6	3.6	8	3.9	31	7.7	16	3.5	31	7.0	9	4.2
TAS	0	0.2	30	12.7	26	8.1	24	9.8	20	9.6	0	0.2
NT	2	1.3	9	6.9	24	14.3	40	20.1	25	14.4	1	0.6
Australia	5	1.3	12	1.9	25	3.1	24	3.1	28	3.0	6	1.8

TABLE D.27 Percentages of Australian Year 4 and Year 8 students by the sex of their mathematics teachers, by jurisdiction

Mathematics	Students taught mathematics by a female teacher		Students taught mathematics by a male teacher	
	% of students	SE	% of students	SE
Year 4				
ACT	56	9.9	44	9.9
NSW	82	4.9	18	4.9
VIC	82	5.8	18	5.8
QLD	85	6.0	15	6.0
SA	87	5.1	13	5.1
WA	86	6.2	14	6.2
TAS	84	4.4	16	4.4
NT	88	6.0	12	6.0
Australia	83	2.6	17	2.6
Year 8				
ACT	52	7.2	48	7.2
NSW	59	5.2	41	5.2
VIC	50	7.3	50	7.3
QLD	66	6.9	34	6.9
SA	27	7.9	73	7.9
WA	45	5.6	55	5.6
TAS	61	10.5	39	10.5
NT	57	14.3	43	14.3
Australia	55	3.2	45	3.2

TABLE D.28 Mathematics teachers' formal education and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Teachers' educational level							
	Completed postgraduate degree		Completed bachelor's degree or equivalent but not a postgraduate degree		Completed post-secondary education but not a bachelor's degree		No further than upper secondary education	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4							
Australia	12	2.6	81	3.2	7	1.9	0	0.0
International average	26	0.3	58	0.4	12	0.3	5	0.2
	Year 8							
Australia	20	2.7	80	2.7	0	0.0	0	0.0
International average	25	0.5	66	0.5	7	0.3	2	0.2

TABLE D.29 Percentages of Year 4 and Year 8 students by mathematics teachers' area of professional development, Australia and the international average

Mathematics	Mathematics content		Mathematics pedagogy/ instruction		Mathematics curriculum		Integrating information technology into mathematics		Improving students' critical-thinking or problem-solving skills		Mathematics assessment		Addressing individual students' needs	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Year 4														
Australia	70	2.7	62	3.9	66	4.1	37	3.8	50	4.2	43	3.6	52	4.0
International average	43	0.5	45	0.5	40	0.5	36	0.5	41	0.5	36	0.5	42	0.5
Year 8														
Australia	65	2.6	67	2.7	71	2.8	59	2.6	49	3.9	47	3.4	58	3.8
International average	56	0.6	59	0.6	50	0.5	50	0.5	45	0.6	44	0.6	42	0.6

TABLE D.30 Percentages of Year 4 students taught the TIMSS mathematics topics, Australia and the international average

Year 4 mathematics	All mathematics (17 topics)		Number (8 topics)		Geometric shapes and measures (7 topics)		Data display (2 topics)	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	87	1.0	89	0.9	83	1.4	93	1.6
International average	76	0.2	83	0.1	68	0.2	78	0.4

TABLE D.31 Percentages of Year 8 students taught the TIMSS mathematics topics, Australia and the international average

Year 8 mathematics	All mathematics (20 topics)		Number (5 topics)		Algebra (6 topics)		Geometry (6 topics)		Data and chance (3 topics)	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	76	0.9	90	0.9	65	1.5	77	1.4	71	2.2
International average	76	0.1	92	0.1	70	0.2	77	0.2	60	0.4

TABLE D.32 Percentages of Year 8 students by how they used the internet for mathematics schoolwork, Australia and the international average

Year 8 mathematics	Percentages of students who use the internet to do the following tasks									
	Access the textbook or other course materials		Access assignments posted online by the teacher		Collaborate with classmates on assignments or projects		Communicate with the teacher		Find information, articles or tutorials to aid in understanding mathematics	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	55	1.4	66	1.2	63	0.8	46	1.1	57	1.0
International average	56	0.2	53	0.2	69	0.2	36	0.2	57	0.2

TABLE D.33 Time spent on mathematics homework per week and Year 8 student achievement in mathematics, Australia and the international average

Year 8 mathematics	3 hours or more				More than 45 minutes but less than 3 hours				45 minutes or less			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
Australia	9	0.8	530	5.6	35	1.2	527	3.4	56	1.6	491	3.7
International average	15	0.1	481	1.1	36	0.2	491	0.7	49	0.2	474	0.7

TABLE D.34 Teaching limited by student needs and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Not limited				Somewhat limited				Very limited				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	34	3.4	547	5.3	58	3.3	508	3.3	8	3.0	474	13.0	9.9	0.15
International average	34	0.5	520	0.9	58	0.5	499	0.6	8	0.3	477	1.7		
	Year 8													
Australia	28	2.3	563	5.7	64	2.3	493	3.4	8	1.4	458	9.2	10.3	0.10
International average	27	0.5	510	1.5	62	0.6	475	0.7	11	0.4	446	2.4		

TABLE D.35 Frequency of student absences and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Never or almost never				Once a month				Once every 2 weeks				Once a week or more			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4															
Australia	63	1.1	528	3.4	23	1.0	523	4.1	5	0.4	474	7.8	8	0.5	450	5.1
International average	67	0.1	516	0.4	18	0.1	501	0.6	5	0.1	465	1.1	10	0.1	455	0.9
	Year 8															
Australia	59	0.8	519	3.3	28	0.8	501	3.3	9	0.4	488	3.8	5	0.3	428	6.0
International average	61	0.2	496	0.6	23	0.1	471	0.7	8	0.1	442	1.0	8	0.1	404	1.2

TABLE D.36 Percentages of Australian Year 4 and Year 8 students by the age of their science teachers, by jurisdiction

Science	Under 25		25–29		30–39		40–49		50–59		60 or more	
	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE	% of students with teachers this age	SE
Year 4												
ACT	1	0.6	27	9.4	14	7.1	24	9.2	34	11.7	0	0.4
NSW	3	2.5	12	5.2	28	8.2	27	7.4	24	8.1	6	3.8
VIC	2	2.1	18	6.0	29	6.7	13	5.0	27	7.0	12	5.4
QLD	6	2.3	14	5.5	20	6.9	36	7.4	20	4.9	4	2.7
SA	3	2.7	26	7.0	17	5.8	19	5.2	33	7.0	2	1.8
WA	2	2.5	17	4.7	9	4.1	34	6.2	34	5.9	3	0.4
TAS	3	3.5	12	6.2	22	8.2	15	7.3	37	8.1	10	5.9
NT	2	2.0	8	7.5	32	14.1	25	10.2	24	13.0	10	6.8
Australia	3	1.1	15	2.8	23	3.6	25	3.3	26	3.5	7	1.9
Year 8												
ACT	2	1.9	9	2.8	27	4.1	27	5.3	28	8.6	7	2.4
NSW	5	2.1	11	2.4	25	3.7	29	4.7	25	3.7	5	2.2
VIC	3	2.5	18	5.6	25	7.0	27	8.8	20	6.3	7	4.0
QLD	4	2.5	16	4.6	32	6.5	22	6.8	25	6.4		
SA	5	3.4	21	5.9	31	7.8	17	4.7	22	6.5	4	1.5
WA	1	0.7	9	3.2	33	6.2	23	5.2	25	5.4	8	3.8
TAS			33	12.2	24	9.3	29	12.3	11	5.7	2	1.8
NT	19	11.7	32	16.1	15	5.5	27	17.0	7	2.9		
Australia	4	1.0	15	2.0	28	2.7	25	3.3	23	2.4	5	1.3

TABLE D.37 Percentages of Australian Year 4 and Year 8 students by the sex of their science teachers, by jurisdiction

Science	Students taught science by a female teacher		Students taught science by a male teacher	
	% of students	SE	% of students	SE
Year 4				
ACT	65	10.3	35	10.3
NSW	86	5.4	14	5.4
VIC	79	5.9	21	5.9
QLD	82	6.5	18	6.5
SA	84	6.0	16	6.0
WA	86	6.7	14	6.7
TAS	82	5.4	18	5.4
NT	89	6.3	11	6.3
Australia	83	2.9	17	2.9
Year 8				
ACT	60	5.4	40	5.4
NSW	56	4.6	44	4.6
VIC	57	8.4	43	8.4
QLD	59	7.3	41	7.3
SA	43	8.2	57	8.2
WA	57	7.3	43	7.3
TAS	54	13.2	46	13.2
NT	59	10.9	41	10.9
Australia	56	3.6	44	3.6

TABLE D.38 Science teachers' formal education and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Teachers' educational level							
	Completed postgraduate degree		Completed bachelor's degree or equivalent but not a postgraduate degree		Completed post-secondary education but not a bachelor's degree		No further than upper secondary education	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4							
Australia	12	2.7	81	3.3	7	1.9	0	0.0
International average	28	0.4	57	0.4	11	0.3	4	0.2
	Year 8							
Australia	19	2.2	81	2.2	1	0.3	0	0.0
International average	28	0.4	64	0.5	7	0.3	2	0.2

TABLE D.39 Percentages of Year 4 and Year 8 students by science teachers' area of professional development, Australia and the international average

Science	Percentages of students by teachers' area of professional development															
	Science content		Science pedagogy/ instruction		Science curriculum		Integrating information technology into science		Improving students' critical-thinking or inquiry skills		Science assessment		Addressing individual students' needs		Integrating science with other subjects	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
	Year 4															
Australia	31	2.9	27	3.4	40	3.6	16	2.5	32	3.3	16	2.6	28	3.1	22	3.3
International average	32	0.5	32	0.5	32	0.5	30	0.5	33	0.5	25	0.4	32	0.5	29	0.5
	Year 8															
Australia	61	2.7	57	3.3	68	2.7	53	2.8	50	2.7	42	2.8	57	2.6		
International average	55	0.5	57	0.5	49	0.5	50	0.5	45	0.5	44	0.5	42	0.5		

TABLE D.40 Percentages of Year 4 students taught the TIMSS science topics, Australia and the international average

Year 4 science	All science (23 topics)		Life science (7 topics)		Physical science (9 topics)		Earth science (7 topics)	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	61	1.4	72	1.6	52	2.0	62	2.3
International average	65	0.2	72	0.2	59	0.3	66	0.3

TABLE D.41 Percentages of Year 8 students taught the TIMSS science topics, Australia and the international average

Year 8 science	All science (22 topics)		Biology (7 topics)		Chemistry (6 topics)		Physics (5 topics)		Earth science (4 topics)	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	59	1.0	55	1.2	61	1.3	54	1.3	67	2.4
International average	73	0.2	73	0.2	76	0.2	72	0.3	68	0.3

TABLE D.42 The Emphasise Science Investigation scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	About half the lessons or more				Less than half the lessons				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4									
Australia	22	2.8	529	4.5	78	2.8	526	3.0	9.9	0.12
International average	27	0.4	508	1.1	73	0.4	505	0.7		
	Year 8									
Australia	16	2.4	520	7.0	84	2.4	515	3.0	9.8	0.10
International average	27	0.5	490	1.3	73	0.5	485	0.7		

TABLE D.43 Percentages of Year 8 students by how they used the internet for science schoolwork, Australia and the international average

Year 8 science	Percentages of students who use the internet to do the following tasks									
	Access the textbook or other course materials		Access assignments posted online by the teacher		Collaborate with classmates on assignments or projects		Communicate with the teacher		Find information, articles or tutorials to aid in understanding science	
	% of students	SE	% of students	SE	% of students	SE	% of students	SE	% of students	SE
Australia	55	1.4	66	1.2	63	0.8	46	1.1	57	0.9
International average	56	0.2	53	0.2	69	0.2	36	0.2	61	0.2

TABLE D.44 Time spent on science homework per week and Year 8 student achievement in science, Australia and the international average

Year 8 science	3 hours or more				More than 45 minutes but less than 3 hours				45 minutes or less			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
Australia	3	0.4	518	7.3	24	0.9	529	3.9	73	1.0	510	2.7
International average	5	0.1	466	1.5	28	0.2	491	0.9	67	0.2	485	0.7

TABLE D.45 Teaching limited by student needs and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Not limited				Somewhat limited				Very limited				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	38	3.4	544	4.4	57	3.5	517	3.3	5	1.6	495	12.9	10.1	0.13
International average	37	0.5	521	0.8	56	0.5	500	0.7	7	0.3	480	2.1		
	Year 8													
Australia	33	3.1	540	5.1	61	3.0	507	3.3	6	1.5	467	10.9	10.5	0.15
International average	28	0.5	511	1.4	62	0.5	480	0.7	10	0.3	454	2.2		

TABLE D.46 Frequency of student absences and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Never or almost never				Once a month				Once every 2 weeks				Once a week or more			
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE
	Year 4															
Australia	63	1.1	533	2.9	23	1.0	531	3.7	5	0.4	489	6.2	8	0.5	463	5.4
International average	67	0.1	517	0.5	18	0.1	503	0.7	5	0.1	471	1.3	9	0.1	457	1.1
	Year 8															
Australia	59	0.8	525	2.6	28	0.8	510	3.4	9	0.4	495	3.8	5	0.3	438	6.1
International average	61	0.2	502	0.6	23	0.1	477	0.7	8	0.1	447	1.1	8	0.1	407	1.3

Data tables with standard errors for Chapter 8

Please note that, due to rounding, totals may not add to 100 per cent.

TABLE D.47 The Students Like Learning Mathematics scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very much like learning mathematics				Like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	37	1.0	535	4.7	36	0.8	516	3.1	27	0.7	496	4.2	9.5	0.04
International average	46	0.2	521	0.5	35	0.1	495	0.5	19	0.1	483	0.8		
	Year 8													
Australia	13	0.7	551	4.4	36	0.9	522	3.3	50	1.2	482	3.0	9.4	0.05
International average	22	0.1	518	0.8	39	0.1	485	0.6	38	0.2	462	0.6		

TABLE D.48 The Students Like Learning Mathematics scale and Australian Year 4 and Year 8 student achievement in mathematics, by sex

Mathematics	Very much like learning mathematics				Like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	32	1.3	523	5.6	38	1.3	515	3.8	31	1.0	499	4.4	9.3	0.05
Male	43	1.3	543	5.2	34	1.1	517	4.8	23	1.0	492	6.1	9.7	0.05
	Year 8													
Female	11	0.7	553	6.7	34	1.1	526	4.5	55	1.4	482	3.4	9.2	0.05
Male	16	1.1	549	5.2	39	1.2	518	3.6	45	1.4	483	3.8	9.6	0.06

TABLE D.49 The Students Like Learning Mathematics scale and Australian Year 4 and Year 8 student achievement in mathematics, by broad socioeconomic background

Mathematics	Very much like learning mathematics				Like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	35	1.6	486	8.3	37	1.7	474	4.1	29	1.6	460	6.4	9.4	0.07
Average number of books	37	1.4	548	4.0	37	1.2	527	3.4	26	0.9	505	4.2	9.6	0.05
Many books	42	1.8	560	6.6	32	1.9	552	6.1	26	1.7	525	6.4	9.7	0.07
	Year 8													
Few resources	10	2.7	491	16.3	32	3.3	448	12.0	59	3.9	428	13.2	9.1	0.13
Some resources	12	0.7	537	4.8	36	1.1	512	3.6	52	1.4	476	2.9	9.3	0.05
Many resources	18	1.1	585	5.3	39	1.3	561	3.3	43	1.5	521	4.6	9.7	0.06

TABLE D.50 The Students Like Learning Science scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very much like learning science				Like learning science				Do not like learning science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	54	1.2	531	2.7	34	0.9	522	3.6	12	0.6	505	6.2	10.0	0.05
International average	56	0.2	518	0.5	33	0.1	492	0.6	11	0.1	483	1.1		
	Year 8													
Australia	28	1.1	550	3.2	43	0.8	512	2.6	29	1.0	482	3.8	9.6	0.05
International average	37	0.2	516	0.7	44	0.2	475	0.7	19	0.2	453	1.1		

TABLE D.51 The Students Like Learning Science scale and Australian Year 4 and Year 8 student achievement in science, by sex

Science	Very much like learning science				Like learning science				Do not like learning science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	53	1.6	527	4.0	36	1.4	524	4.2	11	0.8	519	5.4	10.0	0.07
Male	55	1.3	534	2.9	32	1.2	521	4.5	13	0.7	494	9.1	10.1	0.05
	Year 8													
Female	24	1.3	546	4.1	44	1.2	512	3.4	32	1.2	482	4.6	9.4	0.06
Male	31	1.4	553	4.0	42	0.9	511	3.0	26	1.1	481	4.5	9.8	0.07

TABLE D.52 The Students Like Learning Science scale and Australian Year 4 and Year 8 student achievement in science, by broad socioeconomic background

Science	Very much like learning science				Like learning science				Do not like learning science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	51	1.7	489	3.8	36	1.6	480	6.3	14	1.1	472	9.4	9.9	0.08
Average number of books	54	1.4	540	2.6	34	1.3	536	2.9	12	0.8	514	6.6	10.0	0.05
Many books	59	2.2	559	5.2	29	1.6	551	7.4	12	1.3	536	9.2	10.2	0.10
	Year 8													
Few resources	19	2.6	473	14.2	42	3.6	443	9.6	39	3.8	399	10.3	9.1	0.13
Some resources	25	1.1	534	3.3	44	0.9	503	2.6	31	1.1	479	3.3	9.4	0.06
Many resources	39	1.6	589	3.5	40	1.5	557	3.9	21	1.3	524	5.6	10.1	0.08

TABLE D.53 The Students' Confidence in Mathematics scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very confident in mathematics				Confident in mathematics				Not confident in mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	27	0.8	569	3.9	46	1.0	514	2.9	27	1.0	473	4.1	9.7	0.03
International average	32	0.1	546	0.5	45	0.1	502	0.5	23	0.1	460	0.6		
	Year 8													
Australia	15	0.7	580	3.6	42	0.7	522	3.4	43	0.9	465	2.5	10.0	0.04
International average	14	0.1	554	0.8	43	0.1	494	0.6	43	0.2	449	0.6		

TABLE D.54 The Students' Confidence in Mathematics scale and Australian Year 4 and Year 8 student achievement in mathematics, by sex

Mathematics	Very confident in mathematics				Confident in mathematics				Not confident in mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	21	1.1	562	5.8	48	1.2	514	3.7	32	1.2	479	3.5	9.3	0.04
Male	34	1.2	573	4.0	44	1.4	513	3.6	23	1.3	464	5.9	10.0	0.05
	Year 8													
Female	11	0.8	582	5.0	40	1.1	529	4.4	49	1.2	467	3.4	9.6	0.05
Male	19	0.9	578	4.5	45	1.1	515	3.6	36	1.1	461	3.3	10.4	0.04

TABLE D.55 The Students' Confidence in Mathematics scale and Australian Year 4 and Year 8 student achievement in mathematics, by broad socioeconomic background

Mathematics	Very confident in mathematics				Confident in mathematics				Not confident in mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	18	1.3	519	8.5	49	2.0	477	4.2	32	1.7	445	7.0	9.3	0.05
Average number of books	28	1.0	575	3.5	46	1.3	528	3.1	25	1.0	482	3.8	9.7	0.04
Many books	38	2.0	592	5.8	38	1.9	534	6.0	24	1.5	502	5.7	10.2	0.09
	Year 8													
Few resources	10	2.2	543	30.9	44	3.5	451	10.5	45	3.5	408	9.4	9.6	0.13
Some resources	13	0.7	568	4.4	42	0.8	514	3.3	45	1.1	461	2.6	9.8	0.05
Many resources	24	1.2	602	3.8	44	1.4	557	3.7	32	1.3	496	4.5	10.5	0.07

TABLE D.56 The Students' Confidence in Science scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very confident in science				Confident in science				Not confident in science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	35	0.9	542	3.5	45	0.8	525	2.7	20	0.8	494	4.2	9.7	0.04
International average	40	0.2	532	0.5	42	0.1	501	0.5	18	0.1	464	0.8		
	Year 8													
Australia	17	0.8	571	3.1	37	0.8	526	3.2	45	1.2	482	3.0	9.7	0.05
International average	22	0.2	538	0.8	39	0.2	490	0.7	40	0.2	452	0.8		

TABLE D.57 The Students' Confidence in Science scale and Australian Year 4 and Year 8 student achievement in science, by sex

Science	Very confident in science				Confident in science				Not confident in science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	34	1.4	543	4.7	46	1.3	523	3.9	20	0.9	499	4.3	9.6	0.1
Male	36	1.3	542	4.5	44	1.1	526	2.8	20	1.0	490	6.7	9.7	0.0
	Year 8													
Female	14	0.9	565	4.6	36	1.2	526	3.6	50	1.5	484	3.8	9.4	0.1
Male	20	0.9	575	3.4	39	1.2	527	4.0	41	1.5	480	3.6	10.0	0.1

TABLE D.58 The Students' Confidence in Science scale and Australian Year 4 and Year 8 student achievement in science, by broad socioeconomic background

Science	Very confident in science				Confident in science				Not confident in science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	28	1.5	496	4.7	47	1.7	487	4.0	25	1.3	466	9.3	9.4	0.06
Average number of books	36	1.2	548	3.4	46	1.2	537	2.7	18	0.9	507	3.7	9.7	0.04
Many books	45	1.9	572	5.3	38	1.8	550	6.1	17	1.4	517	7.6	10.1	0.08
	Year 8													
Few resources	7	2.0	514	14.1	31	3.1	447	9.6	62	3.3	418	9.8	9.1	0.09
Some resources	14	0.7	554	3.8	37	0.9	517	3.2	49	1.4	479	2.6	9.5	0.05
Many resources	29	1.6	600	3.8	39	1.5	567	3.9	31	1.5	524	5.0	10.4	0.07

TABLE D.59 The Students Value Mathematics scale and Year 8 student achievement in mathematics, Australia and the international average

Year 8 mathematics	Strongly value mathematics				Value mathematics				Do not value mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Australia	43	0.9	524	3.1	46	0.8	501	3.3	12	0.7	464	3.9	9.9	0.04
International average	42	0.2	498	0.7	45	0.1	477	0.6	13	0.1	449	0.9		

TABLE D.60 The Students Value Mathematics scale and Australian Year 8 student achievement in mathematics, by sex

Year 8 mathematics	Strongly value mathematics				Value mathematics				Do not value mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Female	38	1.1	523	4.5	49	1.0	502	3.7	14	0.9	464	5.2	9.6	0.05
Male	48	1.3	524	3.6	43	1.1	499	4.3	9	0.7	466	4.3	10.1	0.06

TABLE D.61 The Students Value Mathematics scale and Australian Year 8 student achievement in mathematics, by broad socioeconomic background

Year 8 mathematics	Strongly value mathematics				Value mathematics				Do not value mathematics				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Few resources	27	3.0	455	14.9	55	4.2	444	11.8	18	3.6	414	19.0	9.2	0.16
Some resources	41	0.9	512	3.6	47	0.8	493	3.3	12	0.7	460	3.8	9.8	0.05
Many resources	52	1.6	559	3.4	39	1.5	545	4.4	9	0.9	504	7.9	10.2	0.06

TABLE D.62 The Students Value Science scale and Year 8 student achievement in science, Australia and the international average

Year 8 science	Strongly value science				Value science				Do not value science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Australia	27	0.9	547	3.2	41	0.6	517	2.7	32	0.8	482	3.4	9.4	0.04
International average	40	0.2	506	0.7	41	0.1	482	0.6	19	0.1	460	0.9		

TABLE D.63 The Students Value Science scale and Australian Year 8 student achievement in science, by sex

Year 8 science	Strongly value science				Value science				Do not value science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Female	25	1.1	545	4.4	40	1.0	515	3.2	35	1.2	481	4.3	9.3	0.05
Male	29	1.1	549	3.9	42	0.9	519	3.3	29	0.9	484	4.1	9.5	0.06

TABLE D.64 The Students Value Science scale and Australian Year 8 student achievement in science, by broad socioeconomic background

Year 8 science	Strongly value science				Value science				Do not value science				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
Few resources	20	2.5	449	15.5	44	3.4	440	8.6	36	3.5	419	14.0	9.1	0.13
Some resources	24	0.9	533	3.3	41	0.7	508	2.7	35	0.9	477	2.9	9.3	0.04
Many resources	37	1.6	587	4.1	41	1.3	560	3.7	22	1.1	529	5.2	10.0	0.07

TABLE D.65 The Students' Views on Engaging Teaching in Mathematics Lessons scale and Year 4 and Year 8 student achievement in mathematics, Australia and the international average

Mathematics	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	63	1.2	519	3.5	31	0.9	520	3.5	6	0.4	492	6.8	9.7	0.05
International average	68	0.2	510	0.4	26	0.1	498	0.6	5	0.1	481	1.2		
	Year 8													
Australia	34	1.3	521	3.7	42	0.7	506	3.2	24	1.3	485	4.6	9.5	0.07
International average	43	0.2	494	0.7	41	0.2	478	0.6	17	0.2	464	0.9		

TABLE D.66 The Students' Views on Engaging Teaching in Mathematics Lessons scale and Australian Year 4 and Year 8 student achievement in mathematics, by sex

Mathematics	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	63	1.5	512	3.9	31	1.3	516	4.1	5	0.5	499	8.7	9.7	0.06
Male	62	1.5	525	4.2	31	1.1	524	4.8	7	0.6	487	9.5	9.6	0.07
	Year 8													
Female	33	1.8	521	5.2	41	1.1	505	4.0	26	1.6	485	5.3	9.5	0.09
Male	35	1.4	521	4.6	42	1.1	508	3.6	23	1.4	486	5.7	9.6	0.07

TABLE D.67 The Students' Views on Engaging Teaching in Mathematics Lessons scale and Australian Year 4 and Year 8 student achievement in mathematics, by broad socioeconomic background

Mathematics	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	61	1.9	473	5.7	32	1.5	478	5.5	6	1.0	472	10.2	9.4	0.06
Average number of books	64	1.5	531	3.0	31	1.3	532	4.1	5	0.5	496	9.3	9.7	0.04
Many books	61	2.2	550	5.8	32	1.6	553	5.8	7	1.3	515	14.0	10.1	0.08
	Year 8													
Few resources	26	3.7	467	14.6	45	4.2	448	14.0	29	3.7	408	10.8	9.1	0.16
Some resources	33	1.3	508	3.7	42	0.8	499	3.4	25	1.3	479	4.5	9.5	0.07
Many resources	40	2.2	561	4.7	38	1.7	546	4.2	22	1.7	529	6.6	9.7	0.10

TABLE D.68 The Students' Views on Engaging Teaching in Science Lessons scale and Year 4 and Year 8 student achievement in science, Australia and the international average

Science	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Australia	63	1.0	524	3.2	29	0.8	528	3.6	8	0.5	517	5.5	9.7	0.05
International average	69	0.2	510	0.5	25	0.1	500	0.7	6	0.1	489	1.3		
	Year 8													
Australia	38	1.3	534	2.9	39	0.9	507	2.9	22	1.0	490	4.9	9.6	0.06
International average	47	0.2	498	0.7	36	0.2	480	0.8	17	0.2	464	1.2		

TABLE D.69 The Students' Views on Engaging Teaching in Science Lessons scale and Australian Year 4 and Year 8 student achievement in science, by sex

Science	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
Female	63	1.3	523	4.0	30	1.2	529	4.3	7	0.7	523	8.4	9.7	0.06
Male	63	1.5	525	3.7	29	1.2	528	4.9	9	0.8	513	7.3	9.7	0.06
	Year 8													
Female	36	1.7	533	3.8	41	1.3	503	3.3	23	1.3	488	5.7	9.5	0.07
Male	41	1.6	535	3.6	38	1.0	511	3.7	21	1.2	493	5.6	9.7	0.07

TABLE D.70 The Students' Views on Engaging Teaching in Science Lessons scale and Australian Year 4 and Year 8 student achievement in science, by broad socioeconomic background

Science	Very engaging teaching				Engaging teaching				Less than engaging teaching				Average scale score	SE
	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE	% of students	SE	Average achievement	SE		
	Year 4													
A few books	61	2.0	481	4.3	30	1.6	489	5.9	9	1.0	490	9.0	9.6	0.08
Average number of books	63	1.2	535	2.7	30	1.0	539	4.0	7	0.6	526	7.8	9.7	0.05
Many books	66	2.1	554	5.0	26	1.6	559	6.2	7	1.2	543	12.1	9.8	0.10
	Year 8													
Few resources	29	3.3	447	10.0	44	3.3	442	9.6	27	3.5	400	15.8	9.2	0.14
Some resources	37	1.4	521	2.7	41	1.0	498	3.1	22	1.1	484	4.3	9.6	0.06
Many resources	46	1.9	579	3.3	34	1.5	555	4.7	20	1.5	536	5.4	9.9	0.08

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