Monitoring Australian Year 4 student achievement internationally: **TIMSS and PIRLS 2011**

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TIMSS • Trends in International Mathematics and Science Study
PIRLS • Progress in International Reading Literacy Study

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Executive Summary

The Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) are international studies directed by the International Association for the Evaluation of Educational Achievement (IEA). In Australia, the studies were managed by the Australian Council for Educational Research (ACER), and funded by the Australian and state and territory governments.

TIMSS and PIRLS share the goal of providing comparative information about educational achievement across countries to improve teaching and learning (in mathematics and science at Year 4 and Year 8 using TIMSS and in reading at Year 4 using PIRLS). They also provide comparative perspectives on trends in achievement in the context of different educational systems, school organisational approaches and instructional practices and to enable this, TIMSS and PIRLS collect a rich array of background information.

This report analyses and interprets the Australian Year 4 data collected as part of the TIMSS and PIRLS studies. Where appropriate, this report makes comparisons with the results of other countries and the international average to better understand Australian achievement and its context. A companion report details the achievement of Year 8 students in TIMSS.

Who is assessed?

Across the world, Year 4 students in 59 countries and 10 benchmarking participants[1] took part in TIMSS and/or PIRLS 2011. In Australia, over 6000 students in 280 schools participated in the Year 4 sample of TIMSS and PIRLS 2011. In addition, an extra sample of Indigenous students in all participating schools was collected in order to provide a more detailed examination of the achievements of Australia's Indigenous students.

TIMSS and PIRLS 2011 used a two-stage sampling procedure to ensure a nationally representative sample of students. In the first stage, schools were randomly selected to represent states and sectors. In the next stage, one class of Year 4 students was randomly selected to take part in the study.

What is assessed?

Two organising dimensions, a content dimension and a cognitive dimension, framed the mathematics and science assessment for TIMSS 2011, analogous to those used in the earlier TIMSS

1 A benchmarking participant is a province or region that participated in TIMSS and/or PIRLS for their own internal benchmarking. Data from these provinces are not included in international means and are not included in the report.

assessments. The content dimension of the assessment specifies the domains or subject matter to be assessed within mathematics or science, while the cognitive domain specifies the domains or thinking processes to be assessed. The cognitive domains describe the sets of behaviours expected of students as they engage with the mathematics or science 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*; *Earth science*; and *physical science*. In addition there are three cognitive domains in each curriculum area: *knowing*; *applying*; and *reasoning*.

PIRLS also uses two organising dimensions for the assessment, referred to as the *purposes for reading* and the *reading processes.* Each of the reading processes – focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information and examine and evaluate content, language and textual elements – is assessed within each purpose for reading (reading for literacy experience and reading to gain information). The PIRLS 2011 assessment was based on 10 different texts: five for the literary purpose and five for the informational purpose.

What did TIMSS & PIRLS 2011 participants do?

As TIMSS and PIRLS focus on international curricula in three subject areas – reading, mathematics and science – a large number of test items were required to cover the range of topics and abilities. These items (and their related texts, in the case of PIRLS) were grouped into blocks, which were then distributed across a number of assessment booklets. There were 12 PIRLS booklets and 14 TIMSS booklets, each containing multiple-choice and constructed-response items. Participating students completed only one of these booklets for each study (i.e. one for PIRLS and one for TIMSS), which were evenly distributed within classes. This meant that only two or three students in each class completed each particular TIMSS or PIRLS booklet.

Year 4 students completed one booklet for PIRLS, consisting of two text blocks and their related questions; one booklet for TIMSS, containing one mathematics block and one science block; and one student questionnaire. The assessment was conducted over two days, with one booklet (either PIRLS or TIMSS) completed on each day. The order of the assessment (PIRLS or TIMSS first) was determined during sampling and schools were instructed to follow their assigned order, with the questionnaire being completed on the first day, following the assessment booklet.

A questionnaire that focused on students' early literacy and numeracy activities, plus other background information about the student and their home, was sent home to be completed by parents or guardians. Teachers, principals and curriculum experts also completed questionnaires to find out about what is intended to be taught and about how it is actually taught in classrooms.

How are the results reported?

Results are reported as average scores with the standard error, as distributions of scores, and as percentages of students who attain the international benchmarks, for countries and 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; the 'High international benchmark', which was set at 550; the 'Intermediate international benchmark', which was set at 475; and the 'Low international benchmark', which was set at 400.

Australia's performance in TIMSS & PIRLS 2011 at Year 4

This section provides a summary of the findings to be found in more detail in this report.

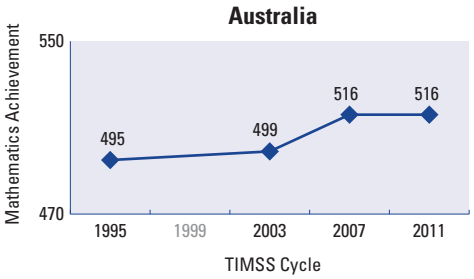
Internationally

In reading (PIRLS):

- With an average reading score of 527 points, Australia's score was lower than that of 21 other participating countries, including Ireland and Northern Ireland, the United States, England and Canada, as well as the participating Asian countries Hong Kong, Singapore and Chinese Taipei. Australia's score was not significantly different to that of six other countries, including New Zealand, and was significantly higher than that of the remaining 17 countries.
- Ten per cent of Australian Year 4 students reached the Advanced international benchmark, 32 per cent the High benchmark and 34 per cent the Intermediate benchmark. Almost one-quarter of students did not reach the Intermediate benchmark. The high achieving countries; Hong Kong, Finland and the Russian Federation had between 18 and 19 per cent of their Year 4 students reach the Advanced benchmark, while fewer than eight per cent failed to achieve the Intermediate benchmark.
- Australian students performed equally well in the two purposes of reading (*literary reading* and *informational reading*) and in the two processes scales (*retrieving and inferencing* and *interpreting, integrating and evaluating*).

In mathematics (TIMSS):

- With an average mathematics score of 516, Australian students performed at a significantly lower level than students in 17 countries, including Ireland and Northern Ireland, the United States and England, as well as the participating Asian countries Singapore, Korea, Hong Kong and Chinese Taipei.
- The performance of Australian Year 4 students has not changed since TIMSS 2007; however it is significantly higher than in TIMSS 1995.

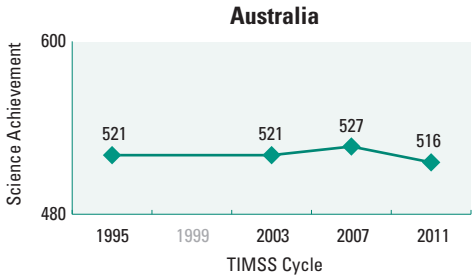


- Ten per cent of Australian students achieved at the Advanced international benchmark, with a further 25 per cent achieving the High international benchmark. Thirty per cent of Australian students did not achieve the Intermediate international benchmark, which is the minimum proficient standard expected.
- The proportion of students achieving at each benchmark has increased significantly since TIMSS 1995.
- Year 4 Australian students are weakest in *number* and strongest in *geometric shapes and measures*, while cognitively, young Australian students are stronger in *applying*.

In science (TIMSS):

- Australia's average score of 516 points in science was significantly lower than that of 18 other countries, including the participating Asian countries Singapore, Chinese Taipei, Korea, Japan, and Hong Kong.

- In TIMSS 2011, Australia's average scale score is not significantly different to the score in TIMSS 1995.



- Seven per cent of Australian students achieved at the Advanced international benchmark, 28 per cent the High international benchmark. Twenty-nine per cent of students in Australia did not reach the Intermediate international benchmark.
- The proportion of students at the Advanced and High benchmarks has decreased significantly since TIMSS 1995. The proportion at the Intermediate and Low benchmarks is the same as in 1995.
- In terms of the content domains, there were no significant strengths or weaknesses. For the cognitive domains, *knowing*, *applying* and *reasoning*, the performance of Australian Year 4 students was similar to their overall science score.

Results for the Australian states and territories

In reading:

The performance of students in the Australian Capital Territory was significantly higher than that of students in all other states. The performance of students in New South Wales and Victoria was not significantly different to each other, and both scored significantly higher than students in the remaining states, with the exception of Tasmania.

Seventeen per cent of students in the Australian Capital Territory achieved the Advanced international benchmark, while just 13 per cent did not achieve the Intermediate benchmark. The next best achieving states were Victoria and New South Wales, in which 12 per cent of students achieved the Advanced international benchmark, almost half (47% and 45% respectively) achieved the High international benchmark and around 20 per cent did not achieve the Intermediate benchmark.

In each of the other states, fewer than ten per cent of students achieved the Advanced benchmark (other than in Tasmania with 11 per cent), and at least one-quarter of the students did not achieve the Intermediate international benchmark.

In mathematics:

The performance of students in the Australian Capital Territory was significantly higher than that of students in all states except Victoria. The performance of students in Victoria and New South Wales was not significantly different to each other, but was significantly higher than performance of students in all remaining states with the exception of Tasmania.

The Australian Capital Territory was the only state with a significant gain in average score since the 2007 TIMSS cycle, but the Australian Capital Territory, New South Wales, Victoria, South Australia and Tasmania have all significantly increased scores from TIMSS 1995.

Fourteen per cent of students in the Australian Capital Territory achieved the Advanced benchmark. Almost half of the students (48%) reached the High international benchmark, while 19 per cent failed to achieve the Intermediate benchmark. The next best achieving states were Victoria and New South Wales with 13 and 12 per cent of students respectively achieving at the

Advanced international benchmark, and around 25 per cent of students in Victoria and New South Wales failing to achieve the Intermediate benchmark.

In each of the other states, fewer than ten per cent of students achieved at the Advanced benchmark and more than 30 per cent of the students did not achieve the Intermediate international benchmark.

In science:

The average science score of students in the Australian Capital Territory was significantly higher than that of students in all other states. The performance of students in New South Wales and Victoria was not significantly different to each other, with students in both of these jurisdictions scoring significantly higher than students in all remaining states, with the exception of Tasmania.

The only change in scores since TIMSS 1995 is a significant decline in scores in Western Australia.

The Australian Capital Territory was the highest performing state, with 13 per cent of students reaching the Advanced international benchmark, just over half (52%) reaching the High international benchmark and 84 per cent achieving at least the Intermediate benchmark. The next best achieving states were Victoria and New South Wales, in which ten per cent and nine per cent respectively achieved the Advanced international benchmark. Forty-one per cent of students in Victoria reached the High benchmark while 38 per cent of students in New South Wales attained this level. Around one-quarter of the students in Victoria and New South Wales did not achieve the Intermediate international benchmark.

In each of the other states, fewer than ten per cent of students achieved at the Advanced international benchmark. In the Northern Territory, 40 per cent of students did not achieve the Intermediate benchmark, while 34 per cent of students in Queensland did not attain this minimum standard of proficiency.

Results for females and males

In reading:

In all but five countries, females significantly outperformed males. In Australia the difference was 17 score points.

While the gender gap appears immutable, several countries have shown this is not the case. Colombia, in particular, has closed the gender gap completely from PIRLS 2001 to PIRLS 2011, and has done this by increasing the average achievement of both females and males. In France and Italy the gender gap has also narrowed, however this is due to a decline in the average achievement of females.

The difference between males and females was significant in Western Australia, Queensland and Victoria, with the size of the gap varying from 33 score points in Western Australia to 17 score points in Victoria. In all other states, there were no significant differences between the average reading scores of male and female students.

In Western Australia only five per cent of males compared to 11 per cent of females achieved the Advanced international benchmark, while 36 per cent of males and 22 per cent of females did not achieve the Intermediate international benchmark. The Australian Capital Territory was the only state in which the proportion of male students not achieving the Intermediate international benchmark was similar to or lower than the proportion of female students at this level. In all other states, a greater proportion of male students did not achieve this standard, and this ranged from 22 per cent in Victoria to 41 per cent in the Northern Territory.

In mathematics:

Internationally 26 countries, including Australia, had no significant gender difference in mathematics achievement at Year 4. Of the 24 remaining countries, 20, including the United States, had small differences favouring male students, and four had relatively larger differences favouring female students (Qatar, Thailand, Oman and Kuwait).

Within Australia, the gender gap was significant only in South Australia, with a 25-point gap in favour of male students.

A higher proportion of male than female students achieved at the Advanced benchmark in all states except Western Australia. The Australian Capital Territory, Victoria, New South Wales and Tasmania had more than ten per cent of male students achieving at the Advanced international benchmark. Only the Australia Capital Territory and Victoria had more than ten per cent of female students reaching this level.

In all states except Tasmania, Western Australia and Northern Territory, the proportion of male students not achieving the Intermediate international benchmark was lower than the proportion of female students who performed at the two lowest benchmarks.

In South Australia there were substantial differences in the proportion of students at the Advanced, High and Low benchmarks. Twice as many males as females achieved at the Advanced benchmark, while 43 per cent of female students did not achieve the Intermediate benchmark, compared to 28 per cent of male students.

In science:

Internationally, 23 countries, including Australia, England, New Zealand and Ireland, had no significant gender differences in science achievement. Of the 27 remaining countries, 16 had relatively small differences favouring male students, and three had relatively small differences favouring females. Eight countries had relatively larger differences favouring female students (the United Arab Emirates, Bahrain, Tunisia, Qatar, Yemen, Oman, Saudi Arabia and Kuwait).

Around seven per cent of female students and eight percent of male students in Australia achieved the Advanced benchmark, however there was a greater proportion of male students than female students not achieving the Low benchmark.

There were no significant gender differences in the average science scores in any of the states.

In terms of benchmarks, there was substantial variation between states. In Tasmania, only seven per cent of females compared to 11 per cent of males achieved the Advanced benchmark. However, 32 per cent of male students in Tasmania, compared to 24 per cent of female students, did not achieve the Intermediate benchmark. In South Australia, only three per cent of female students and six per cent of male students achieved the Advanced benchmark while 30 per cent of male students and 36 per cent of female students did not achieve the Intermediate benchmark.

Results by books in the home

TIMSS and PIRLS collect data at Year 4 level, and do not ask students questions about their parents' occupation or education. Students are asked about the number of books in their home. Books in the home has traditionally acted as a proxy in large scale international studies for a family's educational and social background. Generally, there is a strong correlation between books in the home and parental education and income and a moderate to strong positive correlation between books in the home and achievement, particularly in reading. Research suggests that the number of books in the home can be an indicator of a home environment that values literacy, the acquisition of knowledge and general academic support.

This section provides some evidence about the achievement of students according to the number of books they report in their homes. For the purposes of this report, this variable has been grouped to represent *a few books* – 25 or fewer books (22% of students), *average number of books* – between 26 and 200 books (59% of students) and *many books* – more than 200 books (19% of students).

In reading:

- In general, students who have the most books in the home also have the highest levels of achievement, scoring 19 points, on average, higher than students with an *average number of books* in the home and 64 score points higher than those with *a few books* in the home.

- The highest achieving students in the group who report having many books in the home achieved at a level similar to that of students in many of the top scoring countries, and equivalent to the High international benchmark.
- Of those students who reported having *many books* in the home, 18 per cent achieved the Advanced benchmark, the same proportion as the highest achieving country, Hong Kong. However, only 10 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 attained this level of achievement.
- However, the data also make it evident that while having a home with *many books* (or by implication a home environment that values literacy, the acquisition of knowledge, and general academic support), the relationship is not definitive. Around 16 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark. This still compares favourably with students in the middle category, of whom around 21 per cent of students, and students with *few books* in the home, of whom 40 per cent did not achieve the Intermediate benchmark.

In mathematics:

- Students who reported having the most books in the home were found to have the highest levels of mathematics achievement, scoring, on average, 19 points higher than students with an *average number of book*s in the home, and 71 score points higher than those with *a few books* in the home.
- Of those students who reported having many books in the home, 18 per cent achieved the Advanced benchmark. The proportion of students achieving this highest benchmark fell to 10 per cent for 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.
- At the other end of the achievement scale, a total of 21 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark. However the performance of these students is still substantially better than that of students with access to fewer resources. Of those students in the *average* number of books in the home category, a total of 25 per cent of students did not achieve the Intermediate benchmark, while almost half of the students who reported having *few books* in the home did not achieve the Intermediate benchmark.

In science:

- Students who reported the most books in the home also have the highest levels of achievement in science, scoring 22 points, on average, higher than students with an *average number of books* in the home, and 67 score points higher than those with *a few books* in the home.
- 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 seven per cent of students in the *average* number of books category and just two per cent of those with *few books* in the home attaining this level of achievement.
- Around 18 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark. However the influence of books in the home is clear, as this group of students still performs better than other students. Twenty-four per cent of students with an *average* number of books did not achieve the Intermediate benchmark, and 46 per cent of those with *few books* in the home did not achieve even this basic level.

Results for Indigenous students

In reading:

- Indigenous students attained an average score on the PIRLS test of 475 score points, while the average for non-Indigenous students was 532 score points.

- Eleven per cent of non-Indigenous students achieved the Advanced benchmark compared to three per cent of Indigenous students, however, 48 per cent of Indigenous students (compared to 22 per cent of non-Indigenous students) did not achieve the Intermediate international benchmark, with 21 per cent of Indigenous students not reaching the Low benchmark.

In mathematics:

- Indigenous students attained an average score of 458 score points in mathematics, which was 64 score points lower than the average score for non-Indigenous students of 522.
- Ten per cent of non-Indigenous students reached the Advanced benchmark, compared to two per cent of Indigenous students. More than half (55 per cent) of Indigenous students compared to 28 per cent of non-Indigenous students did not achieve the Intermediate international benchmark, with 28 per cent of Indigenous students not reaching the Low benchmark.
- There was a significant improvement in mathematics achievement for students with an Indigenous background between 2007 and 2011, and between 1995 and 2011, with a 27 and 28 point increase respectively.
- There was a significant increase in the scores of Indigenous students from TIMSS 1995; however, the gap in scores between Indigenous and non-Indigenous students is around the same as that reported in TIMSS 1995.

In science:

- Indigenous students attained an average score in science of 458 score points, half the standard deviation lower than the average score for non-Indigenous Australian students of 522 score points.
- Eight per cent of non-Indigenous students reached the Advanced benchmark compared to two per cent of Indigenous students, while the proportion of Indigenous students who did not achieve the Intermediate international benchmark was twice that of non-Indigenous students, 53 per cent compared to 26 per cent.
- The scores of Indigenous students in science has not changed significantly since TIMSS 1995, but combined with a decline in the average score for non-Indigenous students, the gap has narrowed a little.

Results for language background

Students were categorised according to their own reports about the language spoken at home: those who 'always' spoke English, and those who indicated that they 'sometimes' or 'never' spoke English, who were considered to have a language background other than English (LBOTE). Twenty-one per cent of students in the Year 4 sample indicated that they did not speak English at home.

In reading:

- Students with a language background other than English scored, on average, a significant 18 points lower in reading than these students who always spoke English at home.
- The proportion of students from English-speaking backgrounds achieving the Advanced international benchmark was higher than that of LBOTE students: 11 per cent of English background students and seven per cent of students from a language background other than English. At the lower levels of achievement the differences were greater, with 30 per cent of students from a non-English speaking background compared to 22 per cent from an English speaking background not achieving the Intermediate benchmark.

In mathematics:

- Students with a language background other than English scored, on average, 13 points lower than the students who spoke English at home. This apparent difference was not statistically significant.
- A similar proportion of students from both groups achieved the Advanced international benchmark: 10 per cent of English background students and nine per cent of students from

a language background other than English. At the lower levels of achievement, 33 per cent of students from a non-English speaking background compared to 28 per cent from an English speaking background did not achieve the Intermediate benchmark.

In science:

- At the Year 4 level, students who 'always' spoke English at home achieved a significant 24 score points higher on average than students with a language background other than English.
- Eight per cent of English-background students and five per cent of students from a language background other than English reached the Advanced benchmark. At the lower levels of achievement, 37 per cent of students from a LBOTE background compared to 26 per cent from an English-speaking background did not achieve the Intermediate benchmark.

Results for geographic location

The proportion of Australia's population living in rural and remote areas continues to decline. According to ABS estimates from 2010, about nine per cent of the population live in outer regional areas and about two per cent in remote and very remote areas.

To undertake the analyses in this section of the report, school addresses were coded using the MCEETYA Schools Geographic Location Classification (see the Reader's Guide). Only the broad categories – Metropolitan, Provincial and Remote – are used in these analyses.

In reading:

- Students attending schools in metropolitan areas performed, on average, 14 score points higher than students attending schools in provincial areas, and 70 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 56 score points higher than students attending schools in remote areas.
- Eleven per cent of students in metropolitan schools achieved the Advanced international benchmark, with 78 per cent achieving at least the Intermediate benchmark. In provincial schools, eight per cent of students achieved the Advanced benchmark, and 71 per cent achieved the Intermediate benchmark. In stark contrast, just one per cent of students attending schools in remote areas achieved the Advanced international benchmark, and 48 per cent achieved the Intermediate benchmark.

In mathematics:

- Students attending schools in metropolitan areas scored, on average, 16 score points higher than students attending schools in provincial areas, and 64 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 48 score points higher than students attending schools in remote areas.
- Eleven per cent of students from metropolitan schools, eight per cent of students from provincial schools and three per cent of students in remote schools achieved at the Advanced benchmark. The proportion of students from remote schools who attained the Intermediate international benchmarks was 50 per cent, compared to 72 and 66 per cent of students from metropolitan and provincial schools, respectively.

In science:

- Students attending schools in metropolitan areas scored 13 score points higher on average than students attending schools in provincial areas, and 61 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 48 score points higher than students attending schools in remote areas.
- Eight per cent of students in metropolitan schools achieved the Advanced international benchmark, while 27 per cent did not achieve the Intermediate benchmark. In contrast, just three per cent of students attending schools in remote areas achieved the Advanced international benchmark, 48 per cent did not achieve the Intermediate benchmark.

Student attitudes and home influences

- Students who indicated that they like reading, mathematics or science scored higher on average in the cognitive assessments than did other students.
- Students who felt confident in reading, mathematics or science scored higher on average in the cognitive assessments than did other students.
- A lack of motivation to read was associated with lower achievement in reading and the difference in achievement between those who were motivated to read and those who were not was greater among males and Indigenous students.
- Among Australian students, female students were more likely to like reading and were more confident in reading than their male peers, while male students liked learning mathematics to a greater degree and expressed greater confidence with mathematics than their female peers. There was no difference between male and female students in the degree to which they liked learning science or felt confident with science.
- Fewer Indigenous students liked or felt confident in reading, compared to their non-Indigenous peers. Likewise, Indigenous students' confidence with science was lower than that of their non-Indigenous peers. However, there were no significant differences in the proportions of Indigenous and non-Indigenous students who liked learning mathematics and science, or felt confident with mathematics.
- Australia was one of the countries with the highest proportions of students with *many resources* for learning in the home.
- In general, students whose parents *often* engaged their child in early literacy and numeracy activities before beginning primary school had higher reading and mathematics achievement (respectively) than students whose parents only *sometimes* engaged them in such activities. Correspondingly, students whose parents reported that their child performed *very well* on early literacy and numeracy tasks when they entered primary school had higher reading and mathematics achievement (respectively) than students who were reported to perform *moderately well* or *not well*.
- Attending a pre-primary education program was associated with higher reading, mathematics and science achievement.
- Students whose parents *like* reading had higher reading achievement than those students whose parents *somewhat like* reading or *do not like* reading.
- Students whose parents expected that their child would complete university study (either undergraduate or postgraduate) scored higher in reading, mathematics and science than students whose parents expected them to complete some other form of post-secondary study, or who thought that their child would end their education with secondary school.

Teachers and schools

- The majority of Year 4 students in Australia were taught by female teachers, and teachers aged between 30 and 50.
- The proportion of Year 4 students in Australia who had teachers with post-graduate qualifications is far greater than the average across countries participating in TIMSS and PIRLS.
- Having a teacher with a specialisation in language or reading theory or primary education (with or without a specialisation in science) was associated with better performance in reading and science (respectively) for Australian students. There was no similar relationship found between the qualification of mathematics teachers and students' performance in the TIMSS mathematics assessment.
- Year 4 students whose teachers were satisfied with their careers performed better in reading, mathematics and science than students whose teachers were not as satisfied.

- Far greater proportions of Australian Year 4 students had access to computers to use in their reading, mathematics and science classes than was the case internationally, but this had no impact on their performance in these subjects.
- Only three-quarters of Australian Year 4 students were being taught mathematics by teachers who were *very confident* of teaching mathematics, however only 43 per cent of students were being taught science by teachers who expressed that they were *very confident* teaching science. As well, just 51 per cent of students had teachers who classed themselves as *very well prepared* to teach science, and this declined to under 50 per cent in the areas of physical science and Earth science.
- The economic makeup of schools had an impact on the performance of students, with students in schools with more affluent than disadvantaged students scoring higher in reading, mathematics and science than students in schools with more disadvantaged than affluent students.
- The proportion of a school's student population who spoke English as their first language did not appear to have an influence on average student achievement in reading, mathematics or science.
- Resource shortages in the areas of reading, mathematics and science were quite rare among Australian schools, but did show a relationship with student performance – students in schools that were not affected by resource shortages in reading, mathematics or science had achievement scores that were higher on average than students in schools that were somewhat affected by such shortages.

The school climate

- Achievement in reading, mathematics and science was higher on average –
  - Among students who: liked school and felt like they belong, were engaged during lessons, felt that they were safe and were almost never or only sometimes bullied.
  - In schools in which principals and teachers report a very high or high emphasis on academic success, that teachers thought were safe and orderly, where student factors such as lack of prerequisite knowledge, nutrition and sleep deprivation and disruptive or uninterested students did not impact on student learning and where teachers reported hardly any problems with working conditions.
- Among Australian students, engagement was highest (that is, the greatest proportion of students were in the most engaged category) in science, followed by mathematics and then reading.
- The percentage of Australian Year 4 students in the most engaged category for reading lessons was significantly lower than the international average.
- Compared to the international average, more Australian Year 4 students reported being bullied *about weekly* and fewer reported being bullied *almost never*.
- The percentage of Australian Year 4 students who had teachers who reported schools as *safe and orderly* was significantly higher than the international average.
- Around 44 per cent of students had teachers who reported *hardly any problems* with their working conditions, which was a figure significantly greater than the international average.

Policy considerations

The results of TIMSS 2011 show that Australia's scores in mathematics and science have largely stagnated over the past 16 years. The only area in which Australian achievement has shown improvement over this time has been in mathematics at Year 4 (and this increase occurred between TIMSS 2007 and TIMSS 2003); while our first participation in PIRLS has highlighted that many Year 4 students have substantial literacy problems.

Over this same time, a number of other countries have either dramatically improved their results (Singapore and Hong Kong, for example), or slowly but surely improved (for example the United States in mathematics). Many more countries now outperform Australia in mathematics and science than they did in TIMSS 1995 or in TIMSS 2007, and we have seen that a substantial proportion of developed countries also outperform Australia in PIRLS.

It is clear that in each of the three areas – reading, mathematics and science – Australia has a substantial 'tail' of underperformance. For such a highly developed country, this level of underperformance is not acceptable and its minimisation should become a priority. Examining policy in countries such as the Netherlands, in which all students attained at least the Low benchmark in reading, could provide some pointers. If the seven per cent of students in Australia currently not achieving this very basic level of literacy were to do so, it would lift Australia's overall average score substantially.

In addition, more attention needs to be paid to extending students at the highest levels of achievement. In comparison to higher achieving countries, the proportion of Australian students at the High and Advanced benchmarks is modest.

Science at the primary level continues to be a concern. In comparison to the international average, few primary teachers have a science background; compared to mathematics and reading there is substantially less professional development undertaken in science; and teachers' reported level of confidence in teaching science is substantially lower than their confidence in teaching reading or mathematics. Only around half of the students in TIMSS were being taught science by teachers who felt *well-prepared* to teach all science topics, this dipped to less than half for the particular areas of physical and Earth science.

It is evident that student motivation and self-confidence are also important factors within Australia. Similarly, teachers' job satisfaction is important, as is the provision of a supportive, ambitious school climate. It is important that Australia continues to develop systems that build accountability and support capacity building for teachers and school management in order to address attitudinal barriers towards teaching and learning, particularly in specific subject areas.

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Reader's Guide

Sample surveys

TIMSS and PIRLS are conducted as sample surveys 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 that country. The samples are designed and conducted so that they provide reliable estimates about the population which they represent. Sample surveys are cheaper to undertake and less burdensome for schools than a full census of the particular population.

The basic sample design for TIMSS and PIRLS is generally referred to as a two-stage stratified cluster sample design. The first stage generally consisted of a sample of schools and the second stage consisted of a single 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.

Scores in TIMSS and PIRLS

TIMSS and PIRLS both used item response theory (IRT) methods (please refer to the International Technical report for more information about item response theory) to summarise the achievement for Year 4 students on a scale with a mean of 500 and a standard deviation of 100. It should be noted that the results for mathematics and science should not be compared. While the scales are expressed in the same numerical units, they are not directly comparable in terms of being able to say how much learning in mathematics equals how much learning in science. Nor is it possible to compare the learning of Year 4 students in mathematics and science to those of Year 8 students (presented in a separate volume). That is, achievement on the TIMSS and PIRLS scales cannot be described in absolute terms (like all such scales developed using IRT technology). Comparisons can only be made in terms of relative performance (higher or lower), for example, among countries and population groups as well as between assessments.

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

As this is the first cycle in which Australia has participated in PIRLS, it is not possible to report on any trends for this study.

International comparison statistics

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

The *TIMSS/PIRLS scale centrepoint* is the mean of the scales (for each of Year 4 reading, mathematics and science) established in the first cycle of each 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/PIRLS 2011 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.

Confidence intervals and standard errors

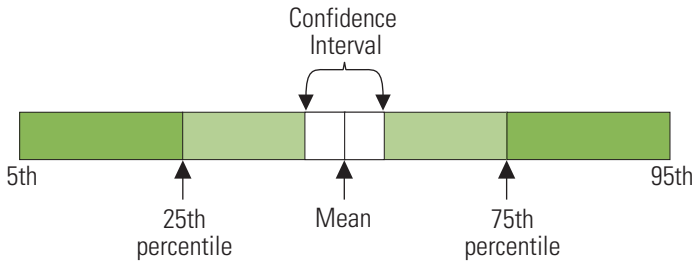
In this and other reports, student achievement is often described by a mean score. For TIMSS and PIRLS, each mean score is calculated from the sample of students who undertook the assessments. These sample means are an approximation of the actual mean score (known as the population mean) that would have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

Reading the achievement graphs



Each country's results are represented in horizontal bars with various colours. On the left end of the bar is the 5th percentile – this is the score below which five per cent of the students have scored. The next line indicates the 25th percentile. The white band is the confidence interval for the mean – that is, we are 'confident' that the mean will lie within this white band. The line in the centre of the white band is the mean. The lines to the right of the white band indicate the 75th and 95th percentiles.

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.

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.

Naming of countries

A number of countries have longer official names than they are usually referred to in conversation. In order to facilitate the reading of these reports, these countries are referred to by their shortened form (e.g. Hong Kong, Korea, Syria) in the text but are referred to by their official name (e.g. Hong Kong SAR; Korea, Rep of; Syrian Arab Republic) in the figure displaying participating countries in Chapter 1. All references to Belgium refer to Flemish-speaking Belgium.

Definitions of background characteristics

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

Indigenous background:

Indigenous background is derived from students' self-identification as being of Australian Aboriginal or Torres Strait Islander descent. For the purposes of this report, data for the two groups are presented together for Indigenous Australian students.

Geographic location:

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, Swansea and Alice Springs). Very remote: very little accessibility of goods, services and opportunities for social interaction (e.g. Bourke, Thursday Island, Yalata, Condingup, Nhulunbuy).

Language spoken at home:

The language spoken at home indicates whether a student has a language background other than English. The question asked how often English was spoken at home. Where the student spoke English never or only sometimes, the student was considered to have a language background other than English. Those who indicated that they spoke English always or almost always were considered to be from an English-speaking background.

Parental Education:

Parental education is based on the answers of Year 8 students to the questions:

- What is the highest level of education completed by your mother (or stepmother or female guardian)?; and
- What is the highest level of education completed by your father (or stepfather or male guardian)?

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.

Year 4 students were not asked about their parents' education level as the reliability of the data provided on this topic by children of this age would be questionable.

Chapter

1 Introduction

The Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) are international studies directed by the IEA (International Association for the Evaluation of Educational Achievement), 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. In Australia, TIMSS and PIRLS are implemented by the Australian Council for Educational Research (ACER), which is Australia's representative to the IEA.

TIMSS and PIRLS share the goal of providing comparative information about educational achievement across countries to improve teaching and learning (in mathematics and science at Year 4 and Year 8 using TIMSS and in reading at Year 4 using PIRLS). They also provide comparative perspectives on trends in achievement in the context of different educational systems, school organisational approaches and instructional practices and to enable this, TIMSS and PIRLS collect a rich array of background information.

Conducted on a regular four-year cycle, TIMSS has assessed mathematics and science internationally in 1995, 1999[1], 2003, 2007 and in 2011. In addition to monitoring trends in achievement at Year 4 and Year 8, TIMSS provides information about relative progress across years as the cohort of students assessed in Year 4 in one cycle moves to Year 8 four years later (e.g. the cohort of Year 4 students of 2003 became the cohort of Year 8 students of 2007 and the cohort of Year 4 students of 2007 became the cohort of Year 8 students of 2011). PIRLS is conducted on a five-year cycle, with assessment having occurred in 2001, 2006 and 2011. PIRLS is conducted with Year 4 students only.

In 2011[2], the cycles for TIMSS and PIRLS coincided for the first time and participating countries were offered an unprecedented opportunity to conduct both TIMSS and PIRLS with their Year 4 students. Some countries elected to participate in both studies but to use separate samples of students for each assessment. Australia was one of a group of countries who elected to have the same sample of Year 4 students[3] participate in TIMSS and PIRLS, thus receiving results for students in reading, mathematics and science.

As a result of this decision, just over 6000 Australian students in Year 4 participated in both studies. These students completed tests in reading, mathematics and science achievement and

1 The 1999 TIMSS assessment was only a partial replication of TIMSS 1995. Internationally only the upper year levels were tested, and the design in Australia was such that it is not comparable with data from other cycles.

2 For comparability across countries and across assessments, testing was conducted at the end of the school year. The countries in the southern hemisphere tested in October to November 2010. The remaining countries tested at the end of the northern hemisphere school year: May to June 2011.

3 The number of students who actually took the TIMSS and PIRLS assessments varies because of student absenteeism.

answered questionnaires on their background and experiences in learning reading, mathematics and science at school. School principals and the students' reading, mathematics and science teachers also completed detailed questionnaires. In 58 other countries and ten regions or benchmarking participants[4], students, teachers and principals completed the same tests and questionnaires.[5]

At the same time, more than 7500 Australian Year 8 students also participated in TIMSS, completing tests to assess their mathematics and science achievement and answering questionnaires about their background and experiences in learning mathematics and science at school. School principals and the students' mathematics and science teachers also completed detailed questionnaires. In 44 other countries and 14 regions or benchmarking participants, students, teachers and principals completed the same tests and questionnaires.

Why TIMSS and PIRLS?

The main goal of TIMSS is to assist countries to monitor and evaluate their mathematics and science teaching across time and across year levels, while PIRLS aims to achieve the same for reading literacy.[6] These studies offer countries an opportunity to:

- have comprehensive and internationally comparable data about what mathematics and science concepts, processes and attitudes students have learned by Year 4 and Year 8 and what reading concepts, processes and attitudes students have learned by Year 4;
- assess progress internationally in mathematics and science learning across time for students in Year 4 and for students in Year 8;
- identify aspects of growth in mathematical and scientific knowledge and skills from Year 4 to Year 8;
- monitor the relative effectiveness of teaching and learning of mathematics and science at Year 4 as compared to Year 8, since the cohort of Year 4 students is assessed again as Year 8 students;
- understand the contexts in which students learn best. TIMSS enables international comparisons among the key policy variables in curriculum, instruction and 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 subgroups and address equity concerns;
- allow countries to add questions of national importance (national options) as part of their data collection effort.

This report provides the Australian perspective for Year 4 achievement in reading, mathematics and science in TIMSS and PIRLS 2011, examining the issues presented above and issues particular to the Australian context, such as:

- How do Australian students score in each subject domain?
- How does this compare internationally and what is happening within Australia?
- Are there trends in mathematics and science achievement that can be seen from these data?[7]

4 A benchmarking participant is a province or region that participated in TIMSS and/or PIRLS for their own internal benchmarking. Data from these provinces are not included in the international mean and are not included in the report.

5 The number of participating countries varied between TIMSS and PIRLS.

6 Parts of this chapter are modified, with permission, from the TIMSS 2011 Assessment Frameworks (Mullis, Martin, Ruddock, O'Sullivan & Preuschoff, 2009) and PIRLS 2011 Assessment Frameworks (Mullis, Martin, Kennedy, Trong & Sainsbury, 2009).

7 2011 was the first year in which Australia participated in PIRLS thus it is not possible to examine any trends in reading achievement.

- Has Australia's achievement remained the same in comparison to other countries to which we would normally compare ourselves?

Another characteristic of TIMSS and PIRLS is that data are also collected at the teacher and school level, so that such data can be used to highlight characteristics of teaching and learning of reading, mathematics and science in Australia.

A companion report provides results pertaining to the achievement of Australian Year 8 students in mathematics and science as measured in TIMSS 2011.

Research model for IEA studies

TIMSS focuses on three levels of the curriculum, considered in relation to the context in which they occur. These levels are shown in Figure 1.1.

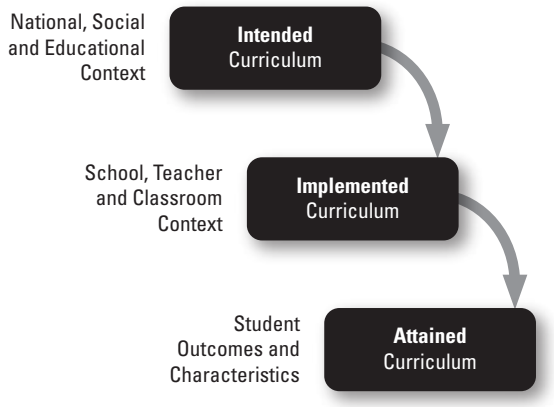


Figure 1.1 Three levels of curriculum developed in IEA research models

The research questions associated with each of the levels of curriculum 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 learned by students, as demonstrated by their attitudes and achievements. *What mathematics and science concepts, processes and attitudes have students learned? 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 curriculum questionnaires. These extensive questionnaires were completed in Australia by curriculum experts in each state and territory education department, the results collated by ACER and submitted to the International Study Centre.

The data describing the implemented curriculum were gathered through the school and teacher questionnaires. The school questionnaire investigated aspects related to the teaching of reading, mathematics and science, such as organisation, teaching resources and time allocation, and the teacher questionnaire explored the implementation of the curriculum in the school by the actual teachers of reading, mathematics and science for the TIMSS and PIRLS students.

Finally the data describing the attained curriculum are those data presented in this report – the achievement data from the assessment conducted for TIMSS and PIRLS 2011.

Organisation of TIMSS and PIRLS

TIMSS was organised by the IEA and managed by the TIMSS & PIRLS International Study Centre, Lynch School of Education, at Boston College in the United States. In Australia, the study was funded by the Australian Government Department of Education, Employment and Workplace Relations (DEEWR) and by State and Territory Departments of Education proportional to the size of their student population. The study was managed in Australia by the Australian Council for Educational Research (ACER), which represents Australia to the IEA.

Meetings of National Research Coordinators occur twice yearly in order to plan and report on each stage of the process, in consultation with Statistics Canada and the IEA Data Processing Centre, Hamburg.

What is assessed

TIMSS

Two organising dimensions – a content dimension and a cognitive dimension – framed the mathematics and science assessment for TIMSS 2011, analogous to those used in the earlier TIMSS assessments. The *content* dimension of the assessment specifies the domains or subject matter to be assessed within mathematics or science, while the *cognitive* dimension specifies the domains or thinking processes to be assessed. The cognitive domains describe the sets of behaviours expected of students as they engage with the mathematics or science content.

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. In mathematics there is more emphasis on *number* at Year 4 than in Year 8, in science there is more emphasis on *life science* in Year 4 than in Year 8. Nevertheless the cognitive framework is the same for both year levels, encompassing a range of cognitive processes involved in working mathematically or scientifically and solving problems right through the primary and middle school years.

PIRLS

PIRLS also uses two organising dimensions for the assessment, referred to as the *purposes for reading* and the *reading processes*.

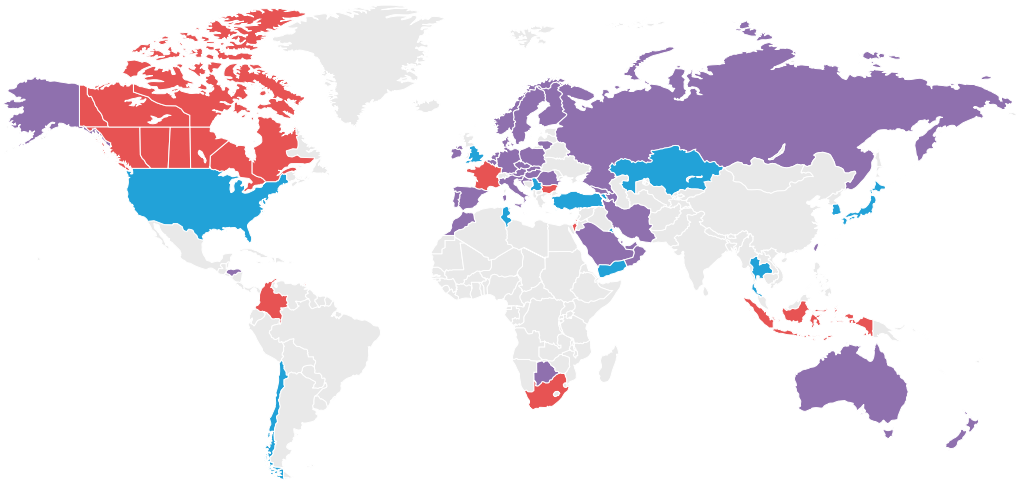
Each of the reading processes – focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information and examine and evaluate content, language and textual elements – is assessed within each purpose for reading (reading for literacy experience and reading to gain information). The PIRLS 2011 assessment was based on 10 different texts, five for the literary purpose and five for the informational purpose.

Further details about the content and cognitive domains and the reading processes and purposes on which the Year 4 TIMSS and PIRLS students were assessed are provided in Appendices 2 and 3.

Who participated?

Countries

A total of 59 countries (including a number of countries which tested older students and are thus not included in the calculation of international means or reported here) and 10 benchmarking participants participated in either the TIMSS assessment or the PIRLS assessment or both. The participating countries are shown in Figure 1.2.



TIMSS and PIRLS

Australia
Austria
Azerbaijan
Chinese Taipei
Croatia
Czech Republic
Denmark
Finland
Georgia
Germany
Hong Kong, SAR
Hungary
Iran, Islamic Rep. of
Ireland
Italy
Lithuania
Malta
Morocco
Netherlands
New Zealand
Northern Ireland
Norway
Oman
Poland
Portugal
Qatar
Romania
Russian Federation
Saudi Arabia
Singapore
Slovak Republic
Slovenia
Spain
Sweden
United Arab Emirates
Abu Dhabi, UAE*
Dubai, UAE*
Alberta, Canada*
Ontario, Canada*
Quebec, Canada*
Botswana†
Honduras†

PIRLS

Belgium (French)
Bulgaria
Canada
Columbia
France
Indonesia
Israel
Trinidad and Tobago
Eng/Afr Rep of South Africa*
Maltese, Malta*
Andalusia, Spain*
Kuwait†
Morocco†

TIMSS Year 4

Armenia
Bahrain
Chile
England
Japan
Kazakhstan
Korea, Rep. of
Kuwait
Serbia
Thailand
Tunisia
Turkey
United States
Yemen
Florida, US†
North Carolina, US*
Yemen†
Belgium (Flemish)

*Benchmarking participant only.
† Tested students in other year levels (Year 6)
Results for these participants are not included in the calculation of the international mean or included in this report. For their results, please see the TIMSS and PIRLS International Reports.

Figure 1.2 Countries participating in TIMSS & PIRLS 2011 at Year 4.

Sample schools

The international sample design for TIMSS and PIRLS 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 state,[8] sector and by geographic location. This ensures that the sample drawn is representative of each of those strata. The second stage of sampling consists of a sample of one classroom from the target year in sampled schools.

To ensure accurate and unbiased data, the TIMSS & PIRLS International Study Centre 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 only achieved these requirements 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. Australia achieved the minimum participation rate for both Population 1 (Year 4) and Population 2 (Year 8).

8 In this report the Australian states and Territories are referred to collectively as the 'states'.

Students

The weighted[9] numbers for Australia for Year 4, along with the number of schools and actual number of students participating, are shown in Table 1.1.

Table 1.1 Australian designed and achieved school sample, Year 4

			PIRLS			TIMSS			
	Designed school sample	*N* schools	*N* students	Weighted *N* students	Weighted % students	*N* schools	*N* students	Weighted *N* students	Weighted % students
ACT	30	29	609	4187	1.7	29	603	4187	1.7
NSW	45	44	1067	82935	33.0	44	1077	82935	33.0
VIC	45	42	764	56232	22.4	42	760	56232	22.4
QLD	45	44	1065	56213	22.4	44	1066	56213	22.4
SA	40	39	772	18855	7.5	39	778	18855	7.5
WA	40	40	865	24788	9.9	40	872	24788	9.9
TAS	30	28	522	6000	2.4	28	524	6000	2.4
NT	15	14	462	2002	0.8	14	466	2002	0.8
TOTAL	290	280	6126	251213	100	280	6146	251213	100

Age of students and reporting of trends

For TIMSS 1995, students were selected from the two adjacent year levels containing the largest number of nine-year-olds for Population 1. However, school entry age is not standard in Australia, which meant that a range of year levels had to be selected from which to sample students. Due to these differences, data collection for TIMSS 1995 was undertaken at the following year levels:

- Years 3 and 4 in the Australian Capital Territory (ACT), New South Wales (NSW), Victoria (VIC) and Tasmania (TAS); and
- Years 4 and 5 in Queensland (QLD), South Australia (SA), Western Australia (WA) and the Northern Territory (NT).

TIMSS 1999 was a partial repeat of TIMSS 1995 and was carried out at Year 8 only. However, the sample was a national one and data were collected in Year 8 in some states and Year 9 in others. Therefore, data from this cycle is not comparable with other years. For the TIMSS 2003 and subsequent cycles, a decision was made by the IEA and the International Study Centre that the focus for Population 1 would be Year 4. In Australia at the time, this had consequences for Western Australia and Queensland, which were the only states to enrol students directly into Year 1, without a preparatory year. In those states, the TIMSS 2003 data showed that students were on average eight months younger than their peers in other states. Differences remain in the average age of Year 4 students across the Australian states, as can be seen in Table 1.2.

Internationally, comparisons can be made with TIMSS 1995, using data sets containing only the revised target year levels from each state and territory. Trend comparisons conducted for this study will be for TIMSS 1995, 2003, 2007 and 2011.

In 2011, due to differences in school starting ages between the states, the age of students in Year 4 varied across states, with the youngest students around 9 years 7 months in Queensland and the oldest around 10 years 5 months in Tasmania (Table 1.2). In the achievement tables for reading,

9 Sample numbers are weighted to represent the proportion of students in each state within the Australian population of Year 4 and 8 students.

mathematics and science (Table 2.1, Table 3.1 and Table 4.1 respectively), the average age of students in each country is also provided, for comparison.

Table 1.2 Average age for Year 4 students, Australia and by state

State/Territory	Average age	SE
ACT	10.1	0.01
NSW	10.1	0.02
VIC	10.2	0.02
QLD	9.6	0.02
SA	10.0	0.02
WA	9.9	0.01
TAS	10.4	0.02
NT	10.0	0.02
Australia	10.0	0.01

What did participants do?

Procedures for administering the test were determined by the TIMSS & PIRLS International Study Centre 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 school principal, assisted the National Centre with the management of TIMSS and PIRLS within the school, including administering the School and Teacher questionnaires. The actual test and student questionnaires were administered, in most cases, by a teacher from the school. The Test Administrator followed strict guidelines and had to complete a report about any situation that constituted a deviation from these guidelines. A National Quality Control Observer visited 10% of schools to observe the test administration. An International Quality Control Observer visited a further 15 schools as well as examining the operations of the National Centre.

As TIMSS and PIRLS focus on international curricula in three subject areas – reading, mathematics and science – a large number of test items were required to cover the range of topics and abilities. These items (and their related texts, in the case of PIRLS) were grouped into blocks, which were then distributed across a number of assessment booklets. There were 12 PIRLS booklets and 14 TIMSS booklets, each containing multiple-choice and constructed-response items. Participating students completed only one of these booklets for each study (i.e. one for PIRLS and one for TIMSS), which were evenly distributed within classes. This meant that only two or three students in each class completed each particular TIMSS or PIRLS booklet. Further information on the TIMSS and PIRLS assessment booklets and the types of items students attempted to complete is presented in Appendix 2, or available in the assessment frameworks.[10]

Year 4 students completed one booklet for PIRLS, consisting of two text blocks and their related questions; one booklet for TIMSS, containing one mathematics block and one science block; and one student questionnaire. The assessment was conducted over two days, with one booklet (either PIRLS or TIMSS) completed on each day. The order of the assessment (PIRLS or TIMSS first) was determined during sampling and schools were instructed to follow their assigned order, with the questionnaire being completed on the first day, following the assessment booklet.

10 The TIMSS 2011 Assessment Frameworks (Mullis, Martin, Ruddock, O'Sullivan & Preuschoff, 2009) and the PIRLS 2011 Assessment Frameworks (Mullis, Martin, Kennedy, Trong & Sainsbury, 2009).

TIMSS and PIRLS contextual framework

For a more complete understanding of what the TIMSS and PIRLS achievement results mean and how they may be used to improve student learning in reading, mathematics and science, it is important to understand the contexts in which students learn. After the achievement data were collected from students, each student completed a background questionnaire. The background information collected included demographic data and students' attitudes towards reading, mathematics and science.

Teacher and School Questionnaires were also administered to the mathematics and science teacher(s) of the selected class and to the principal of the school.

The internationally standard Student Questionnaire sought information on students and their family background, aspects of learning and instruction in science and context of instruction including instructional time and class size.

The Teacher Questionnaire examined a variety of issues related to qualifications, pedagogical practices, teaching styles, use of technology, assessment and assignment of homework and classroom climate.

The School Questionnaire, answered by the principal (or the principal's designate), sought descriptive information about the school and information about instructional practices. For example, questions were asked about recruitment and numbers of staff, teacher morale, school and teacher autonomy, school resources and school policies and practices, such as use of student assessments.

The Home Questionnaire, called the Learning to Read survey, is designed to be answered by students' parents or guardians and sought information about the students' early at-home experiences with numeracy and literacy-type activities, as well as information about the parents' own experiences and attitudes towards reading activities.

How results are reported

International comparative studies have provided an arena to observe the similarities and differences between educational policies and practices and enable researchers and others to observe what is possible for students to achieve and what environment is most likely to facilitate their learning. TIMSS and PIRLS provide regular information on educational outcomes within and across countries by providing insight about the range of skills and competencies in mathematics and science at two key year levels and reading at one year level.

Similar to other international studies, TIMSS and PIRLS results are reported as means that indicate average performance and various statistics that reflect the distribution of performance. School, teacher and student variables further enhance the understanding of student performance. TIMSS and PIRLS also attach meaning to the performance scales by providing a profile of what students have achieved in terms of 'benchmarks'. Students at a particular benchmark typically demonstrate not only the knowledge and skills associated with that level but also the proficiencies required at lower levels. Further details on the benchmarks, as well as exemplars, are provided in Appendices 2 and 3.

It should be noted that the results for Year 4 and Year 8 are not directly comparable, nor are the results for reading, mathematics and science. While the scales for the two year levels and the three subject areas are expressed in the same numerical units, they are not directly comparable in terms of being able to say how much achievement or learning at one year level or in one subject equals how much achievement or learning at the other year level or subject. That is, achievement on the TIMSS and PIRLS scales cannot be described in absolute terms (like all scales developed using IRT technology). Comparisons only can be made in terms of relative performance (higher or lower), for example, among countries and population groups as well as between assessments.

Organisation of this report

Chapter 2 describes the international and national results in reading literacy for Year 4 students in detail, including the reading purposes and processes subscales, as well as describing the international benchmarks. Chapter 3 focuses on the international and national results for achievement overall, in the content and cognitive domains and for the international benchmarks, for mathematics at both year levels. Chapter 4 mirrors this for science. Chapter 5 reports on student attitudes and early home experiences in relation to achievement, Chapter 6 focuses on teachers and schools, Chapter 7 examines the school climate from multiple perspectives and Chapter 8, the final chapter, presents a summary and policy considerations arising from the TIMSS and PIRLS results.

Chapter

2 Reading

Key findings:

- With an average reading score of 527 points, Australia's score was lower than that of 21 other participating countries.
- Ten per cent of Australian Year 4 students reached the Advanced international benchmark, 32 per cent the High benchmark and 34 per cent the Intermediate benchmark. Almost one-quarter of students did not reach the Intermediate benchmark.
- Female Year 4 students scored higher on average in the PIRLS assessment than did their male peers. Greater proportions of female students reached the Advanced international benchmark while greater proportions of male students did not reach the Intermediate benchmark.
- The Australian Capital Territory was the best performing state in terms of both average reading score and performance at the international benchmarks.
- Students from homes with more literacy resources (in terms of books in the home) have higher achievement, on average, in reading than students from less well resourced homes.
- Indigenous students scored significantly lower that non-Indigenous students in the reading assessment, but their average score was still at the Intermediate benchmark.
- Students from metropolitan schools performed better in reading than students from provincial schools who in turn performed better than students from remote schools.
- In terms of the purposes and comprehension processes of reading that PIRLS assesses, Australian students performed equally well in the two purposes of reading (*literary reading* and *informational reading*) and in the two processes scales (*retrieving and inferencing* and *interpreting, integrating and evaluating*). This pattern was apparent in all states, across gender and Indigenous background.

Reading is probably the most important skill for children to develop in their early years, underpinning learning in all other areas. Recognising the importance of reading in the development of children, the International Association for the Evaluation of Educational Achievement (IEA) marked the beginning of the 21st century by inaugurating the Progress in International Reading Literacy (PIRLS) study, to measure children's reading achievement at Year 4, every five years. Year 4 is an important point in children's development as readers, as it is at this age that most students make the transition from learning to read to reading to learn.

For the first time in 2011, Australia participated in the PIRLS assessment. Australia also participates in PISA, in which one of the three assessed domains is reading literacy, with 15-year-old students. Participation in PIRLS presents policy makers with an opportunity to benchmark Australian students in this core skill against other countries at an earlier stage of their development as learners, and thus complements participation in PISA.

How is reading assessed in PIRLS?

Reading literacy in PIRLS is defined as:

> *… the ability to understand and use those written language forms required by society and/or valued by the individual. Young readers can construct meaning from a variety of tests. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment. (Mullis, Martin, Kennedy, Trong & Sainsbury, 2009, p. 11)*

This ability is assessed by having participating students read selected texts and respond to a variety of questions about the texts they have read. PIRLS focuses on three aspects of students' reading literacy:

- Purposes for reading
- Processes of comprehension
- Reading behaviours and attitudes

The first two aspects are assessed using the PIRLS reading literacy tasks, while the third is investigated using responses to the Student and Home (completed by students' parents or guardians) questionnaires.

Reading purposes and processes

PIRLS defines the two major purposes of reading for Year 4 students, both in and out of school, as:

- Reading for literary experience, and
- Reading to acquire and use information.

The four types of comprehension processes assessed in PIRLS are:

- To focus on and retrieve explicitly stated information,
- To make straightforward inferences,
- To interpret and integrate ideas and information, and
- To examine and evaluate content, language and textual elements.

Each of these four processes is assessed within each of the purposes for reading. Further information about the breakdown of the PIRLS assessment across the reading purposes and processes is provided in Appendix 2.

The PIRLS benchmarks

The PIRLS achievement scale summarises Year 4 students' performance in reading a variety of literary and informational texts. Students' achievement is based on their responses to test questions designed to assess a range of comprehension processes (e.g. retrieval, inferencing, integration and evaluation).

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 reading literacy 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, PIRLS uses four points on the scale as international benchmarks. The benchmarks represent the range of performance shown by students internationally (and complement the TIMSS International Benchmarks).

For PIRLS 2011, the Advanced international benchmark is 625, the High international benchmark is 550, the Intermediate international benchmark is 475 and the Low international benchmark is 400 score points. Box 2.1 provides a summary of the PIRLS benchmarks.

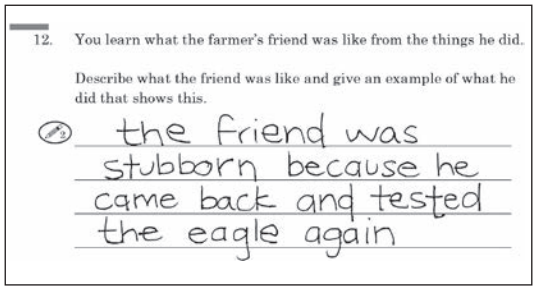
Box 2.1 The PIRLS 2011 international reading benchmarks

Low International Benchmark	Intermediate International Benchmark	High International Benchmark	Advanced International Benchmark
400	475	550	625
Literary When reading literary texts, students can locate and retrieve an explicitly stated detail. **Informational** When reading informational texts, students can locate and reproduce explicitly stated information that is at the beginning of the text.	**Literary** When reading literary texts, students can retrieve and reproduce explicitly stated actions, events and feelings; make straightforward inferences about the attributes, feelings and motivations of main characters; interpret obvious reasons and causes and give simple explanations; and begin to recognise language features and styles. **Informational** When reading informational texts, students can locate and reproduce one or two pieces of information from within the text; and use subheadings, textboxes and illustrations to locate parts of the text.	**Literary** When reading literary texts, students can locate and distinguish significant actions and details embedded across the text; make inferences to explain relationships between intentions, actions, events and feelings, and give text-based support; interpret and integrate story events and character actions and traits from different parts of the text; evaluate the significance of events and actions across the entire story; and recognise the use of some language features (e.g. metaphor, tone, imagery). **Informational** When reading informational texts, students can locate and distinguish relevant information within a dense text or a complex table; make inferences about logical connections to provide explanations and reasons; integrate textual and visual information to interpret the relationship between ideas; and evaluate content and textual elements to make a generalisation.	**Literary** When reading literary texts, students can integrate ideas and evidence across a text to appreciate overall themes; and interpret story events and character actions to provide reasons, motivations, feelings and character traits with full text-based support. **Informational** When reading informational texts, students can distinguish and interpret complex information from different parts of text, and provide full text-based support; integrate information across a text to provide explanations, interpret significance and sequence activities; and evaluate visual and textual features to explain their function.

At Year 4, students achieving the Advanced international benchmark are able to interpret story events and character actions to provide reasons, motivations, feelings and character traits with full text-based support, and when reading informational texts are able to distinguish and interpret complex information from different parts of text, integrate information across texts and evaluate textual and visual features to explain their function.

As an example, Box 2.2 shows an item from the literary text '*Fly eagle fly*'. Students were asked to interpret a character's actions from an allegorical text to provide a trait, and give an example from the text to support this interpretation. Providing both pieces of this response was quite difficult for Year 4 students internationally, with 29 per cent of students on average across all countries answering this correctly.

Box 2.2 Advanced international benchmark – Example item

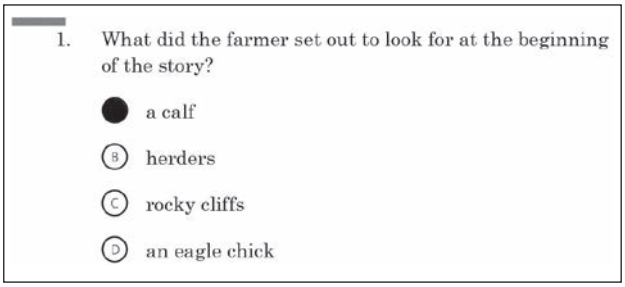

12. You learn what the farmer's friend was like from the things he did.

Describe what the friend was like and give an example of what he did that shows this.

the friend was stubborn because he came back and tested the eagle again

At the Low international benchmark, students are able to retrieve an explicitly stated detail in a literary text, or to locate and reproduce two or three pieces of information from within the text. Box 2.3 provides an example of this, also from '*Fly eagle fly*', students were asked to retrieve an explicitly stated detail from the beginning of the text.

Box 2.3 Low international benchmark – Example item



Further information about the types of reading skills and strategies demonstrated by 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 Appendix 2.

International student achievement in reading

This section reports the PIRLS 2011 reading results as average scores and distributions on the PIRLS scale, which has a range of 0–1000. The PIRLS reading achievement scale was established in PIRLS 2001 to have a mean of 500 and a standard deviation of 100, and was designed to remain constant from assessment to assessment. Figure 2.1 shows the distributions of student achievement for the 45 countries that participated in PIRLS 2011, including the average scale score with its 95 per cent confidence interval, and the ranges in performance for the middle half of students (25th to 75th percentiles) as well as the extremes (5th and 95th percentiles). The average age of students in each of the countries is also shown.

The PIRLS target population is defined as the year level that represents four years of schooling, counting from the first year of ISCED Level 1.[1] ISCED Level 1 corresponds to the first stage of basic education, with the first year of Level 1 marking 'systematic apprenticeship of reading, writing and mathematics'. In Australia, ISCED Level 1 corresponds to Year 1 in all states and thus the PIRLS target population is Year 4.

Hong Kong, Finland, the Russian Federation and Singapore were the top-performing countries of PIRLS 2011, scoring well in excess of the High International Benchmark of 550. The scores for these countries were not significantly different to each other but were significantly higher than all other countries.

Australia's average score of 527 score points is significantly higher than that of 17 other countries. It is, however, significantly lower than the average score for 21 other countries, including Ireland and Northern Ireland, the United States, England and Canada, as well as the participating Asian countries Hong Kong, Singapore and Chinese Taipei.

The results reveal substantial differences in achievement in reading between the highest and lowest performing countries (see Appendix 4 for multiple comparison tables of the average achievement of countries). The scores for the top four countries is almost three-quarters of a standard deviation higher than the scale midpoint, while the score for Morocco at 310 is almost two standard deviations lower than the scale midpoint.

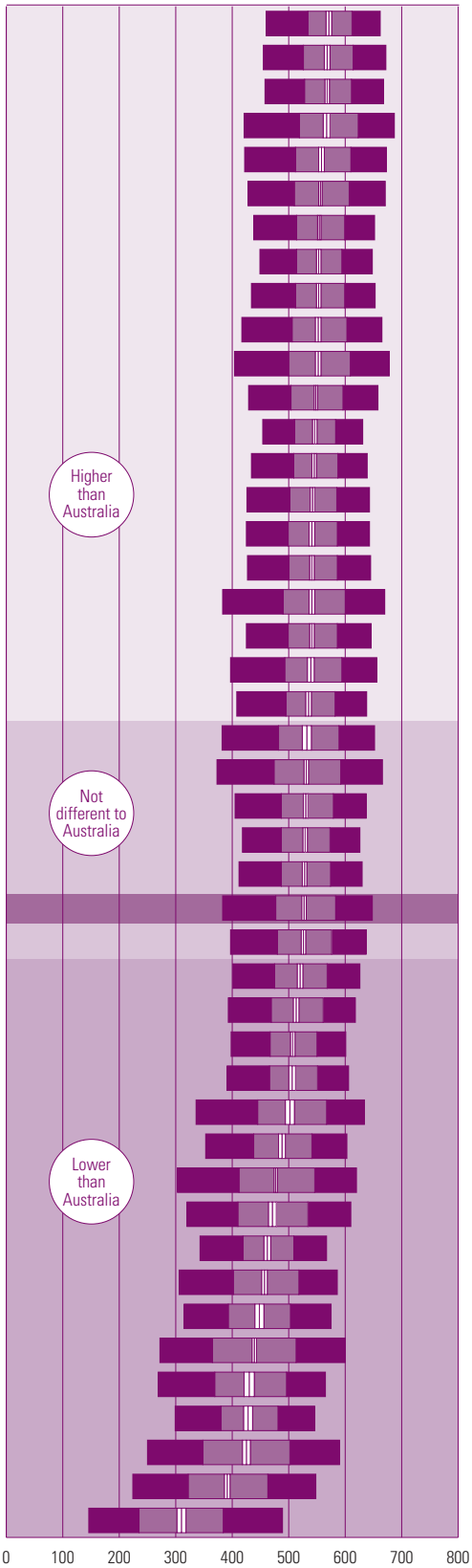
Figure 2.1 also shows the range of achievement within countries, with 202 score points separating the 5th and 95th percentiles for Hong Kong, but more than 300 score points separating highest and lowest achievers in Qatar (340 points), Oman (324 points) and the UAE (328 score points). Australia has a moderately wide gap between high and low achievers (265 scale points), similar to that of England (274 points). This means that our most able students rank amongst the highest

1 ISCED is the International Standard Classification of Education, developed by the UNESCO Institute for Statistics (UNESCO, 1997)

achievers in the world in PIRLS, whilst those with poor results rank amongst the lowest. New Zealand had the widest gap between high and low performers (293 points). As a comparison, the gap for students in the Netherlands was 177 points.

Figure 2.1 also shows the average age at the time of testing in each country. Even within Australia, school starting age varies between states; across 45 countries this is likely to be much more of an issue. The average age varies by about one year, from 9.7 years in Italy and Norway, and 9.8 years in Malta, to almost 11 years in the Russian Federation, Finland and Denmark. Students in one of the highest achieving countries, Hong Kong, are relatively young (10.1 years), and Australian Year 4 students are a similar age (10.0 years).

	Mean	SE	Average age at time of testing	Gap 95th –5th percentiles
Hong Kong	571	2.3	10.1	202
Russian Federation	568	2.7	10.8	217
Finland	568	1.9	10.8	210
Singapore	567	3.3	10.4	266
Northern Ireland	558	2.4	10.4	251
United States	556	1.5	10.2	243
Denmark	554	1.7	10.9	214
Croatia	553	1.9	10.7	199
Chinese Taipei	553	1.9	10.2	219
Ireland	552	2.3	10.3	248
England	552	2.6	10.3	274
Canada	548	1.6	9.9	229
Netherlands	546	1.9	10.2	177
Czech Republic	545	2.2	10.4	205
Sweden	542	2.1	10.7	217
Italy	541	2.2	9.7	218
Germany	541	2.2	10.4	221
Israel	541	2.7	10.1	287
Portugal	541	2.6	10.0	218
Hungary	539	2.9	10.7	259
Slovak Republic	535	2.8	10.4	230
Bulgaria	532	4.1	10.7	270
New Zealand	531	1.9	10.1	293
Slovenia	530	2.0	9.9	232
Austria	529	2.0	10.3	208
Lithuania	528	2.0	10.7	218
Australia	527	2.2	10.0	265
Poland	526	2.1	9.9	240
France	520	2.6	10.0	225
Spain	513	2.3	9.8	225
Norway	507	1.9	9.7	203
Belgium	506	2.9	10.1	215
Romania	502	4.3	10.9	298
Georgia	488	3.1	10.0	250
Malta	477	1.4	9.8	317
Trinidad and Tobago	471	3.8	10.3	290
Azerbaijan	462	3.3	10.2	224
Iran	457	2.8	10.2	280
Colombia	448	4.1	10.4	260
United Arab Emirates	439	2.2	9.8	328
Saudi Arabia	430	4.4	10.0	296
Indonesia	428	4.2	10.4	247
Qatar	425	3.5	10.0	340
Oman	391	2.8	9.9	324
Morocco	310	3.9	10.5	343



Note: See Reader's Guide for interpretation of graph

Figure 2.1 Distribution of reading achievement, by country

Performance at the international benchmarks

In addition to the mean scores it is useful to use the international benchmarks described previously to gain further insight into student achievement. Figure 2.2 shows the proportion of students in each country at each of the international benchmarks.

The countries are ordered by the proportion of students reaching the Intermediate benchmark. While no minimum standard of proficiency has been set for PIRLS at this stage, the minimum standard set for TIMSS in mathematics and science is the performance at the Intermediate Benchmark and is therefore deemed to be a useful standard for this report.

Hong Kong, Finland and the Russian Federation again head the table (Figure 2.2), with between 18 and 19 per cent of their Year 4 students reaching the Advanced benchmark, and between seven and eight per cent of their students reaching only the Low benchmark or not achieving this level at all. Of interest is the other of the four highest achieving countries, Singapore. Singapore achieved an outstanding 24 per cent of students at the Advanced benchmark, but also had 13 per cent of its students at the Low benchmark or not achieving at even this basic level.

Between 15 and 19 per cent of the students in Northern Ireland, England, the United States and Ireland also achieved the Advanced benchmark, and between 13 and 17 per cent of their students were at the Low international benchmark or did not reach that level.

Only ten per cent of Australian students achieved the Advanced international benchmark, with 32 per cent at the High international benchmark and 34 per cent at the Intermediate international benchmark. Of concern are the 17 per cent of Australian Year 4 students achieving at the Low international benchmark and seven per cent of Australian students achieved below this level. A similar proportion of students can be seen at these low benchmark levels in New Zealand, however a higher proportion of New Zealand students were achieving at the Advanced benchmark.

In the Netherlands, seven per cent of students achieved the Advanced benchmark, ten per cent of students were at the Low benchmark, but all students did achieve this level (that is, no students from the Netherlands were in the Below Low group).

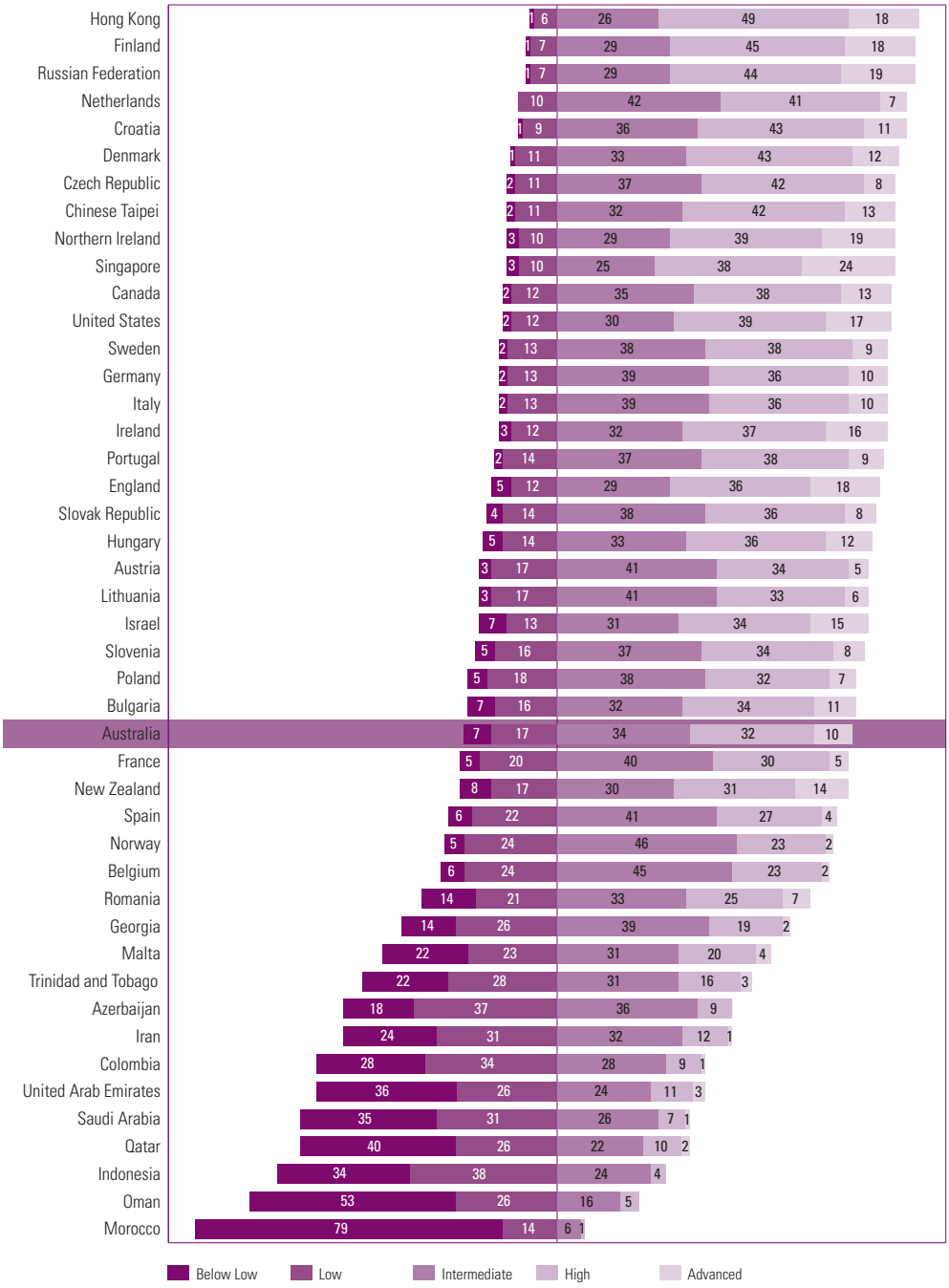


Figure 2.2 Percentages of students at the international benchmarks for reading, by country

Reading achievement by gender

Traditionally, in Australia and internationally, females perform better on reading achievement at all levels of schooling. For example Rothman (2002) examined the performance of five cohorts of Australian students on reading comprehension tests. These tests were conducted as part of a number of studies, including the Australian Studies of School Performance (ASSP) and the Youth in Transition (YIT) survey. Mean scaled scores on the reading comprehension tests differed by gender for each cohort between 1975 and 1998, with females scoring significantly higher on each. Recent research in the United States has found that females have an advantage on reading at all levels from kindergarten through to Year 8 (Robinson & Lubienski, 2011). Cross-nationally, the previous cycles of PIRLS reported significant gender differences in favour

of females in every participating country in 2001 (Mullis, Martin, Gonzalez and Kennedy, 2003) and in all but two countries in PIRLS 2006 (Mullis, Martin, Kennedy & Foy, 2007), and PISA has consistently reported statistically significant and usually large differences in reading achievement between females and males amongst 15-year-old students (Lokan, Cresswell & Greenwood, 2001; Thomson, De Bortoli, Nicholas, Hillman & Buckley, 2010).

Figure 2.3 shows the gender differences in reading achievement in PIRLS 2011. It presents achievement separately for males and females, as well as the proportion of each in the population, and the difference between scores. The accompanying graph shows the size of the difference and whether that difference is statistically significant. The countries are presented in order of increasing size of the difference between females and males in reading achievement. Internationally on average, the difference at Year 4 was 520 points compared to 504, 17 points after rounding, in favour of females.

In Colombia, Italy, France, Spain and Israel, the differences between males and females were not statistically significant. For all other countries, the differences were significant, ranging from 5 score points in French-speaking Belgium to 54 score points in Saudi Arabia. Noteworthy is that some of the largest differences (from 27 to 54 score points) were found in Arabic-speaking countries, including the United Arab Emirates, Morocco, Qatar, Oman and Saudi Arabia.

While the gender gap in reading appears to be an immutable fact, given that it exists in so many countries and is so substantial in so many of them, there is evidence from PIRLS that it is not immutable, and some countries have managed to narrow or even close the gap. Colombia, in particular, has closed the gender gap completely from PIRLS 2001 to PIRLS 2011, and has done this by increasing the average achievement of both females and males. In France and Italy the gender gap has also narrowed, however this is due to a decline in the average achievement of females.

Internationally, both Australian Year 4 females and males typically achieved at a level significantly higher than their respective international means. The gender gap was 17 score points, which was similar to that of many other countries, including New Zealand, the Russian Federation and Hong Kong.

Country	Female				Male				Difference (absolute value)	SE
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE		
Colombia	49	1.3	447	4.6	51	1.3	448	4.6	1	3.9
Italy	50	0.7	543	2.4	50	0.7	540	2.7	3	2.4
France	49	0.8	522	3.4	51	0.8	518	2.4	5	2.7
Spain	49	0.8	516	2.5	51	0.8	511	2.8	5	2.5
Belgium	49	0.9	509	3.1	51	0.9	504	3.1	**5**	2.3
Israel	51	1.6	544	3.1	49	1.6	538	3.4	6	3.4
Czech Republic	49	1.2	549	2.5	51	1.2	542	2.5	**6**	2.6
Netherlands	51	0.7	549	2.1	49	0.7	543	2.2	**7**	2.0
Austria	49	1.2	533	2.2	51	1.2	525	2.3	**8**	2.3
Germany	49	0.8	545	2.3	51	0.8	537	2.7	**8**	2.5
Slovak Republic	49	0.8	540	3.1	51	0.8	530	2.8	**10**	2.1
United States	51	0.5	562	1.9	49	0.5	551	1.7	**10**	1.8
Canada	49	0.6	553	1.9	51	0.6	542	2.1	**12**	2.1
Denmark	50	0.7	560	1.9	50	0.7	548	2.1	**12**	2.2
Poland	48	0.9	533	2.5	52	0.9	519	2.7	**14**	3.1
Azerbaijan	47	0.9	470	3.6	53	0.9	456	3.5	**14**	2.3
Croatia	50	0.8	560	2.1	50	0.8	546	2.2	**14**	2.2
Sweden	49	1.0	549	2.4	51	1.0	535	2.5	**14**	2.7
Portugal	49	1.2	548	3.0	51	1.2	534	2.8	**14**	2.4
Norway	52	1.0	514	2.2	48	1.0	500	2.7	**14**	3.1
Chinese Taipei	47	0.6	561	2.1	53	0.6	546	2.1	**15**	2.1
Bulgaria	49	0.9	539	4.5	51	0.9	524	4.3	**15**	3.5
Romania	48	0.9	510	4.8	52	0.9	495	4.3	**15**	3.3
Ireland	49	2.2	559	2.9	51	2.2	544	3.0	**15**	3.9
Hungary	49	0.9	547	3.2	51	0.9	532	3.2	**16**	2.6
Slovenia	48	0.8	539	2.2	52	0.8	523	2.7	**16**	3.1
Northern Ireland	50	1.2	567	2.5	50	1.2	550	3.2	**16**	3.4
Hong Kong	46	1.2	579	2.3	54	1.2	563	2.5	**16**	2.2
Australia	49	1.1	536	2.7	51	1.1	519	2.7	**17**	3.1
Singapore	49	0.6	576	3.5	51	0.6	559	3.6	**17**	2.6
International Average	49	0.2	520	0.5	51	0.2	504	0.5	**17**	0.5
Malta	49	0.5	486	1.9	51	0.5	468	2.0	**18**	2.8
Indonesia	51	0.9	437	4.5	49	0.9	419	4.3	**18**	2.3
Lithuania	48	0.8	537	2.4	52	0.8	520	2.4	**18**	2.8
Russian Federation	49	1.0	578	2.8	51	1.0	559	3.1	**18**	2.3
Iran	49	2.9	467	4.3	51	2.9	448	4.3	**20**	6.4
New Zealand	49	1.0	541	2.2	51	1.0	521	2.7	**20**	3.1
Finland	49	0.8	578	2.3	51	0.8	558	2.2	**21**	2.3
Georgia	48	0.9	499	2.7	52	0.9	477	4.0	**22**	3.0
England	49	1.0	563	3.0	51	1.0	540	3.1	**23**	3.0
United Arab Emirates	50	1.6	452	3.0	50	1.6	425	3.5	**27**	4.8
Morocco	48	0.8	326	4.0	52	0.8	296	4.6	**29**	3.9
Qatar	47	3.4	441	4.7	53	3.4	411	4.2	**30**	6.0
Trinidad and Tobago	49	2.0	487	4.5	51	2.0	456	4.3	**31**	4.6
Oman	49	0.7	411	3.0	51	0.7	371	3.4	**40**	2.9
Saudi Arabia	52	1.5	456	3.1	48	1.5	402	8.2	**54**	8.8

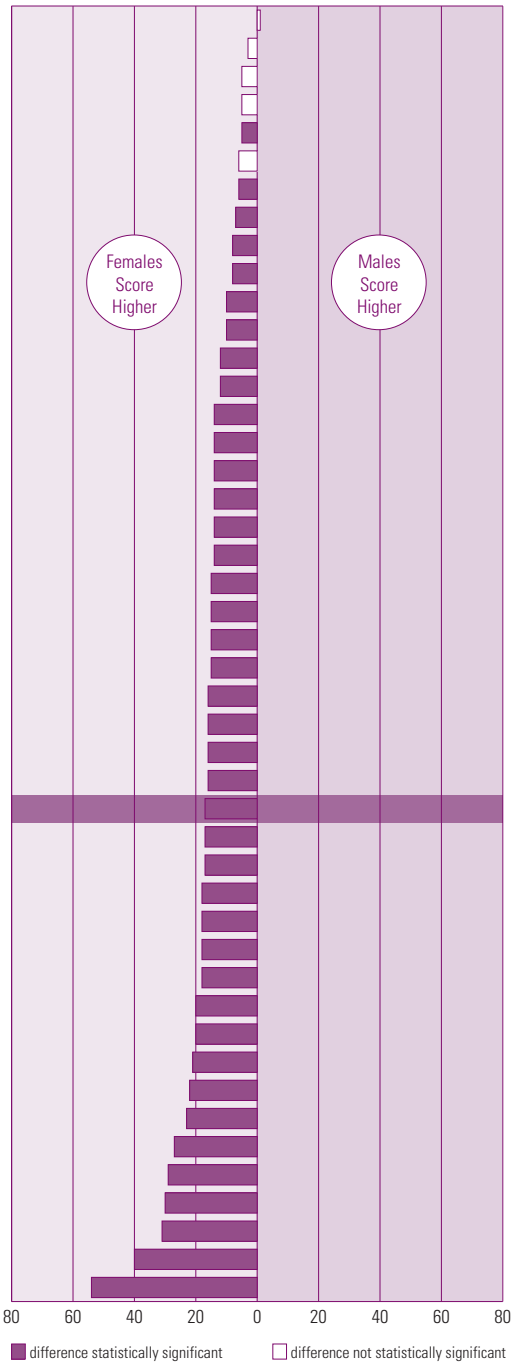


Figure 2.3 Gender Differences in reading achievement, by country

As illustrated in Figure 2.4, the range of scores was greater for Year 4 males (269) than for Year 4 females (256) in Australia. The figure also illustrates the weaker performance of some Year 4 males when compared to that of females; five per cent of Year 4 males scored below 373 (the 5th percentile in Figure 2.4), while the corresponding 5th percentile for Year 4 females was 26 scale score points higher, at 399.

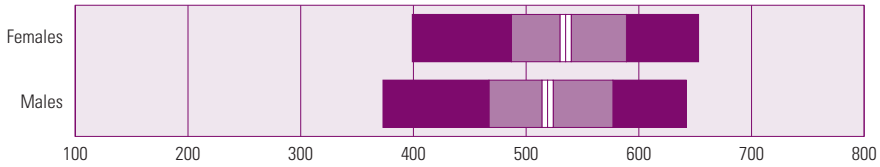


Figure 2.4 Distribution of reading achievement within Australia, by gender

Performance at the international benchmarks by gender

Figure 2.5 also illustrates the gender differences apparent in reading at Year 4 in Australia. Twelve per cent of female students achieved the Advanced international benchmark in PIRLS 2011, compared to eight per cent of male students. At the other end of the achievement scale, 21 per cent of female students compared to 28 per cent of male students did not reach the Intermediate benchmark.

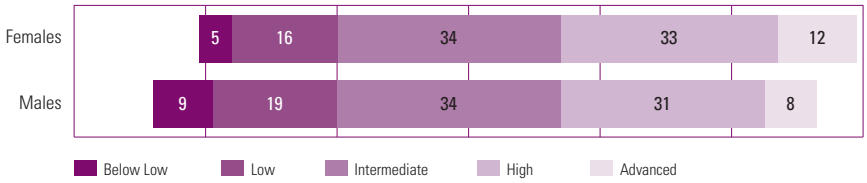


Figure 2.5 Percentages of Australian students at the international benchmarks for reading, by gender

Reading achievement by state

Figure 2.6 presents the distribution of reading performance for each of the Australian states from PIRLS 2011. To place the state results in perspective, the means and distributions for Australia as a whole, and for Hong Kong, the highest achieving country, are also included in each figure. The states are shown in order of highest mean score.

Figure 2.6 should be read in conjunction with Table 2.1, which presents the multiple comparisons of mean performance between states and indicates which are significantly different from each other.

The largest range of student performance was seen in the Northern Territory, Tasmania and Western Australia, with the range from the 5th to 95th percentile of around 280 score points. The range provides an indication of the diversity of scores achieved by students in each state. The larger the range, the more 'spread' there is from the mean for that state, while in states with smaller ranges, scores are more closely clustered around the mean. The range of performance for the highest achieving state, the Australian Capital Territory, was the narrowest of all the states, at 240 score points, while the distribution for next highest achievers, New South Wales and Victoria, was 262 and 259 score points respectively. For comparison, the range from 5th to 95th percentile for Hong Kong was 202 score points.

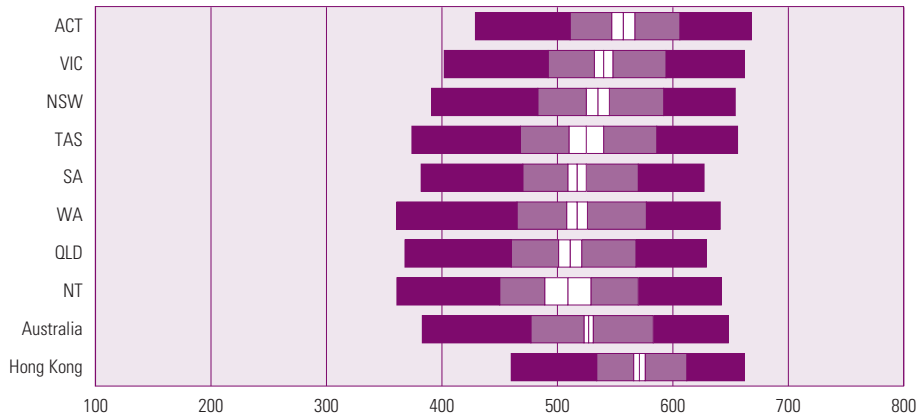


Figure 2.6 Distribution of reading achievement scores, by state

Table 2.1 shows that the range of average scores across the states was not large, being 49 score points, about half a standard deviation, between the Australian Capital Territory and the Northern Territory. However the performance of students in the Australian Capital Territory was significantly higher than that of students in all other states. The performance of students in New South Wales and Victoria was not significantly different to each other, and both scored significantly higher than students in the remaining states, with the exception of Tasmania.

Table 2.1 Multiple comparisons of average reading achievement, by state

STATE	Mean	SE	ACT	VIC	NSW	TAS	SA	WA	QLD	NT
ACT	558	5.3		▲	▲	▲	▲	▲	▲	▲
VIC	539	4.0	▼		●	●	▲	▲	▲	▲
NSW	535	4.9	▼	●		●	▲	▲	▲	▲
TAS	525	7.5	▼	●	●		●	●	●	●
SA	518	4.0	▼	▼	▼	●		●	●	●
WA	516	4.5	▼	▼	▼	●	●		●	●
QLD	511	5.0	▼	▼	▼	●	●	●		●
NT	509	10.3	▼	▼	▼	●	●	●	●	

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

▲ Average performance statistically significantly higher than in comparison state.

● No statistically significant difference from comparison state.

▼ Average performance statistically significantly lower than in comparison state.

Gender differences in reading achievement by state

Figure 2.7 shows the gender differences in reading at Year 4. The gender gap was significant in Western Australia, Queensland and Victoria, and the size of the gap varied from 33 score points in Western Australia to 17 score points in Victoria. In all other states, there were no significant differences between the average reading scores of male and female students.

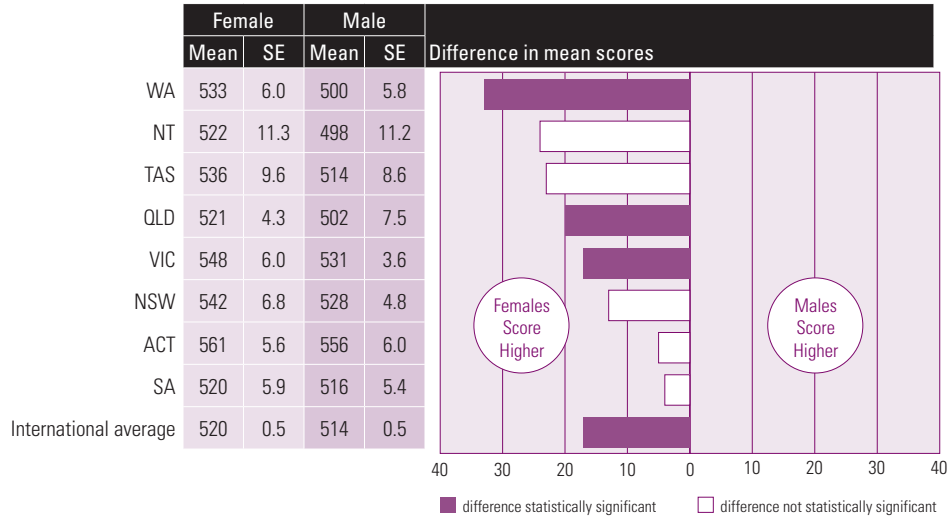


Figure 2.7 Gender differences in reading achievement, by state

Performance at the international benchmarks by state

Figure 2.8 show the proportion of students in each state at each of the international benchmarks for reading, along with the percentages for Australia as a whole, and Hong Kong, as the highest scoring country, for comparison.

The Australian Capital Territory was the best performing state, with 17 per cent of students achieving the Advanced international benchmark, just over half (56%) reaching the High international benchmark, and 86 per cent achieving at least the Intermediate benchmark. While the proportion of students in the Australian Capital Territory who performed at the Advanced international benchmark was almost the same as that achieving this level in the highest scoring country, in Hong Kong, 67 per cent of students achieved at least the High international benchmark and 93 per cent achieved at least the Intermediate benchmark.

The next best achieving states were Victoria and New South Wales, in which 12 per cent of students achieved the Advanced international benchmark, almost half (47% and 45% respectively) achieved the High international benchmark and 80 per cent of students in Victoria and 78 per cent of students in New South Wales achieved at least the Intermediate benchmark.

In each of the other states, fewer than ten per cent of students achieved the Advanced benchmark (other than in Tasmania with 11 per cent), and at least one-quarter of the students did not achieve the Intermediate international benchmark.

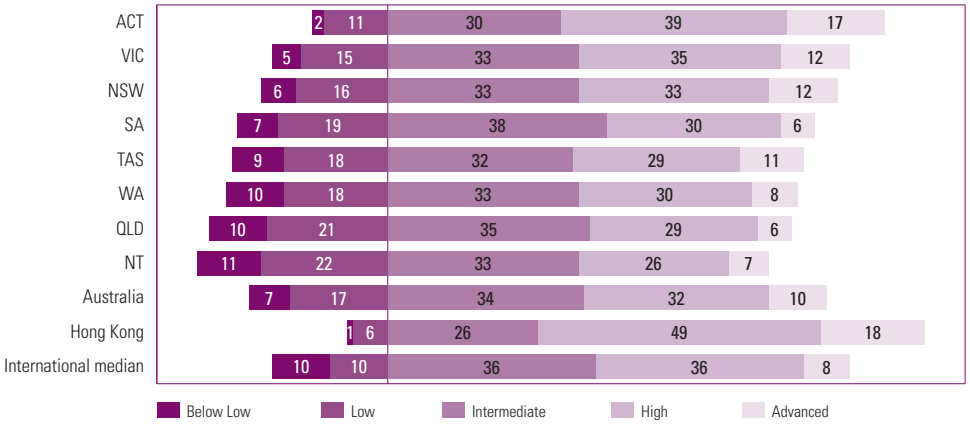


Figure 2.8 Percentages of students at the international benchmarks for reading, by state

Figure 2.9 shows the proportion of students by gender in each state at each of the international benchmarks in reading. In the states with significant gender differences overall, the differences in proportions at each benchmark are substantial. In Western Australia only five per cent of males compared to 11 per cent of females achieved the Advanced international benchmark, with a total of 46 per cent of females and 31 per cent of males achieving at least the High benchmark. At the other end of the achievement spectrum, 36 per cent of males and 22 per cent of females did not achieve the Intermediate international benchmark.

In South Australia there were few gender differences, with only five per cent of male students and six per cent of female students achieving the Advanced international benchmark, 35 per cent of both male and female students achieving at the High international benchmark, 73 per cent of males and 75 per cent of females achieving at least the Intermediate international benchmark.

The Australian Capital Territory was the only state in which the proportion of male students not achieving the Intermediate international benchmark was similar to the proportion of female students at this level. In all other states, a greater proportion of male students did not achieve this standard, and this ranged from 22 per cent in Victoria to 41 per cent in the Northern Territory.

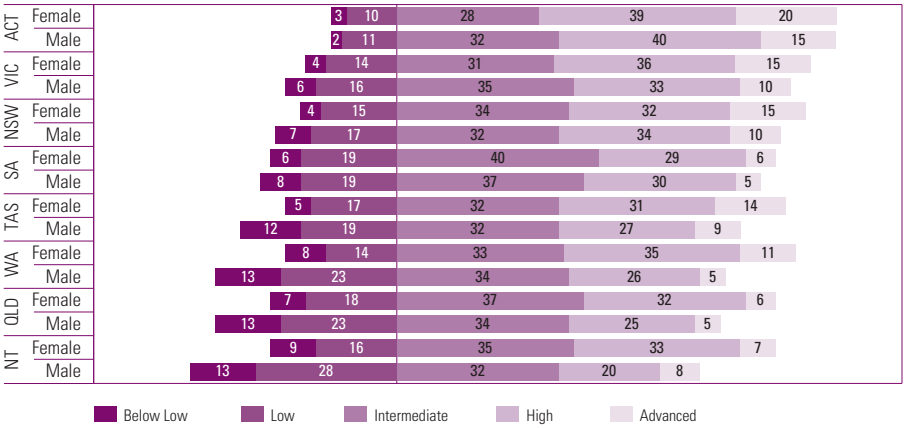


Figure 2.9 Percentages of students at the international benchmarks for reading, by gender within state

Reading achievement by books in the home

Throughout a child's development, the time devoted to literacy-related activities remains essential to the acquisition of reading literacy skills and the effects can be long-lasting. The amount of time which is able to be spent on such activities is predicated to some extent on the availability of such resources. For example, a recent study of the effects of books and schooling in 27 countries concluded that:

> *Regardless of how many books the family already has, each addition to a home library helps the children get a little farther in school. But the gains are not equally great across the entire range; instead they are larger at the bottom, far below elite level, in getting children from modest families a little further along in the first few years of school. Moreover, having books in the home has a greater impact on children from the least educated families, not on children of the university educated elite (Evans, Kelly, Sikora & Trieman, 2010, p. 17)*

Books in the home has also traditionally acted as a proxy in large scale international studies for a family's educational and social background. Generally, there is a strong correlation between books in the home and parental education and income (Ammermueller & Pischke, 2009), and a moderate to strong positive correlation between books in the home and achievement, particularly in reading (Mullis et al., 1998). Beaton et al. (1996) suggests that the number of books in the home can be an indicator of a home environment that values literacy, the acquisition of knowledge and general academic support.

This section looks at the performance of children in PIRLS according to their self-reports of the number of books in their homes. Internationally, a larger proportion of Australian students than in any other country report having more than 100 books in their homes. Forty-one per cent of Australian students reported having this many books, the next highest countries being Canada and New Zealand, with 38 per cent of students reporting a moderately large number of books. For the purposes of this report, this variable has been grouped to represent *a few books* – 25 or fewer books, *average number of books* – between 26 and 200 books and *many books* – more than 200 books. Table 2.2 provides the percentage of students in each category, and the average reading achievement score for students in each group. In general, students who have the most books in the home also have the highest levels of achievement, scoring 19 points, on average, higher than students with an *average number of books* in the home and 64 score points higher than those with *a few books* in the home.

Table 2.2 Mean reading achievement within Australia, by number of books in the home

	% of students	Mean	SE	Gap 95th – 5th percentiles
Many books	19	553	3.9	197
Average number of books	59	534	2.3	209
A few books	22	489	2.9	246

Figure 2.10 shows the distribution of scores in PIRLS for students in each category. The highest achieving students in the group who report having many books in the home achieved at a level similar to that of students in many of the top scoring countries, and equivalent to the High international benchmark, and the gap between the 5th and 95th percentiles is narrower than for the other two groups at 197 score points. In contrast, for students with a few books in the home the average score was around that of the Intermediate benchmark, and the gap in achievement between those who scored well and those who did not was much larger at 246 score points. The lowest scoring students in this group scored on a par with students in the lowest performing countries.

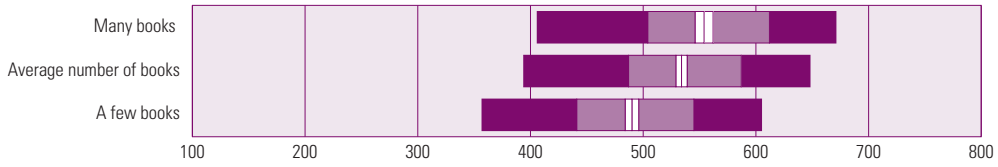


Figure 2.10 Distribution of reading achievement within Australia, by number of books in the home

Examining the proportion of students at each of the benchmarks (Figure 2.11) gives a good idea of the capacity of students in each group. Of those students who reported having *many books* in the home, a very commendable 18 per cent achieved the Advanced benchmark, the same proportion as the highest achieving country, Hong Kong. The proportion in this highest benchmark falls away quickly though, with 10 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.

However, unlike Hong Kong, around 16 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark, with 12 per cent achieving the Low benchmark and four per cent of students not even achieving this very basic level. Of those students in the middle category, those with between 26 and 200 books in the home, around 15 per cent of students achieved the Low benchmark, and around six per cent of students failed to achieve this level. However 27 per cent of the students who reported having *a few books* in the home just achieved the Low benchmark, and a further 13 per cent of students did not achieve the Low benchmark.

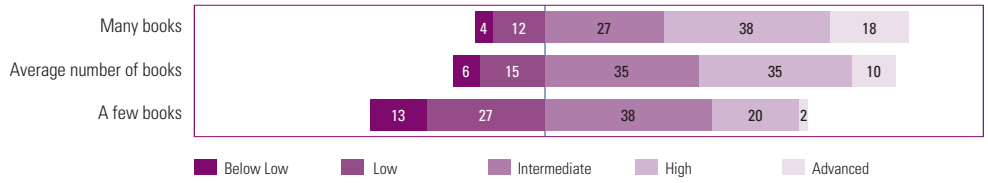


Figure 2.11 Percentages of Australian students at the international benchmarks for reading, by number of books in the home

Reading achievement by Indigenous background

The educational achievement of Australia's Indigenous students in core subject areas such as reading, mathematics and science is an important issue. Previous TIMSS studies have provided a picture of Indigenous achievement in mathematics and science, and PISA has provided this for achievement for 15-year-olds. PIRLS allows us to complete this picture, adding an international comparison of reading performance at Year 4.

As shown in Table 2.3, seven per cent of the PIRLS sample at Year 4 self-identified as Indigenous. These students attained an average score on the PIRLS test of 475 score points. While this is half a standard deviation lower than the average for non-Indigenous Australian students, the difference is not as great as differences at other year levels or in other subject areas. The mean score for Indigenous students is the same as the Intermediate international benchmark, while that for non-Indigenous students is almost the same as the High international benchmark. This is a large difference, and can be thought of in terms of the level of sophistication and depth with which students are able to complete tasks. For example at the Intermediate benchmark, students typically are able to locate and reproduce two or three pieces of information from within a text, whereas students at the High benchmark are able to locate and distinguish information from a dense text or complex table.

Table 2.3 Mean reading achievement within Australian, by Indigenous background

	% of students	Mean	SE	Gap 95th –5th percentiles
Non-Indigenous	93	532	2.2	257
Indigenous	7	475	5.5	280

Figure 2.12 presents the distribution of achievement for Indigenous and non-Indigenous students in Australia. The spread of scores from 5th to 95th percentile is similar, although slightly wider for Indigenous students – 280 score points compared to 257 for non-Indigenous students.

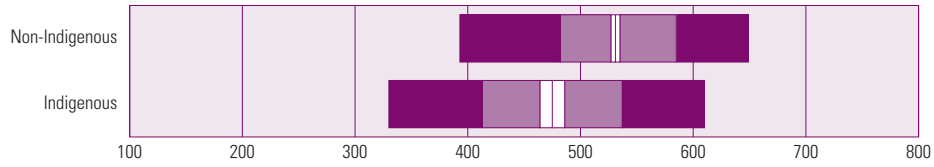


Figure 2.12 Distribution of reading achievement within Australia, by Indigenous background

Figure 2.13 adds to the picture of performance by providing the proportion of Indigenous and non-Indigenous students at each of the international benchmarks for reading. The differences are apparent at both ends of the distribution: 11 per cent of non-Indigenous students achieved the Advanced benchmark compared to three per cent of Indigenous students, and of concern is the fact that 48 per cent of Indigenous students (compared to 22 per cent of non-Indigenous students) did not achieve the Intermediate international benchmark, with 21 per cent of Indigenous students not reaching the Low benchmark.

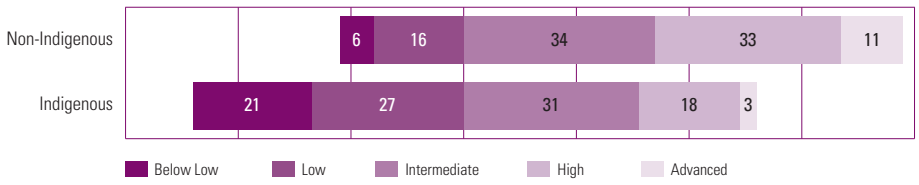


Figure 2.13 Percentages of Australian students at the international benchmarks for reading, by Indigenous background

Reading achievement by language background

How often English is spoken at home is a factor that is associated with achievement, and it could be particularly relevant to achievement in reading. Students who come from homes in which English is not spoken frequently have less exposure to the language of instruction and test, which could be a disadvantage. Table 2.4 shows the means and standard errors for students who 'always' spoke English at home, compared to those who indicated that they 'sometimes' or 'never' spoke English at home, who were considered to have a language background other than English (LBOTE).

Twenty-one per cent of students in the PIRLS Year 4 sample indicated that they did not speak English at home, and these students certainly seem to be disadvantaged compared to those who spoke English at home. Students with a language background other than English scored, on average, a significant 18 points lower than these students who always spoke English at home.

Table 2.4 Mean reading achievement within Australia, by language background

	% of students	Mean	SE	Gap 95th –5th percentiles
English	79	531	2	263
LBOTE	21	513	5	268

Figure 2.14 shows the distribution of scores for students by their language background. The spread of scores between the 5th and 95th percentile was almost the same for the two groups of students.

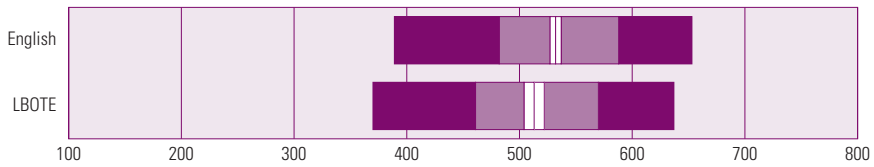


Figure 2.14 Distribution of reading achievement within Australia, by language background

The distribution of scores for Year 4 students speaking a language other than English at home, in reading, is reflected in the proportions of students achieving at each of the international benchmarks (Figure 2.15). At the top end of achievement, the proportion of students from English-speaking backgrounds achieving the Advanced international benchmark was higher than that of LBOTE students: 11 per cent of English background students and seven per cent of students from a language background other than English. At the lower levels of achievement the differences were greater, with 30 per cent of students from a non-English speaking background compared to 22 per cent from an English speaking background not achieving the Intermediate benchmark, and 21 per cent of the non-English background students not achieving the Low international benchmark.

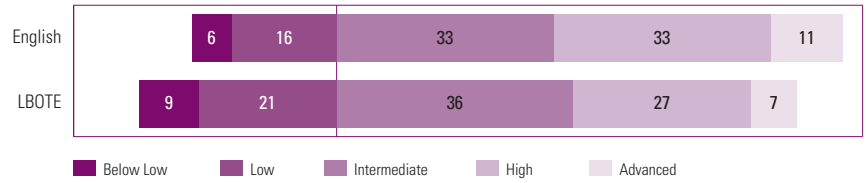


Figure 2.15 Percentages of Australian students at the international benchmarks for reading, by language background

Reading achievement by geographic location of the school

The proportion of Australia's population living in rural and remote areas continues to decline. According to Australian Bureau of Statistics estimates from 2010, about nine per cent of the population live in outer regional areas and about two per cent in remote and very remote areas.

To undertake the analyses in this section of the report, school addresses were coded using the MCEETYA Schools Geographic Location Classification (see the Reader's Guide). Only the broad categories – Metropolitan, Provincial and Remote – are used in these analyses.

The average performance of students attending schools in these three geographic locations is presented in Table 2.5. All differences are significant, despite the large standard errors for students in remote schools. Students attending schools in metropolitan areas performed, on average, 14 score points higher than students in students attending schools in provincial areas, and 70 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 56 score points higher than students attending schools in remote areas.

Table 2.5 Mean reading achievement within Australia, by geographic location

	% of students	Mean	SE	Gap 95th –5th percentile
Metropolitan	72	532	2.6	262
Provincial	27	518	4.5	266
Remote	1	462	17.4	289

Figure 2.16 provides the spread of scores for reading achievement by geographic location of school. The range of scores from 5th to 95th percentiles was not vastly different for any of the three groups.

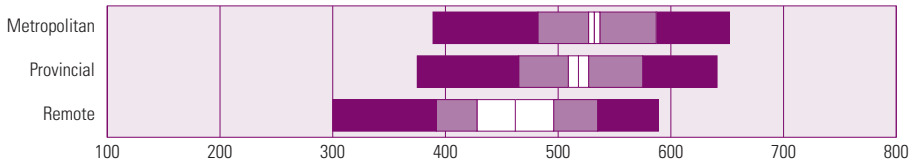


Figure 2.16 Distribution of reading achievement within Australia, by geographic location

Figure 2.17 shows the proportion of students in the three broad geographical groups at each of the international benchmarks for reading. This shows alarming differences in the proportion of students achieving the benchmarks. Eleven per cent of students in metropolitan schools achieved the Advanced international benchmark, and 44 per cent achieved at least the High benchmark, with 78 per cent achieving at least the Intermediate benchmark. In stark contrast, just one per cent of students attending schools in remote areas achieved the Advanced international benchmark, 17 per cent achieved at least the High benchmark and 48 per cent achieved the Intermediate benchmark.

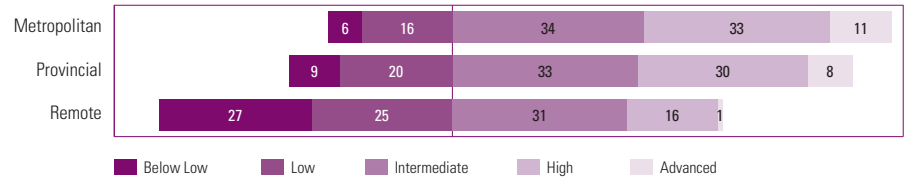


Figure 2.17 Percentage of Australian students at the international benchmarks for reading, by geographic location

This chapter so far has reported on the content achievement measured by PIRLS, examining achievement in terms of state, gender, number of books in the home, Indigenous background, language background and geographic location. The next section of this chapter examines achievement in the cognitive areas of purposes for reading and comprehension processes.

Achievement in the PIRLS purposes for reading and comprehension processes

The PIRLS assessment framework describes two overarching purposes that account for most of the reading undertaken by students, both in and out of school: *reading for literary experience* and *reading to acquire and use information*. Children are usually exposed to stories from a young age, either orally or by being read to. As they grow older, they also encounter a wide variety of informational texts in the form of advertisements, games, social media, as well as directions and labels on everyday packages and items. In primary school, children's literary texts and readers typically contain a range of stories and narratives. More recently, there has been increased attention on informational reading in the early grades, recognising that children must learn to read a range of non-narrative text types in order to succeed in content area subjects as they progress through school. Also, understanding expository text is often key to success as adults, both in careers and in everyday life.

Within both reading purposes, the PIRLS framework describes four major processes of reading comprehension:

- Focusing on and retrieving explicitly stated information;
- Making straightforward inferences;
- Interpreting and integrating ideas and information; and
- Examining and evaluating content, language, and textual elements.

Purposes for reading

The two main purposes for reading described in the PIRLS framework are shown in Box 2.4 below. PIRLS 2011 used two numerical scales to look at student achievement in these two purposes for reading. To enable countries to compare their students' relative performance in each of the purposes for reading, the international mean for each purpose was scaled to 500, the same as for the PIRLS international scale mean.

Box 2.4 The purposes for reading

Reading for literary experience	Reading to acquire and use information
The reader becomes involved in imagined events, settings, actions, consequences, characters, atmosphere, feelings and ideas; he or she brings an appreciation of language and knowledge of literary forms to the text. This is often accomplished through reading fiction.	The reader engages with types of texts where she or he can understand how the world is and has been, and why things work as they do. Texts take many forms, but one major distinction is between those organised chronologically and those organised non-chronologically. This area is often associated with information articles and instructional texts.

The PIRLS 2011 assessment included five literary passages and five informational passages. The literary texts were fictional stories where the students could engage with the events, character's actions and feelings, the settings and ideas, as well as the language itself. The informational passages covered a range of content and organisational structures. In addition to prose, each passage involved some variety in format and included features such as photographs, illustrations, text boxes, maps and diagrams.

Table 2.6 provides the scores for Australia, the states, by gender and by Indigenous background for achievement in reading purposes. Some countries performed relatively better in either *literary* or *informational reading* for example students in Chinese Taipei scored at a significantly higher (compared to their overall reading score) level on *informational reading* and significantly lower on *literary reading*. On the other hand students in the United States performed significantly better than their overall reading score on *literary reading*, and significantly lower on *informational reading*.

Among the top four performing countries, the Russian Federation and Finland performed equally well in the two reading purposes, while Hong Kong performed relatively lower in *literary reading*, and both Hong Kong and Singapore relatively higher in *informational reading*.

Australian students also performed equally well in the two reading purposes, and this was evident at all levels, by state, by gender and for Indigenous and non-Indigenous students.

Table 2.6 Relative mean achievement in reading purposes, for Australia and by state, gender and Indigenous background

	Reading overall		Literary purposes		Absolute difference from overall reading score	Informational purposes		Absolute difference from overall reading score
	Mean	SE	Mean	SE		Mean	SE	
Australia	527	2.2	527	2.2	0	528	2.2	1
ACT	558	5.3	558	5.3	0	559	5.8	1
NSW	535	4.9	535	5.1	0	535	4.7	1
VIC	539	4.0	540	4.4	0	540	4.0	1
QLD	511	5.0	510	4.6	1	512	5.0	0
SA	518	4.0	517	4.3	1	518	4.5	0
WA	516	4.5	517	4.0	0	517	4.8	0
TAS	525	7.5	526	8.2	1	525	7.8	1
NT	509	10.3	509	9.9	0	507	10.1	2
Female	536	2.7	539	3.0	3	534	2.9	2
Male	519	2.7	516	3.2	3	522	2.8	3
Non-Indigenous	532	2.2	532	2.2	0	533	2.2	1
Indigenous	475	5.6	476	6.0	1	476	5.6	1

Note: No statistical differences are calculated between the mean of the overall scale score and the reading purposes and processes scales. This is because the data in the purposes and processes scales underpin or contribute to the data in the overall reading score.

Processes of reading comprehension

The processes of reading comprehension are described in Box 2.5 below. For reporting purposes the four processes were combined into two achievement scales. The first is the *retrieving and inferencing processes* achievement scale, which combines the retrieval and straightforward inferencing processes. The second scale is the *interpreting, integrating and evaluating processes* scale, which combines the process of interpreting and integrating with the examining and evaluating process. To enable countries to compare their students' relative performance in each of the processes for reading, the international mean for each was scaled to 500.

Box 2.5 The processes of reading comprehension

Focus on and retrieve explicitly stated information	Readers are required to recognise information or ideas presented in the text, and how that information is related to the information being sought. Specific information to be retrieved is typically located in a single sentence or phrase.
Make straightforward inferences	Readers move beyond the surface of texts to fill in the 'gaps' in meaning. Proficient readers often make these kinds of inferences automatically, even though it is not stated in the text. The focus may be on the meaning of part of the text, or the more global meaning representing the whole text.
Interpreting and integrating ideas and information	Readers need to process the text beyond the phrase or sentence level. Readers attempt to construct a more specific or complete understanding of the text by integrating personal knowledge and experience with meaning that resides in the text. Because of this, meaning that is constructed is likely to vary among readers.
Examine and evaluate content, language, and textual elements	Readers draw on their interpretations and weigh their understanding of texts against their world view – rejecting, accepting or remaining neutral to the text's representation. Readers need to draw on their knowledge of text genre and structure, as well as their understanding of language conventions. Readers may also reflect on the author's devices for conveying meaning and judge their adequacy, or identify weaknesses in how the text was written.

Table 2.7 presents the average achievement on the *retrieving and inferencing* and *interpreting, integrating and evaluating* scales. Internationally, compared to their overall reading performance, many countries performed relatively higher in one comprehension process and relatively lower in the other. There was a tendency for higher performing countries to perform relatively lower in the *retrieving and inferencing* process and relatively higher in the *interpreting, integrating and evaluating* process. For example, eight of the twelve highest performing countries, including Hong Kong, the Russian Federation, Singapore, Northern Ireland, the United States, Chinese Taipei, England and Canada, all performed relatively higher in the *interpreting, integrating and evaluating* scale than they did overall. Finland performed equally well across both reading comprehension scales, as did Australia.

As found with the reading purposes subscales, this was the same across all states, by gender and for Indigenous and non-Indigenous students.

Table 2.7 Relative mean achievement in comprehension processes, for Australia and by state, gender and Indigenous background

	Reading overall		Retrieving and straightforward inferencing		Absolute difference from overall reading score	Interpreting, Integrating and evaluating		Absolute difference from overall reading score
	Mean	SE	Mean	SE		Mean	SE	
Australia	527	2.2	527	2.6	0	529	2.2	2
ACT	558	5.3	558	5.2	0	558	5.2	0
NSW	535	4.9	536	4.6	1	536	4.6	1
VIC	539	4.0	541	4.1	2	541	4.1	2
QLD	511	5.0	513	5.2	2	513	5.2	2
SA	518	4.0	519	4.5	1	519	4.5	1
WA	516	4.5	518	4.5	2	518	4.5	2
TAS	525	7.5	524	7.6	1	524	7.6	1
NT	509	10.3	509	10.3	0	509	10.3	0
Female	536	2.7	536	3.1	0	538	2.8	2
Male	519	2.7	517	3.1	2	521	2.7	2
Non-Indigenous	532	2.2	531	2.5	1	534	2.1	2
Indigenous	475	5.6	472	6.0	3	479	5.2	4

Note: No statistical differences are calculated between the mean of the overall scale score and the reading purposes and processes scales. This is because the data in the purposes and processes scales underpin or contribute to the data in the overall reading score.

The next chapter of this report will examine Australian students' performance in mathematics in TIMSS 2011.

Chapter

3 Mathematics

Key Findings

- With an average mathematics score of 516, Australian students performed at a significantly lower level than students in 17 countries in TIMSS, including the United States and England.
- The performance of Australian Year 4 students has not changed since TIMSS 2007, however it is significantly higher than in TIMSS 1995.
- The proportion of Year 4 students achieving at the Advanced, High and Intermediate international benchmark in mathematics significantly increased since 1995.
- Trends in achievement scores by gender show that gender equity in mathematics achievement at Year 4 has been sustained in Australia.
- The Australian Capital Territory was the best performing state in terms of both average mathematics score and performance at international benchmarks. It was also the only state with a significant gain in average score since the 2007 TIMSS cycle, but the Australian Capital Territory, New South Wales, Victoria, South Australia and Tasmania have all significantly increased scores from TIMSS 1995.
- Students from homes with more literacy resources had higher achievement, on average, in mathematics than students from less well resourced homes.
- Indigenous students performed at a significantly lower level than non-Indigenous students, however the gap in mathematics achievement scores has declined with Indigenous students registering a significant improvement from the 2007 cycle while non-Indigenous students had no change.
- Students from metropolitan schools performed better than students from provincial schools who in turn performed better than students from remote schools.
- In terms of mathematics content and cognitive domains, Australian students seem to be weakest in *number* and are strongest in *geometric shapes and measures*, while cognitively, Australian students are stronger in *applying*. This pattern of strength and weakness was apparent in all states.

This chapter presents the TIMSS 2012 international and national results for mathematics at Year 4 level. The reporting of these results includes both mean scores and percentage of students achieving the international benchmarks, as both are important to policy makers.

How is mathematics assessed in TIMSS?

The mathematics assessment framework is organised around two dimensions – a *content dimension*, which specifies the domains or subject matter to be assessed within mathematics (for example, number, geometric shapes and measures, etc) and a *cognitive dimension*, which specifies the thinking processes and sets of behaviours expected of students as they engage with the mathematics content. Items are developed that probe students' understandings in each dimension.

Mathematics content and cognitive domains

In the TIMSS 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, number sentences, patterns and relationships. These are shown in Table 3.1. For a detailed description of each of the content domains in mathematics, refer to the TIMSS 2011 Assessment Frameworks (Mullis, et al., 2009).

Table 3.1 TIMSS mathematics content domains and proportion of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Number	Whole numbers	50
	Fractions and decimals	
	Number sentences	
	Patterns and relationships	
Geometric shapes and measures	Lines and angles	35
	Two and three dimension shapes	
	Location and movement	
Data display	Reading and interpreting	15
	Organising and representing	

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 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. These skills and abilities should play a central role in developing items and achieving a balance in learning outcomes assessed by the items in Year 4. The student behaviours used to define the mathematics framework at Year 4 have been classified into three cognitive domains.

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; and

Reasoning – which goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts and multi-step problems.

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 mathematics cognitive domains and proportion of assessment for each domain

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

The TIMSS benchmarks

The TIMSS mathematics achievement scale summarises Year 4 students' performance when interacting with a variety of mathematical tasks and questions. 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. For mathematics in TIMSS 2011, the Advanced international benchmark is 625, the High international benchmark is 550, the Intermediate international benchmark is 475 and the Low international benchmark is 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 levels for both the Intermediate and the Low benchmarks. Box 3.1 provides a summary of the TIMSS Year 4 mathematics benchmarks.

Box 3.1 The TIMSS 2011 international mathematics benchmarks, Year 4

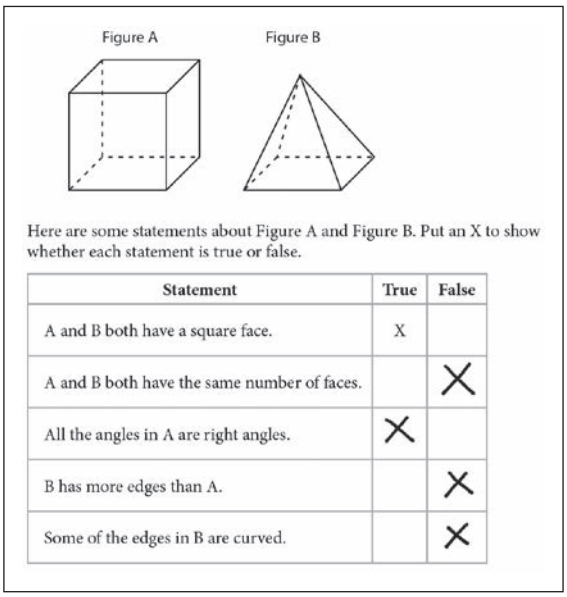
625	**Advanced International Benchmark** *Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.* They can solve a variety of multi-step word problems involving whole numbers including proportions. Students at this level show an increasing understanding of fractions and decimals. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can draw a conclusion from data in a table and justify their conclusion.
550	**High International Benchmark** *Students can apply their knowledge and understanding to solve problems.* Students can solve word problems involving operations with whole numbers. They can use division in a variety of problem situations. They can use their understanding of place value to solve problems. Students can extend patterns to find a later specified term. Students demonstrate understanding of line symmetry and geometric properties. Students can interpret and use data in tables and graphs to solve problems. They can use information in pictographs and tally charts to complete bar graphs.
475	**Intermediate International Benchmark** *Students can apply basic mathematical knowledge in straightforward situations.* Students at this level demonstrate an understanding of whole numbers and some understanding of fractions. Students can visualise three-dimensional shapes from two-dimensional representations. They can interpret bar graphs, pictographs and tables to solve simple problems.
400	**Low International Benchmark** *Students have some basic mathematical knowledge.* Students can add and subtract whole numbers. They have some recognition of parallel and perpendicular lines, familiar geometric shapes and coordinate maps. They can read and complete simple bar graphs and tables.

Further information about the types of mathematics skills and strategies demonstrated by 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 Appendix 3.

At Year 4, students at the Advanced international benchmark applied their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They could solve a variety of multi-step word problems and showed an increasing understanding of whole numbers, fractions and decimals. Students applied geometric knowledge to a range of two- and three-dimensional shapes in a variety of situations. They can draw a conclusion from data in a table and justify their conclusion.

As an example, Box 3.2 shows an item from geometric shapes and measures. Students were given the pictures of two common solid shapes and accompanying statements about the figures. They were asked to classify the four statements as 'true' or 'false'. To get full credit, the student had to classify all four statements correctly. This was quite difficult for Year 4 students internationally, with 32 per cent of students on average across all countries answering this correctly. In Australia, 45 per cent of the students answered the question correctly, which was significantly higher than the international average.

Box 3.2 Advanced international benchmark – Example item



Here are some statements about Figure A and Figure B. Put an X to show whether each statement is true or false.

Statement	True	False
A and B both have a square face.	X	
A and B both have the same number of faces.		X
All the angles in A are right angles.	X	
B has more edges than A.		X
Some of the edges in B are curved.		X

At the Low international benchmark, students have some basic mathematical knowledge and can add and subtract whole numbers. For example, they can add a four-digit and a three-digit whole number. They are familiar with numbers into the thousands. They have some recognition of parallel and perpendicular lines, familiar geometric shapes and coordinate maps. They can read and complete simple bar graphs and tables.

Box 3.3 provides an example of the type of item likely to be answered correctly by students achieving at Low international benchmark. Students were asked to add two three-digit whole numbers. This item was quite easy for Year 4 students internationally with 73 per cent on average across all countries answering this correctly. The proportion of correct responses was much higher in Singapore, Korea and Japan with over 90 per cent of the students answering the question correctly. In Australia, 69 per cent of the students answered the question correctly. While this appears to be slightly lower than the international average, the difference was not statistically significant.

Box 3.3 Low international benchmark – Example Item

There are 218 passengers and 191 crew members on a ship.
How many people are on the ship altogether?

Answer: 409

International student achievement in mathematics

This section reports the TIMSS 2011 mathematics results as average scores and distributions on the Year 4 TIMSS scale, which has a range of 0–1000. The TIMSS mathematics achievement scale was established in TIMSS 1995 to have a mean of 500 and a standard deviation of 100, and was designed to remain constant from assessment to assessment. Figure 3.1 shows the distributions of student achievement for the participants in the TIMSS 2011 Year 4 mathematics assessment, including the average scale score with its 95 per cent confidence interval, and the ranges in performance for the middle half of students (25th to 75th percentiles) as well as the extremes (5th and 95th percentiles). The average age of students in each of the countries is also shown.

As for PIRLS, the TIMSS target population is defined as the year level that represents four years of schooling, counting from the first year of ISCED Level 1.[1] In Australia, this is defined as Year 4 in all states.

Singapore, Korea and Hong Kong were the top-performing countries of TIMSS 2011, scoring well in excess of the High international benchmark of 550. The scores for these countries were not significantly different from each other but were significantly higher than all other countries.

Australia's average score of 516 score points was significantly higher than the score for 27 other countries, including New Zealand. It was, however, significantly lower than the average score for 17 other countries, including Ireland and Northern Ireland, the United States and England, as well as the participating Asian countries Singapore, Korea, Hong Kong and Chinese Taipei.

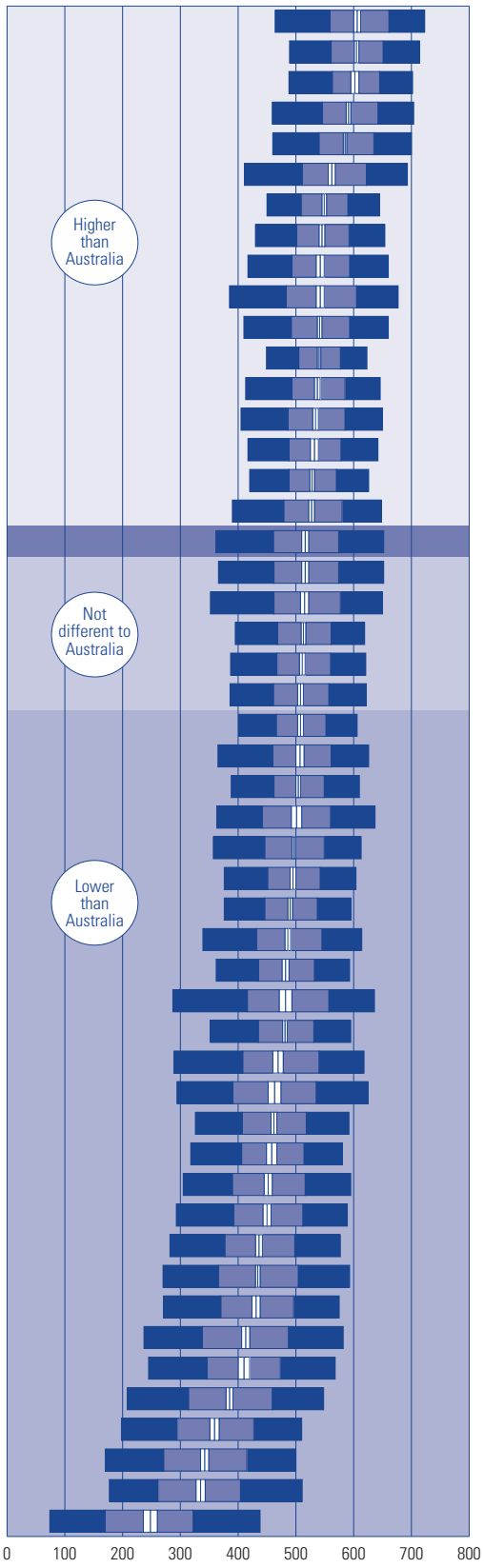
The results reveal substantial differences in achievement in mathematics between the highest and lowest performing countries (see Appendix 4 for multiple comparison tables of countries' average achievement). The scores for the top four countries is almost one standard deviation higher than the scale midpoint, while the score for Yemen at 248 is almost two and a half standard deviations lower than the scale midpoint. Figure 3.1 also shows the range of achievement within countries, with 259 score points separating the 5th and 95th percentiles for Singapore, but more than 300 score points separating highest and lowest in Yemen (364), Romania (349), Qatar (345 points), Oman (340 points) and the UAE (323 score points).

Australia's gap between high and low achievers, of 286 scale points, was mid-range, similar to that of England (292 points). New Zealand had a 275 scale points gap between high and low performers. As a comparison, the gap for students in the Netherlands was the lowest, at 174 points.

Figure 3.1 also shows the average age at the time of testing in each country. Even within Australia, school starting age varies between states; across 51 countries this is likely to be much more of an issue. The average age varies by about one year, from 9.7 years in Italy, Norway Kuwait, to almost 11 years in Finland, Russian Federation, Serbia, Denmark and Yemen. Students in one of the highest achieving countries, Hong Kong, are relatively young (10.1 years), and Australian Year 4 students are a similar age (10.0 years).

1 ISCED is the International Standard Classification of Education, developed by the UNESCO Institute for Statistics (UNESCO, 1997).

	Mean	SE	Average age at the testing	Gap 95th - 5th percentiles
Singapore	606	3.2	10.4	259
Korea	605	1.9	10.4	225
Hong Kong	602	3.4	10.1	214
Chinese Taipei	591	2.0	10.2	245
Japan	585	1.7	10.5	240
Northern Ireland	562	2.9	10.4	282
Belgium	549	1.9	10.0	195
Finland	545	2.3	10.8	224
England	542	3.5	10.2	292
Russian Federation	542	3.7	10.8	243
United States	541	1.8	10.2	250
Netherlands	540	1.7	10.2	174
Denmark	537	2.6	11.0	233
Lithuania	534	2.4	10.7	245
Portugal	532	3.4	10.0	225
Germany	528	2.2	10.4	206
Ireland	527	2.6	10.3	258
Australia	516	2.9	10.0	286
Serbia	516	3.0	10.8	290
Hungary	515	3.4	10.7	298
Slovenia	513	2.2	9.9	224
Czech Republic	511	2.4	10.4	234
Austria	508	2.6	10.3	205
Italy	508	2.6	9.7	236
Slovak Republic	507	3.8	10.4	261
Sweden	504	2.0	10.7	222
Kazakhstan	501	4.5	10.4	274
Malta	496	1.3	9.8	256
Norway	495	2.8	9.7	228
Croatia	490	1.9	10.7	219
New Zealand	486	2.6	9.9	275
Romania	482	5.8	10.9	349
Spain	482	2.9	9.8	231
Poland	481	2.2	9.9	243
Turkey	469	4.7	10.1	329
Azerbaijan	463	5.8	10.2	331
Chile	462	2.3	10.1	266
Thailand	458	4.8	10.5	262
Armenia	452	3.5	10.0	290
Georgia	450	3.7	10.0	296
Bahrain	436	3.3	10.4	295
United Arab Emirates	434	2.0	9.8	323
Iran	431	3.5	10.2	304
Qatar	413	3.5	10.0	345
Saudi Arabia	410	5.3	10.0	323
Oman	385	2.9	9.9	340
Tunisia	359	3.9	10.0	312
Kuwait	342	3.4	9.7	330
Morocco	335	4.0	10.5	334
Yemen	248	6.0	11.2	364



Note: See Reader's Guide for interpretation of graph

Figure 3.1 Distribution of mathematics achievement, by country

Performance at the international benchmarks

In addition to the mean scores it is useful to use the international benchmarks described previously to gain further insight into student achievement. Figure 3.2 shows the proportion of students in each country at each of the international benchmarks.

The countries are ordered by the proportion of students reaching the Intermediate proficiency standard. The Intermediate benchmark is the minimum proficient standard set for TIMSS in mathematics and science.

Korea, Hong Kong, Singapore, Chinese Taipei and Japan again head the table (Figure 3.2), with between 30 and 43 per cent of their Year 4 students proficient at the Advanced benchmark, and a very low proportion, between three and seven per cent, of their students reaching only the Low benchmark or not achieving this level at all. Northern Ireland was the best performing of the non-Asian countries, with 24 per cent of students at the Advanced benchmark, however unlike the high performing Asian countries, 15 per cent of its students were achieving either at or below the Low benchmark.

England and the United States had 18 and 13 per cent respectively, achieving at the Advanced benchmark, and between 22 and 19 per cent of their students at the Low international benchmark or not reaching that level. In the Netherlands, the country with the narrowest gap between high and low achievers, five per cent of students achieved the Advanced benchmark, eleven per cent of students were at the Low benchmark, and only one per cent did not achieve this level.

Ten per cent of Australian students achieved at the Advanced international benchmark, with a further 25 per cent achieving the High international benchmark. Seventy per cent of Australian students achieved at least the Intermediate international benchmark, which is the minimum proficient standard expected. Of concern are the 30 per cent of Australian Year 4 students achieving at the Low international benchmark or not achieving at this level. In terms of what these students can do, in *number* as an example, students at the Low benchmark can add or subtract whole numbers, while those achieving at the Advanced benchmark are able to solve multi-step word problems.

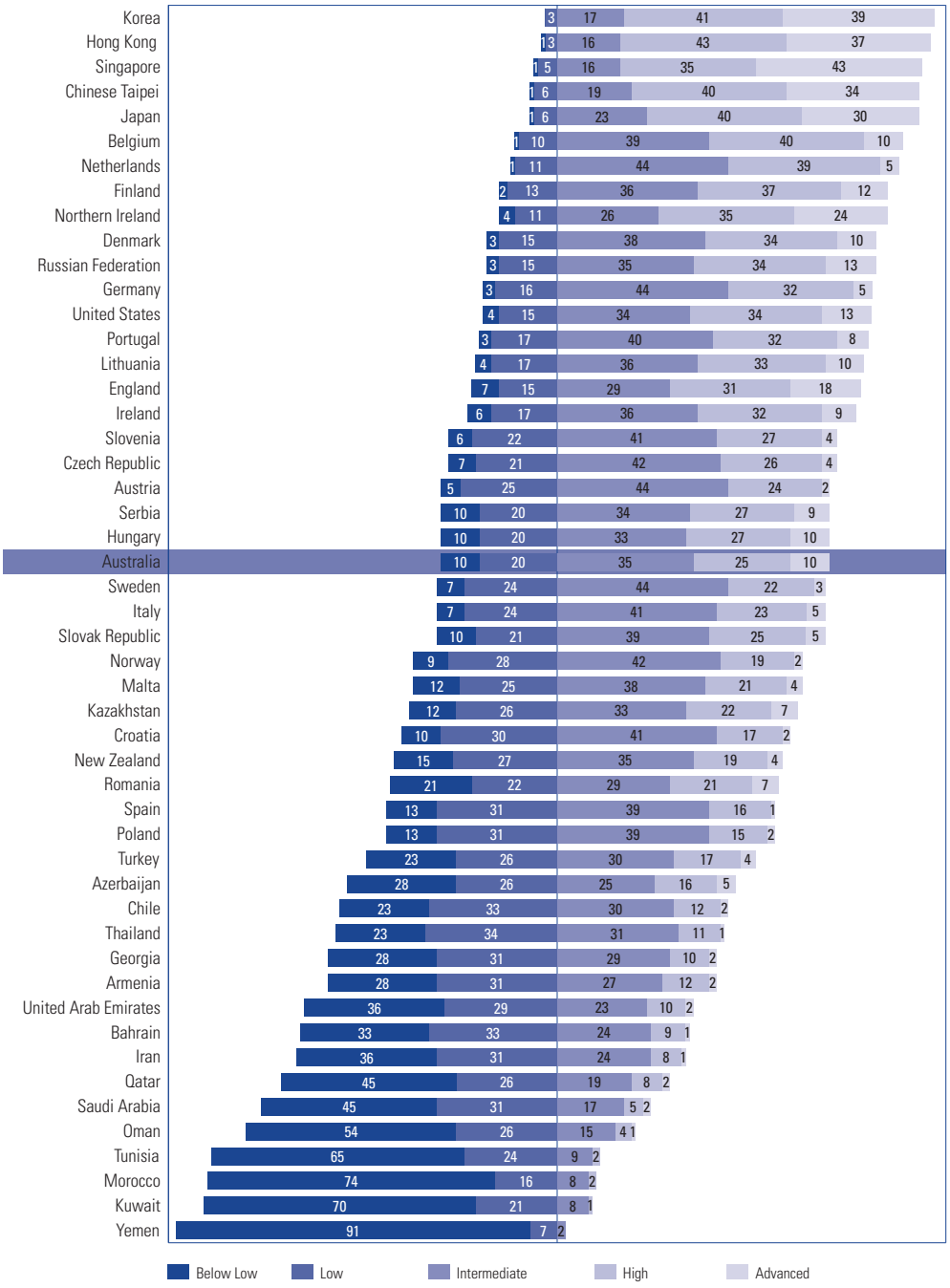


Figure 3.2 Percentages of students at the international benchmarks for mathematics, by country

Trends in international mathematics achievement

Figure 3.3 shows trends in Year 4 mathematics achievement for some selected countries that have comparable data from previous TIMSS assessment. 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 in this are those with which we usually make comparisons: the US, England and New Zealand, 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 (1995–2011).

Looking at the overall trends in Year 4 mathematics achievement during the 1995–2011 period, there have been more countries with increases than with decreases. Of the 17 participating

countries with data spanning this period, 12 countries had increases in average mathematics achievement, three countries had decreases, and two countries had no difference. Among the countries with the greatest increase from 1995 to 2011 were Portugal, England, Slovenia, Hong Kong and Iran, with average mathematics achievement increases of more than 40 points. The country with the greatest decrease was Czech Republic with a 30-point drop from 1995–2011. There is however, a notable significant increase (24 score points) in the Czech Republic score between 2007–2011.

In TIMSS 2011, Australia's score in mathematics at Year 4 had not changed from the 2007 score. However, there was an overall significant increase of more than 20 points from 1995–2011, which was similar to Korea and the United States. In New Zealand there was a non-significant decrease from the last cycle of TIMSS, but overall New Zealand had a 17-point increase from 1995–2011, which was similar to Singapore, with an increase of 16 points.

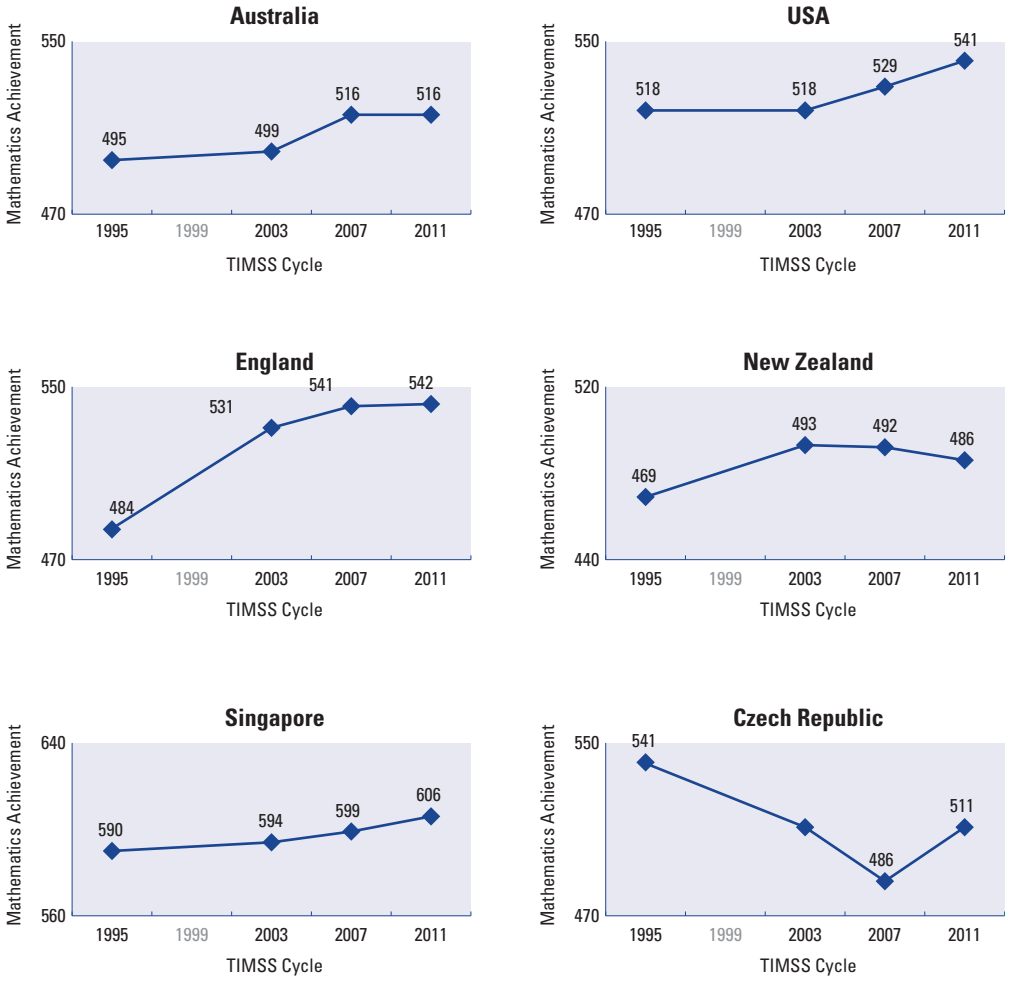


Figure 3.3 Trends in mathematics achievement, 1995-2011, selected countries

The proportions of Australian students achieving at the Advanced, High and Intermediate benchmarks has increased significantly since TIMSS 1995.

Table 3.3 shows each country's relative position to Australia in each TIMSS cycle's Year 4 mathematics. Whilst there are new country participants in TIMSS 2011, in terms of relative position internationally, Australia was still outperformed at Year 4 in 2011 by all of the Asian countries, as well as England and the United States. Slovenia, Czech Republic and Austria, whose relative positions were significantly lower than Australia in 2007, have recently caught up and are now at the same level, while Denmark, which had the same relative position as Australia in 2007, has now out-performed Australia. In terms of trends since 1995, the Czech Republic and Portugal

both scored significantly lower than Australia in 1995 but the Czech Republic has since gained the same relative position as Australia in 2011, and Portugal scored significantly higher than Australia in TIMSS 2011.

Table 3.3 Relative trends in mathematics achievement, by country

Country	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Singapore	↑	↑	↑	↑
Korea	↑	-	-	↑
Hong Kong	↑	↑	↑	↑
Chinese Taipei	↑	↑	↑	-
Japan	↑	↑	↑	↑
Northern Ireland	↑	-	-	-
Belgium	↑	-	↑	-
Finland	↑	-	-	-
England	↑	↑	↑	↓
Russian Federation	↑	↑	↑	-
United States	↑	↑	↑	•
Netherlands	↑	↑	↑	↑
Denmark	↑	•	-	-
Lithuania	↑	↑	↑	-
Portugal	↑	-	-	↓
Germany	↑	↑	-	-
Ireland	↑	-		↑
Australia				
Serbia	•	-	-	-
Hungary	•	•	↑	•
Slovenia	•	↓	↓	•
Czech Republic	•	↓	-	↓
Austria	•	↓	-	↑
Italy	↓	•	•	-
Slovak Republic	↓	↓	-	-
Sweden	↓	↓	-	-
Kazakhstan	↓	↑	-	-
Malta	↓	-	-	-
Norway	↓	↓	↓	↓
Croatia	↓	-	-	-
New Zealand	↓	↓	•	↓
Romania	↓	-	-	-
Spain	↓	-	-	-
Poland	↓	-	-	-
Turkey	↓	-	-	-
Azerbaijan	↓	-	-	-
Chile	↓	-	-	-

Thailand	↓	-	-	-
Armenia	↓	↓	↓	-
Georgia	↓	↓	-	-
Bahrain	↓	-	-	-
United Arab Emirates	↓	-	-	-
Iran	↓	↓	↓	↓
Qatar	↓	↓	-	-
Saudi Arabia	↓	-	-	-
Oman	↓	-	-	-
Tunisia	↓	↓	↓	-
Kuwait	↓	↓	-	-
Morocco	↓	↓	↓	-
Yemen	↓	↓	-	-

↑ Score significantly higher than Australia
↓ Score significantly lower than Australia
● Score not significantly different to that of Australia
- Did not participate in this cycle

Mathematics achievement by gender

Previous TIMSS assessments have shown gender differences in mathematics achievement at Year 4 to be small on average, although the situation may vary considerably from country to country.

Figure 3.4 shows gender differences in mathematics achievement in the TIMSS 2011 Year 4. It presents average achievement separately for female and male students as well as the difference between the average scores. The bar graph shows the size of the achievement difference and whether that difference is statistically significant. Participants are shown in order by the increasing size of the difference between female and male students in average mathematics achievement.

Averaging mathematics achievement across countries, it is clear that there was little achievement difference between female and male students (International Average: 490 vs. 491) at Year 4 level. Twenty-six countries, including Australia, had no significant gender difference in mathematics achievement. Of the 24 remaining countries, 20, including the United States, had small differences favouring male students, and four had relatively larger differences favouring female students (Qatar, Thailand, Oman and Kuwait).

Consistent with findings from TIMSS 2007, the largest achievement differences (12–35 score points) favouring female students were in Arabic-speaking countries from the Middle East, including Qatar, Oman, Yemen, Kuwait and Saudi Arabia.

In Australia, both male and female students achieved at a significantly higher level than their respective international means. There was, however, no statistically significant difference in the average mathematics score of Australian male and female students, with only 6 score points between them. This was similar to other countries including England, Ireland and Singapore.

	Females				Males					
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE	Difference (absolute value)	SE
Northern Ireland	49	1.3	562	3.3	51	1.3	563	3.6	0	3.8
New Zealand	49	0.8	486	3.3	51	0.8	486	2.8	0	3.1
Iran	49	2.9	431	5.2	51	2.9	431	5.4	0	8.0
International Average	49	0.2	490	0.5	51	0.2	491	0.6	1	
Lithuania	48	0.8	533	2.6	52	0.8	534	2.9	1	2.6
Russian Federation	49	1.0	543	3.7	51	1.0	542	4.1	1	2.4
Hungary	49	1.0	514	3.6	51	1.0	517	3.9	2	3.2
Turkey	48	0.6	470	5.2	52	0.6	469	4.8	2	3.8
Chinese Taipei	47	0.6	592	2.5	53	0.6	590	2.4	2	2.8
Armenia	47	0.8	454	4.1	53	0.8	451	3.6	3	3.0
Ireland	49	2.3	526	3.7	51	2.3	529	3.3	3	4.6
England	48	1.0	541	4.2	52	1.0	544	3.5	3	3.4
Japan	49	0.5	584	2.0	51	0.5	587	2.5	3	3.0
Romania	48	0.9	481	6.7	52	0.9	484	5.9	3	4.5
Singapore	49	0.6	608	3.6	51	0.6	604	3.5	4	3.0
Kazakhstan	48	0.8	498	4.4	52	0.8	504	4.8	**5**	2.6
Sweden	49	1.0	501	2.5	51	1.0	506	2.4	5	2.7
Hong Kong	46	1.2	598	3.2	54	1.2	604	3.9	**6**	2.3
Serbia	48	0.9	513	3.8	52	0.9	519	3.5	6	4.1
Portugal	49	1.1	529	4.1	51	1.1	535	3.4	6	3.2
Australia	49	1.0	513	3.3	51	1.0	519	3.6	6	3.8
Denmark	51	0.7	534	2.9	49	0.7	540	2.9	**6**	2.8
Bahrain	50	1.6	440	4.5	50	1.6	432	4.0	7	5.5
Georgia	48	0.9	454	3.2	52	0.9	447	4.9	7	3.9
Finland	49	0.8	542	2.5	51	0.8	549	2.9	**7**	2.8
Norway	51	1.1	492	2.8	49	1.1	499	3.5	**7**	2.8
Malta	49	0.5	492	1.6	51	0.5	499	2.1	**7**	2.5
Tunisia	47	0.8	363	4.5	53	0.8	356	4.4	7	4.4
Morocco	48	0.8	338	4.6	52	0.8	331	4.3	7	3.9
Azerbaijan	47	0.8	466	6.4	53	0.8	460	5.9	7	3.9
Korea	48	0.4	601	2.1	52	0.4	608	2.2	**7**	2.0
Germany	49	0.8	523	2.7	51	0.8	532	2.6	**8**	2.7
Slovak Republic	49	0.9	503	4.0	51	0.9	511	-3.9	**8**	2.6
Belgium	50	0.9	545	2.2	50	0.9	553	2.4	**8**	2.5
United Arab Emirates	50	1.6	438	2.8	50	1.6	430	3.5	8	5.0
Netherlands	52	1.0	536	2.1	48	1.0	544	2.1	**8**	2.4
Chile	51	1.4	457	2.7	49	1.4	466	2.8	**9**	3.3
Austria	49	1.2	504	2.7	51	1.2	513	3.3	**9**	2.8
Poland	48	0.9	476	2.4	52	0.9	486	2.5	**9**	2.5
Italy	50	0.7	503	3.1	50	0.7	512	2.9	**9**	3.0
United States	51	0.5	536	2.1	49	0.5	545	1.9	**9**	1.7
Croatia	50	0.8	485	2.4	50	0.8	495	2.4	**10**	2.8
Slovenia	48	0.8	508	2.2	52	0.8	518	3.1	**10**	3.2
Spain	49	0.8	477	3.1	51	0.8	488	3.4	**11**	3.0
Czech Republic	48	1.2	505	2.8	52	1.2	516	2.7	**11**	2.7
Yemen	40	2.8	255	7.0	60	2.8	243	7.0	12	7.6
Qatar	47	3.4	420	4.7	53	3.4	407	4.2	**13**	5.6
Thailand	49	0.9	465	4.8	51	0.9	451	5.6	**14**	4.4
Saudi Arabia	52	1.5	418	4.6	48	1.5	402	10.0	16	11.2
Oman	49	0.7	398	3.2	51	0.7	372	3.4	**26**	3.3
Kuwait	54	1.6	358	3.6	46	1.6	323	5.8	**35**	6.8

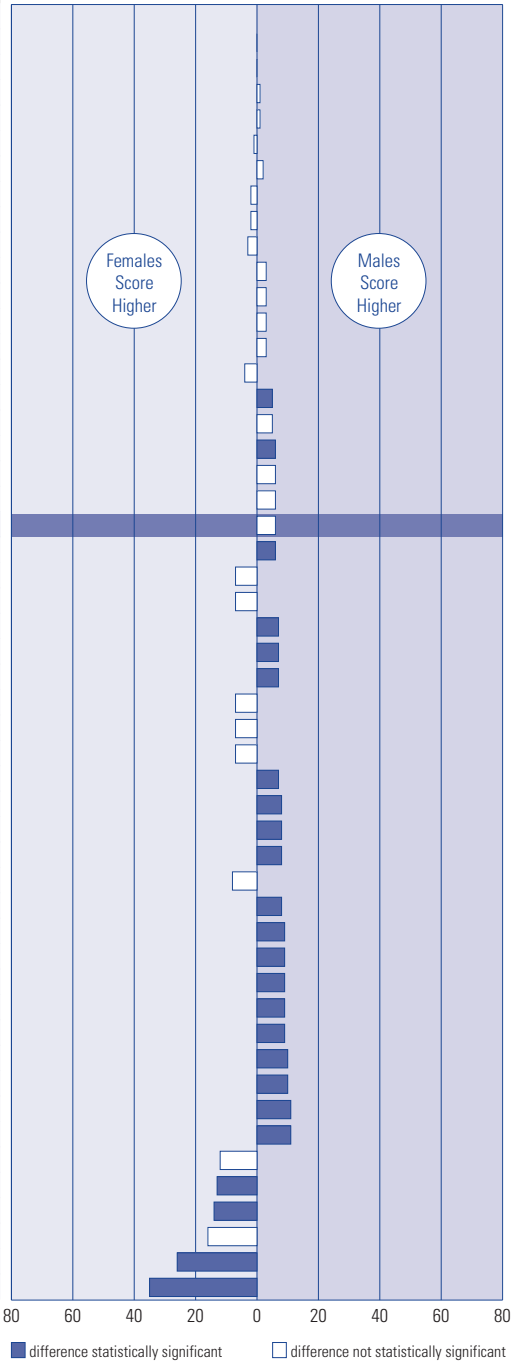


Figure 3.4 Gender differences in mathematics achievement, by country

Despite the lack of gender difference in mathematics achievement, Figure 3.5 shows the range of scores was slightly greater for Australian Year 4 male students (294 points) than for Year 4 female students (279 points). The figure also illustrates a similar performance for both male and female students with five per cent of the males scoring below 365 (5th percentile), similar to the corresponding 5th percentile for females (369).

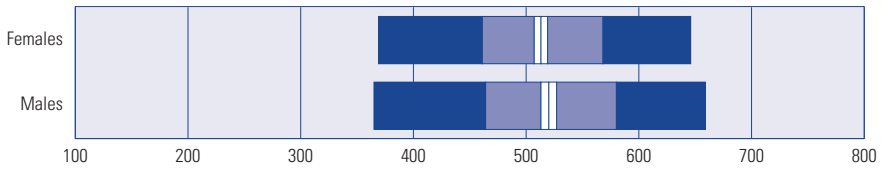


Figure 3.5 Distribution of mathematics achievement within Australia, by gender

Performance at the international benchmarks by gender

Figure 3.6 also illustrates the absence of significant gender differences in mathematics achievement in Year 4 in Australia. A slightly higher proportion of male students (11%) compared to nine per cent of female students achieved at the Advanced international benchmark in TIMSS 2011. At the lower end of the achievement scale, 31 per cent of female students compared to 28 per cent of male students did not reach the Intermediate benchmark.

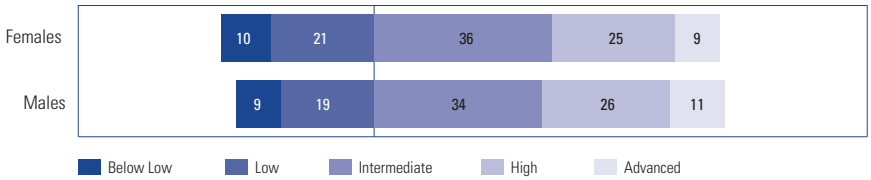


Figure 3.6 Percentages of Australian students at the international benchmarks for mathematics, by gender

Trends in mathematics achievement by gender

For countries with gender differences in mathematics achievement, trends in achievement can be influenced by differential performance by male and female students, revealing progress (or lack thereof) towards gender equity. Figure 3.7 shows a graphic representation of trends from 1995 to 2011 in mathematics achievement of male and female Year 4 students in Australia. As described in the previous section, at Year 4 there is already gender equity in mathematics achievement in Australia, which is also reflected in the trends across cycles of TIMSS.

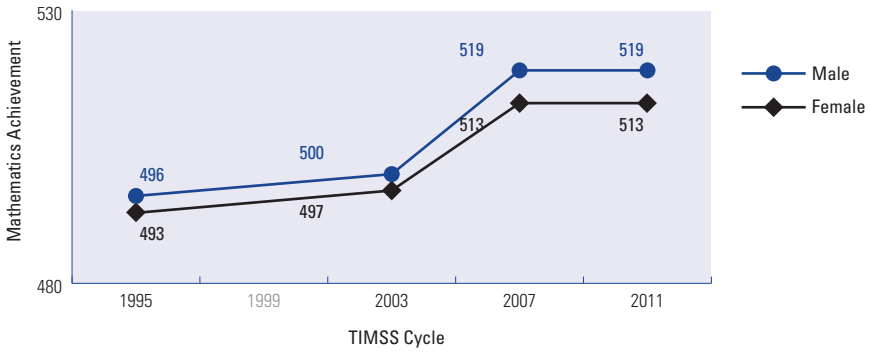


Figure 3.7 Trends in mathematics achievement within Australia, 1995-2011, by gender

Mathematics achievement by state

Figure 3.8 presents the distribution of Year 4 mathematics achievement for each of the Australian states for TIMSS 2011. To place the state results in perspective, the means and distributions for Australia as a whole, and for Singapore, the highest achieving country in mathematics, are also included in the figure. The states are shown in order of highest mean score.

Figure 3.8 should be read in conjunction with Table 3.4, which presents the multiple comparisons of mean mathematics performance between states and indicates which are significantly different to each other.

The largest range of student performance was seen in Western Australia, Tasmania and Northern Territory, with the range from the 5th to 95th percentile of around 300 score points. The highest achieving state, the Australian Capital Territory, had the narrowest gap of all the states, at 263 score points, while the distribution for next highest achievers, Victoria and New South Wales, was 282 and 286 score points respectively. The range from 5th to 95th percentile for Australia was 286 while that of Singapore was 259 score points.

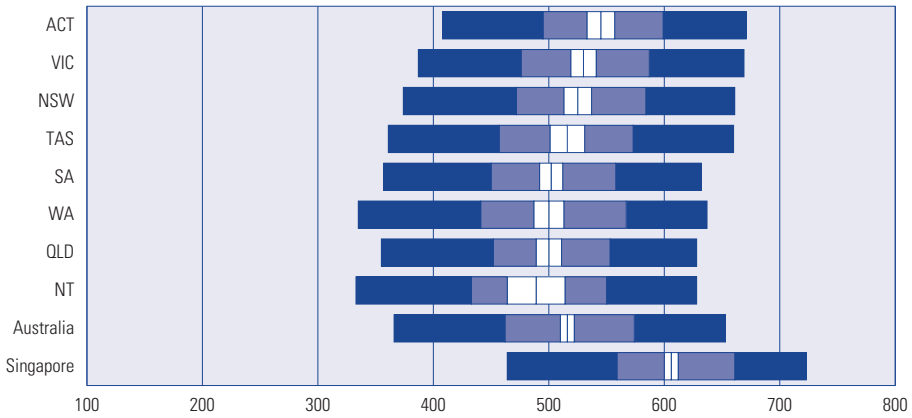


Figure 3.8 Distribution of mathematics achievement, by state

Table 3.4 shows that the spread of average scores across the states was not large, being 56 score points, just over half a standard deviation, between the Australian Capital Territory and the Northern Territory. The performance of students in the Australian Capital Territory was significantly higher than that of students in all states except Victoria. The performance of students in Victoria and New South Wales was not significantly different to each other, but was significantly higher than the performance of students in all remaining states with the exception of Tasmania.

Table 3.4 Multiple comparisons of average mathematics achievement, by state

STATE	Mean	SE	ACT	VIC	NSW	TAS	SA	WA	QLD	NT
ACT	545	5.9		●	▲	▲	▲	▲	▲	▲
VIC	531	5.6	●		●	●	▲	▲	▲	▲
NSW	525	6.0	▼	●		●	▲	▲	▲	▲
TAS	517	7.7	▼	●	●		●	●	●	●
SA	502	5.2	▼	▼	▼	●		●	●	●
WA	499	6.4	▼	▼	▼	●	●		●	●
QLD	499	5.5	▼	▼	▼	●	●	●		●
NT	489	12.8	▼	▼	▼	●	●	●	●	

Note: Read across the row to compare a state's performance with the performance of each state listed in the column heading.
▲ Average performance statistically significantly higher than in comparison state.
● No statistically significant difference from comparison state.
▼ Average performance statistically significantly lower than in comparison state.

Gender difference in mathematics achievement by state

Figure 3.9 shows the gender differences by state in mathematics at Year 4. The gender gap was significant only in South Australia, with a 25-point gap in favour of male students. In all other states, the differences were not statistically significant.

	Female		Male		
	Mean	SE	Mean	SE	Diff
WA	504	8.4	493	7.4	–11
NT	489	14.0	490	12.7	1
TAS	516	7.8	519	10.4	3
QLD	498	4.2	503	7.5	6
VIC	529	7.4	534	5.8	5
NSW	520	7.1	530	7.3	10
ACT	540	8.6	550	6.0	10
SA	488	6.7	514	6.2	25
International Average	490	0.5	491	0.6	1

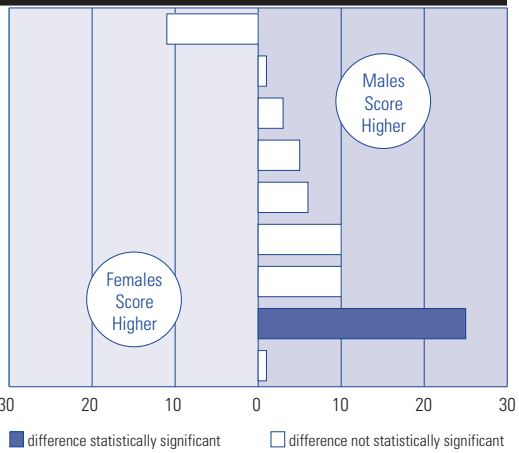


Figure 3.9 Gender differences in mathematics achievement, by state

Performance at the international benchmarks by state

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

The Australian Capital Territory was the best performing state, with 14 per cent of students achieving the Advanced international benchmark. Almost half of the students (48%) reached the High international benchmark, and 81 per cent achieved at least the Intermediate benchmark. As a comparison, 43 per cent of students in Singapore achieved at the Advanced international benchmark and 94 per cent of the students achieved at the Intermediate international benchmark.

The next best achieving states were Victoria and New South Wales with 13 and 12 per cent of students respectively achieving at the Advanced international benchmark, 41 and 39 per cent respectively achieving the High international benchmark and 75 per cent of students in Victoria and 74 per cent of students in New South Wales achieving at least the Intermediate benchmark.

In each of the other states, ten per cent of students or less achieved at the Advanced benchmark and more than 30 per cent of the students did not achieve the Intermediate international benchmark.

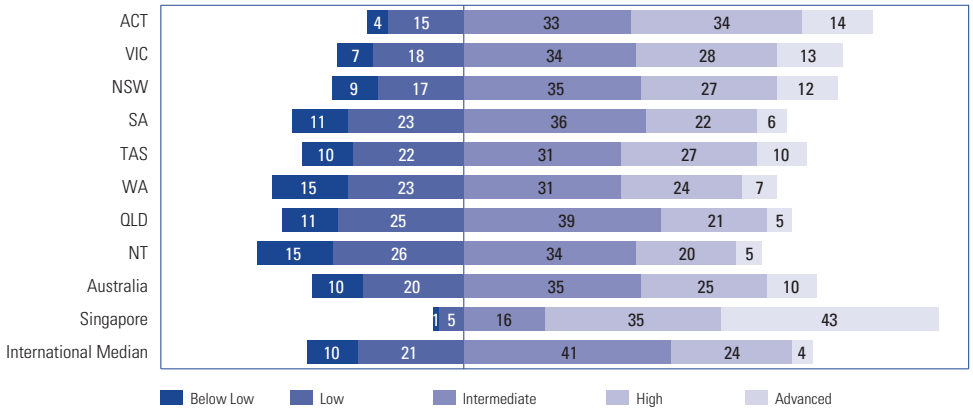


Figure 3.10 Percentages of students at the international benchmarks for mathematics, by state

Figure 3.11 shows the proportion of students by gender in each state at each of the international benchmarks in Year 4 mathematics. Overall, a higher proportion of male students compared to female students achieved at the Advanced benchmark in all states, except Western Australia. The Australian Capital Territory, Victoria, New South Wales and Tasmania had more than ten per cent of male students achieving at the Advanced international benchmark. Only the Australia Capital Territory and Victoria had more than ten per cent of female students reaching this level. In all states except Tasmania, Western Australia and Northern Territory, the proportion of male students not achieving the Intermediate international benchmark was lower than the proportion of female students who performed at the two lowest benchmarks.

In South Australia (where there was a significant gender difference in the average mathematics scores of male and female students), substantial differences in proportions at each benchmark (except the Intermediate benchmark) are also apparent. At the high end, twice as many males as females achieved at the Advanced benchmark. At the lower end of the achievement spectrum, 43 per cent of female students achieved at the Low benchmark or did not reach it, compared to 28 per cent of male students.

Western Australia is the only state in which a slightly higher proportion of female students than male students reached the High benchmark. Thirty-two per cent of female students and 29 per cent of male students achieved at the High benchmark. At the lower end of the achievement spectrum, the proportions were similar with 38 per cent of female students and 39 per cent of male students not achieving the Intermediate international benchmark.

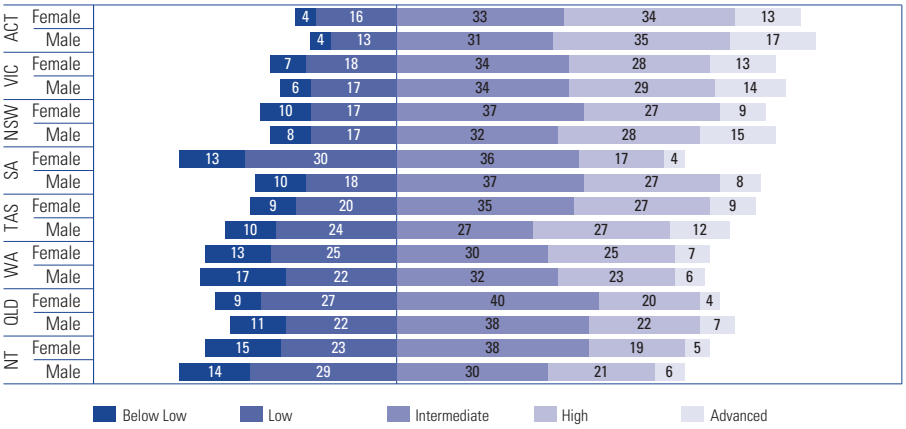


Figure 3.11 Percentages of students at the international benchmarks for mathematics, by gender within state

Trends in mathematics achievement by state

Table 3.5 shows the change in average mathematics achievement scores in each state from previous TIMSS cycles (1995, 2003 and 2007) to the 2011 cycle. It also provides an indication of whether the difference is significant or not. It is apparent from the table that none of the states had a significant decline in achievement scores across the TIMSS cycles from 1995 to 2011.

Between 1995 and 2011, there has been a significant improvement in all of the states other than Queensland, Western Australia and Northern Territory. Tasmania has shown the greatest improvement of more than 30 score points, followed by New South Wales and Victoria with 29 and 24 score points respectively. Both the Australia Capital Territory and South Australia recorded gains of just under 20 score points.

Victoria and Western Australia showed a significant improvement between 2003 and 2011 with increases of more than 20 score points.

The Australian Capital Territory is the only state that had a significant improvement in Year 4 mathematics achievement between the two most recent cycles of TIMSS assessment, with a 32-point increase between 2007 and 2011.

Queensland and Northern Territory are the only two states that have registered no statistically significant gains in Year 4 mathematics achievement across all the cycles of TIMSS assessment.

Table 3.5 Trends in mathematics achievement, by state

	TIMSS 2011		TIMSS 2007		2011 - 2007 difference	TIMSS 2003		2011 - 2003 difference	TIMSS 1995		2011 - 1995 difference
State	Mean	SE	Mean	SE		Mean	SE		Mean	SE	
ACT	545	5.9	513	7.7	▲	523	13.7		527	5.8	▲
NSW	525	6.0	534	6.4		510	9.2		496	6.7	▲
VIC	531	5.6	532	8.2		508	6.8	▲	507	7.8	▲
QLD	499	5.5	485	6.7		484	7.1		484	7.7	
SA	502	5.2	493	8.5		485	8.3		485	7.0	▲
WA	499	6.4	493	5.4		472	7.8	▲	483	7.6	
TAS	517	7.7	510	6.0		497	13.2		486	8.5	▲
NT	489	12.8	484	9.6		479	14.9		491	8.4	

▲ Difference is a statistically significant improvement over time.

Mathematics achievement by books in the home

Educational resources in the home can reflect potential advantage or disadvantage for students. In this section, the focus is on the number of books in the home, which acts as a proxy for a student's educational and social background, as discussed in Chapter 2. This section looks at the mathematics achievement of students in Year 4 according to their 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, *average number of books* equals between 26 and 200 books and *many books* equals more than 200 books.

Internationally, Korea had the greatest proportion of students (65%) who reported having more than 100 books in their homes. Australia followed with 41 per cent, Canada with 40 per cent Sweden and New Zealand with 39 and 38 per cent respectively.

Table 3.6 provides the percentage of students in each category, and the mean achievement score for students in each group. The majority of Australian students (59%) reported having an *average number of books* and only 19 per cent reported having *many books* at home. The students who have the most books in the home were found to have the highest levels of mathematics achievement, scoring, on average, 19 points higher than students with an *average number of book*s in the home, and 71 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 have higher achievement, on average, in mathematics than students from less well-resourced homes.

Table 3.6 Mean mathematics achievement within Australia, by number of books in the home

	% of Students	Mean	SE	Gap 95th - 5th percentiles
Many books	19	544	4.4	293
Average number of books	59	525	3.0	263
A few books	22	473	4.3	271

Figure 3.12 shows the distribution of scores in mathematics achievement of Year 4 students for each category of books at home. The spread of scores between the 5th and 95th percentile do not vary greatly across the groups, ranging from 263 to 293 score points. The highest achieving students, who were also those 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 *average number of books* at home.

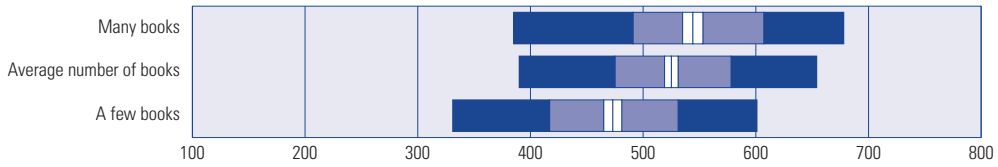


Figure 3.12 Distribution of mathematics achievement within Australia, by number of books in the home

To get an idea of the capacity of students in each of these groups, proportions of students at each benchmark were examined. Figure 3.13 shows that of those students who reported having *many books* in the home, 18 per cent achieved the Advanced benchmark. The proportion of students achieving this highest benchmark falls to 10 per cent for 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.

However, the data also make it evident that while having a home with *many books* (or by implication a home environment that values literacy, the acquisition of knowledge, and general academic support), the relationship is not definitive. At the other end of the achievement scale, a total of 21 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 seven per cent of students not even achieving 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 in the *average number of books* in the home category, a total of 25 per cent of students did not achieve the Intermediate benchmark, comprising 19 per cent of students who achieved the Low benchmark and six per cent of students not achieving this level. Almost half of the students who reported having *few books in the home* did not achieve the Intermediate benchmark, with 29 per cent of these achieving at the Low benchmark and a further 20 per cent falling below the Low benchmark.

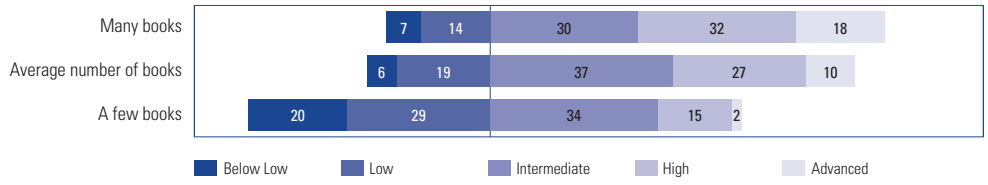


Figure 3.13 Percentages of Australian students at the international benchmarks for mathematics, by number of books in the home

Mathematics achievement by Indigenous background

The education attainment of Australian'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 this area. Indigenous status in TIMSS is based on students' self-reports of their backgrounds. As shown in Table 3.7, seven per cent of the TIMSS Year 4 sample identified as Indigenous (including Aboriginal and Torres Strait Island peoples). These students attained an average score of 458 score points in mathematics, which is 64 score points lower than the average score for non-Indigenous students of 522. The mean score for Indigenous students is lower

than the Intermediate international benchmark, while the average mathematics score of non-Indigenous students is almost at the High international benchmark (set at 550 points).

Table 3.7 Mean mathematics achievement within Australia, by Indigenous background

	% of students	Mean	SE	Gap 95th - 5th percentiles
Non-Indigenous	93	522	2.7	276
Indigenous	7	458	7.8	287

Figure 3.14 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 287 score points, compared to 276 for non-Indigenous students.

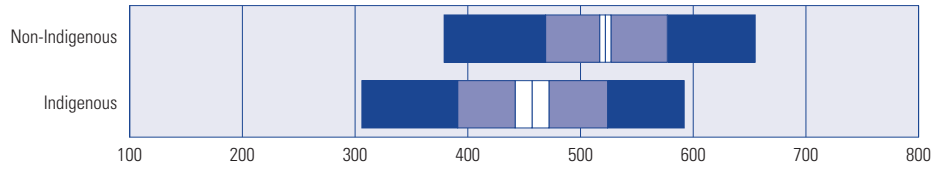


Figure 3.14 Distribution of mathematics achievement within Australia, by Indigenous background

Figure 3.15 adds to the picture of performance by providing the proportions 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 two per cent of Indigenous students. Of even greater concern is that 55 per cent of Indigenous students compared to 28 per cent of non-Indigenous students did not achieve the Intermediate international benchmark, with 28 per cent of Indigenous students not even reaching the Low benchmark.

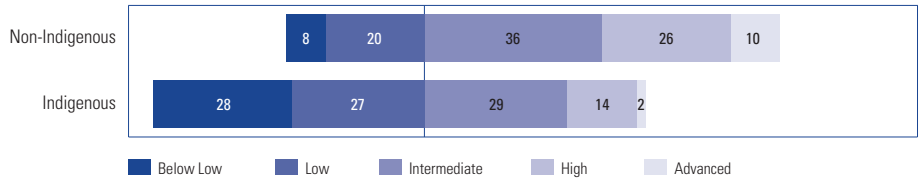


Figure 3.15 Percentages of Australian students at the international benchmarks for mathematics, by Indigenous background

Figure 3.16 shows trends in mathematics achievement at Year 4 by Indigenous background for TIMSS cycles from 1995 to 2011. Between 2007 and 2011, there was a significant improvement in mathematics achievement for students with an Indigenous background with a 27 points increase. However, the overall change between 1995 and 2011 was a 28 points increase.

In 1995 and 2003 the score difference between non-Indigenous and Indigenous students was 69 and 60 score points respectively. In 2007, an increase in the average score of non-Indigenous students and a decline in the average score of Indigenous students resulted in a larger gap of 91 score points.

In 2011, this situation had changed again; the average score of Indigenous students had increased significantly from 2007, while that of non-Indigenous students remained unchanged, leading to a significant decrease in the gap between average mathematics performance of Indigenous and non-Indigenous Year 4 students.

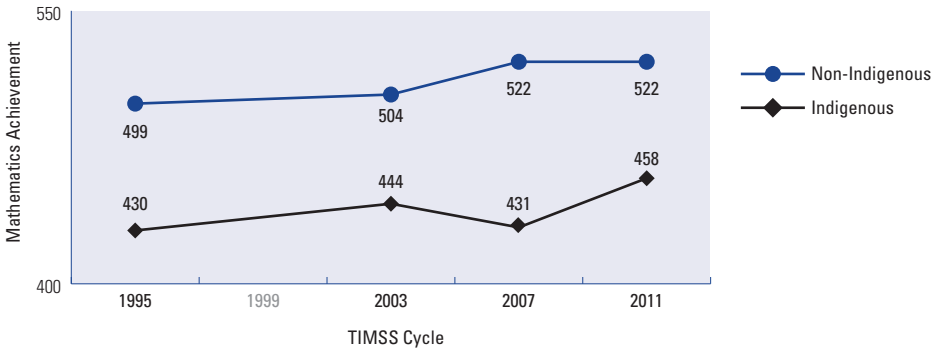


Figure 3.16 Trends in mathematics achievement within Australia, 1995-2011, by Indigenous background

Mathematics achievement by language background

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. Table 3.8 shows the means and standard errors for students who 'always' spoke English at home (English), compared to those who indicated that they 'sometimes' or 'never' spoke English at home (Language background other than English – LBOTE).

Twenty per cent of students in the TIMSS Year 4 sample indicated that they did not speak English at home. Students with a language background other than English scored, on average, 13 points lower than the students who spoke English at home. This apparent difference was, however, not statistically significant.

Table 3.8 Mean mathematics achievement within Australia, by language background

	% of students	Mean	SE	Gap 95th - 5th percentiles
English	80	520	2.6	279
LBOTE	20	507	6.2	302

Figure 3.17 shows the distribution of mathematics scores for students by their language background. The spread of scores between the 5th and 95th percentile was larger for students with a language background other than English, with a range of 302 score points, compared to 279 score points for students who spoke English at home.

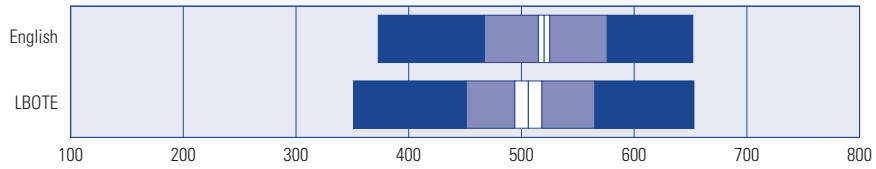


Figure 3.17 Distribution of mathematics achievement within Australia, by language background

Figure 3.18 shows the proportions of students achieving at each of the international benchmarks. At the top end of achievement, the proportion of students from both groups achieving the Advanced international benchmark is not markedly different: 10 per cent of English background students and nine per cent of students from a language background other than English. At the lower levels of achievement, 33 per cent of students from a non-English speaking background compared to 28 per cent from an English speaking background did not achieve the Intermediate benchmark, with 12 per cent of the non-English background students not achieving the Low international benchmark.

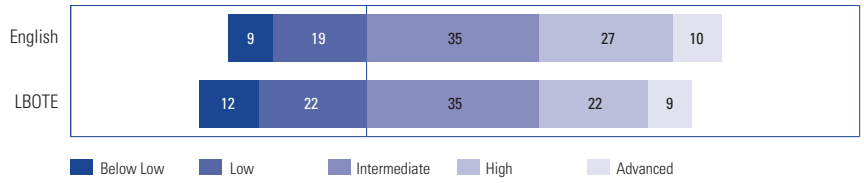


Figure 3.18 Percentages of Australian students at the international benchmarks for mathematics, by language background

Mathematics achievement by geographic location of the school

As explained in Chapter 2, the proportion of Australia's population living in rural and remote areas continues to decline. To undertake the analyses in this section of the report, school addresses were coded using the MCEETYA Schools Geographic Location Classification (see the Reader's Guide). Only the broad categories – Metropolitan, Provincial and Remote – are used in reporting here.

The average mathematics performance of students attending schools in the three geographic locations is presented in Table 3.9. 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 72 per cent of the sample. Students attending schools in metropolitan areas scored, on average, 16 score points higher than students attending schools in provincial areas, and 64 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 48 score points higher than students attending schools in remote areas. All these differences are statistically significant.

Table 3.9 Mean mathematics achievement within Australia, by geographic location

	% of students	Mean	SE	Gap 95th - 5th percentiles
Metropolitan	72	521	3.2	284
Provincial	27	505	5.6	284
Remote	1	457	7.8	321

Figure 3.19 provides the spread of scores in mathematics achievement for Year 4 students according to geographic location of school. The range of scores from the 5th to 95th percentiles was the same for students from provincial and metropolitan schools, but the spread for remote schools was substantially larger, at 321 score points.

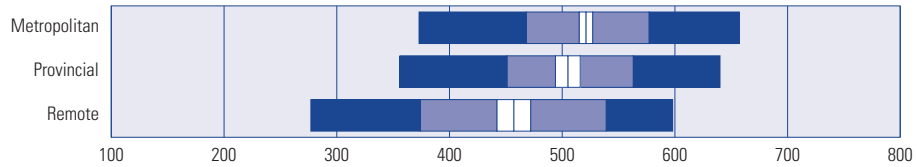


Figure 3.19 Distribution of mathematics achievement within Australia, by geographic location

Figure 3.20 shows the proportion of Year 4 students in each of the international benchmarks in mathematics by geographic location. Half of the students in remote schools did not reach the Intermediate international benchmark, which is the minimum proficient standard expected. More than half of these students performed below the Low international benchmark. In contrast, only 11 per cent of students from provincial schools and nine per cent of students from metropolitan schools were performing at a level below that of the Low international benchmark. The difference in achievement is even more evident at the higher end of the achievement spectrum. While some students from remote schools did achieve scores above the international mean score of 500, only three per cent achieved at the Advanced international benchmark, compared to eight per

cent of students from provincial schools and 11 per cent of students from metropolitan schools. The proportion of students from remote schools who attained the Intermediate international benchmarks was 50 per cent, compared to 72 and 66 per cent of students from metropolitan and provincial schools, respectively.

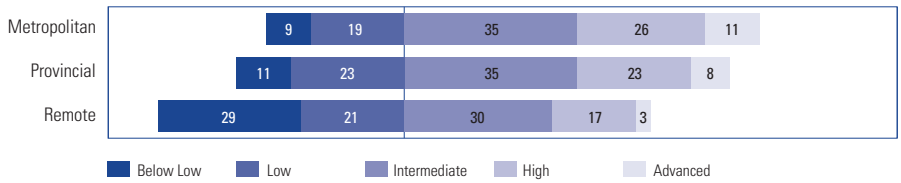


Figure 3.20 Percentage of Australian students at the international benchmarks for mathematics, by geographic location

This chapter so far has reported on the mathematics content achievement measured by TIMSS, examining achievement in terms of state, gender, number of books in the home, Indigenous background, language background and geographic location. The next section of this chapter examines achievement in the mathematics content and cognitive domains.

Achievement in the TIMSS mathematics content and cognitive domains

Achievement on the TIMSS mathematics assessment can also be described in terms of mathematics content and cognitive domains, as described in the TIMSS 2011 Assessment Frameworks (Mullis, Martin, Ruddock, O'Sullivan & Preuschoff, 2009). The content domain outlines the subject matter to be assessed and includes *number*, *geometric shapes and measures* and *data display* at Year 4. On the other hand, the cognitive dimension details the thinking processes that students will need to use as they engage with the content. 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, despite containing different items.

Mathematics content domains

At the international level, there is considerable diversity among countries in terms of relative strengths and weaknesses in the content domains, although the TIMSS 2011 participants with the highest achievement overall also tended to have the highest achievement in the content domains. Among the top-performing countries, Singapore performed relatively better in *number* (619) than in mathematics overall (606), and relatively less well in *geometric shapes and measures* (589) and *data display* (588). Korea performed equally well in all three domains while Hong Kong performed relatively better in *geometric shapes and measures* (605) and less well in *data display* (593). Chinese Taipei did relatively better in *data display* (600) and less well in *geometric shapes and measures* (573).

Armenia was the lowest achieving country in *data display* with an average domain score of 386, while Qatar had the lowest average score in *geometric shape and measures* (399) and Saudi Arabia had the lowest score in *number* (410).

Australian Year 4 students' achievement in all three content domains was significantly higher than the TIMSS scale average of 500. Performance in *geometric shapes and measures* (534), appeared to be stronger, while *number* (508) was a possible area of weakness. This was evident at all levels, by state, by gender and by Indigenous background.

Table 3.10 provides the scores for Australia by states, by gender and by Indigenous background for Year 4 achievement in mathematics content domains. Overall, the order of the states in their

performance in each of the content and cognitive domains was almost the same, with only very minor shifts depending on the domain. Students in the Australian Capital Territory scored significantly higher than students in all states other than Victoria in *data display* and *number*, while students in New South Wales and Victoria scored significantly higher than students in all states other than the Australian Capital Territory and Tasmania in *geometric shapes and measures* content domain.

At Year 4 level, there were no statistically significant gender differences in mathematics content domains, while in terms of Indigenous background, non-Indigenous students scored significantly higher than Indigenous students in all three content domains.

Table 3.10 Relative achievement in mathematics content domains, for Australia and by state, gender and Indigenous background

	Mathematics overall		Data Display		Absolute difference from overall mathematics score	Geometry		Absolute difference from overall mathematics score	Number		Absolute difference from overall mathematics score
	Mean	SE	Mean	SE		Mean	SE		Mean	SE	
Australia	516	2.9	515	3.1	1	534	3.0	18	508	3.2	8
ACT	545	5.9	543	4.8	2	560	5.8	15	535	5.5	10
NSW	525	6.0	524	6.1	1	544	6.0	19	517	6.5	8
VIC	531	5.6	529	5.5	1	548	6.0	18	526	6.4	5
QLD	499	5.5	500	6.2	1	516	5.9	17	489	6.3	9
SA	502	5.2	501	5.0	1	518	5.2	16	493	5.2	9
WA	499	6.4	501	6.4	1	516	6.8	17	490	7.3	9
TAS	517	7.7	515	8.2	2	534	8.8	17	509	8.9	8
NT	489	12.8	488	14.0	1	503	14.6	14	479	13.7	10
Male	520	3.5	520	3.6	0	537	3.9	17	512	3.9	8
Female	513	3.3	512	3.9	1	532	3.6	19	505	3.6	8
Non-Indigenous	522	2.7	521	2.8	1	539	2.8	18	514	2.9	8
Indigenous	458	7.8	460	11.0	2	479	9.4	21	447	10.0	10

Note: No statistical differences are calculated between the mean of the overall scale score and the cognitive domains or the content domains. This is because the data in the content domains underpin or contribute to the data in the overall mathematics score.

Mathematics cognitive domains

As for the mathematics content domains, there was a broad range of achievement across the countries in the mathematics cognitive domains. The countries scoring highest on the overall mathematics assessment tended to also be the highest-scoring countries in cognitive domains. At Year 4 level, Singapore achieved the highest average scale score for mathematics in the *knowing* (629) and *applying* (602) cognitive domains while Korea achieved the highest scale score in the *reasoning* (603) cognitive domain. At the lower ends of the scale Saudi Arabia was the lowest achieving country in all three cognitive domains.

Australian Year 4 students performed at a level that was statistically significantly higher than the TIMSS scale average in all three cognitive domains with their highest average scale score on the *applying* cognitive domain.

Similar to the content domains table, Table 3.11 provides the scores for Australia by states, by gender and by Indigenous background for Year 4 achievement in mathematics cognitive domains. The best performing state (Australian Capital Territory) scored significantly higher than students in all states other than New South Wales and Victoria in all three cognitive domains. Students in

New South Wales and Victoria also scored significantly higher than students in all states other than the Australian Capital Territory and Tasmania in all the cognitive domains.

Also similar to the content domains, there were no statistically significant gender differences in mathematics cognitive domains, while non-Indigenous students scored significantly higher than Indigenous students in all three cognitive domains.

Table 3.11 Relative achievement in mathematics cognitive domains, for Australia and by state, gender and Indigenous background

	Mathematics overall		Knowing		Absolute difference from overall mathematics score	Applying		Absolute difference from overall mathematics score	Reasoning		Absolute difference from overall mathematics score
	Mean	SE	Mean	SE		Mean	SE		Mean	SE	
Australia	516	2.9	516	3.5	1	519	3.0	3	513	2.6	3
ACT	545	5.9	545	7.7	0	545	6.2	0	536	5.9	9
NSW	525	6.0	528	7.5	3	529	6.6	4	521	6.0	4
VIC	531	5.6	534	6.2	3	535	5.5	4	527	5.0	3
QLD	499	5.5	497	6.2	2	501	5.3	2	498	4.6	1
SA	502	5.2	498	6.8	4	503	5.6	1	501	5.4	1
WA	499	6.4	496	7.3	4	503	6.3	4	499	5.6	1
TAS	517	7.7	516	9.6	1	519	8.0	2	514	7.8	3
NT	489	12.8	488	15.2	2	494	13.0	5	492	10.9	3
Male	520	3.5	521	4.5	1	522	3.6	2	518	3.8	2
Female	513	3.3	514	3.9	1	518	3.5	5	509	3.0	4
Non-Indigenous	522	2.7	523	3.3	1	524	2.9	3	518	2.7	4
Indigenous	458	7.8	452	9.2	6	464	7.8	6	461	7.8	3

Note: No statistical differences are calculated between the mean of the overall scale score and the cognitive domains or the content domains. This is because the data in the cognitive domains underpin or contribute to the data in the overall mathematics score.

The next chapter of this report will examine Australian students' achievement in science in TIMSS 2011.

Chapter

4 Science

Key Findings

- Australia's average score in science achievement was significantly lower than that of 18 other countries, including the United States, England as well as the participating Asian countries, Hong Kong, Singapore and Chinese Taipei.
- In TIMSS 2011, Australia's average scale score was significantly lower than TIMSS 2007.
- Seventy-one per cent of students in Australian reached the Intermediate international benchmark.
- Internationally, on average, there was little achievement difference between females and males. In Australia, there were no significant gender differences.
- The Australian Capital Territory was the highest performing state in Year 4 science, followed by New South Wales and Victoria.
- Students who identified themselves as Indigenous performed at a significantly lower level in science than non-Indigenous students.
- There were no significant differences in the performance of Indigenous students between TIMSS 2011 and previous cycles. For non-Indigenous students, however, the mean score for science achievement in TIMSS 2011 was significantly lower than the mean score in TIMSS 2007.
- The proportion of students at the Advanced and High benchmarks has decreased significantly since TIMSS 1995. The proportion at the Intermediate and Low benchmarks was the same as in 1995.
- The geographic location of schools has a significant impact on science achievement at Year 4, such that metropolitan students performed better than provincial students, who similarly performed better than students in remote schools.
- Students in Year 4 who spoke a language other than English at home achieved significantly lower on average in science than students who spoke English only.
- In terms of the content domains, there were no significant strengths or weaknesses. For the cognitive domains, *knowing*, *applying* and *reasoning*, the performance of Australian Year 4 students was similar to their overall science score.

The TIMSS scientific assessment framework contends 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. nutrition, medication, hygiene) and the world in which they live (e.g. 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.

How is science assessed in TIMSS?

The scientific assessment framework is organised around two dimensions – a content dimension, which specifies the domains or subject matter to be assessed within science (for example, *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 addition, the concept of scientific inquiry is treated as an overarching assessment strand that overlaps with all of the scientific fields and has both content- and skills-based components. Assessment of scientific inquiry includes items and tasks requiring students to demonstrate knowledge of the tools, methods and procedures necessary to *do* science, to apply this knowledge to engage in scientific investigations and to use scientific understanding to propose explanations based on evidence.

Science content and cognitive domains

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

- *Life science*
- *Physical science*
- *Earth science*

As shown in Table 4.1, each of these content domains has several topic areas, for example the domain *physical science* includes classification and properties of matter; physical state and changes in matter; energy sources, heat and temperature; light and sound; electricity and magnetism; forces and motion. Table 4.1 also shows the target percentage of the TIMSS 2011 assessment for each content domain.

Table 4.1 TIMSS science content domains and proportion of assessment for each domain

Content domains	Topic areas	Target % of TIMSS assessment
Life science	Characteristics and life processes of living things	45
	Life cycles, reproduction and heredity	
	Interaction with the environment	
	Ecosystems	
	Human health	
Physical science	Classification and properties of matter	35
	Sources and effects of energy	
	Forces and motion	
Earth science	Earth's structure, physical characteristics and resources	20
	Earth's processes, cycles and history	
	Earth in the solar system	

To respond correctly to TIMSS test items, students need to be familiar with the science content of the items. At the same time, items were designed to elicit the use of particular cognitive skills. The TIMSS 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. These skills and abilities should play a central role in developing items and achieving a balance in learning outcomes assessed by the items in Year 4. The student behaviours used to define the science framework at Year 4 have been classified into three cognitive domains.

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 4.2 shows the percentage of time devoted to cognitive domains at Year 4. These three cognitive domains are used for both Year 4 and Year 8, but the balance of testing time differs, reflecting the difference in age and experience of students in the two year levels. 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 science cognitive domains and proportion of assessment for each domain

Cognitive Domain	
Knowing	40
Applying	40
Reasoning	20

Further details on the content domains, as well as examples of TIMSS science items and tasks, are presented in Appendix 3.

The TIMSS benchmarks

The TIMSS scientific achievement scale summarises Year 4 students' performance when interacting with a variety of scientific tasks and questions. 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, to provide descriptions of achievement on the scale in relation to performance on the questions asked, TIMSS uses four points on the scale as international benchmarks. The benchmarks represent the range of performance shown by students internationally.

For science in TIMSS 2011, the Advanced international benchmark is 625, the High international benchmark is 550, the Intermediate international benchmark is 475 and the Low international benchmark is 400 (the same scores as for the mathematics benchmarks in TIMSS described in Chapter 3, and the reading benchmarks in PIRLS described in Chapter 2).

The descriptions of the levels are cumulative, so that a student who reached the High benchmark can typically demonstrate the knowledge and skills for levels for both the Intermediate and the Low benchmarks. Box 4.1 provides a summary of the TIMSS Year 4 science benchmarks.

Box 4.1 The TIMSS 2011 international science benchmarks, Year 4

625	**Advanced International Benchmark** *Students apply knowledge and understanding of scientific processes and relationships and show some knowledge of the process of scientific inquiry.* Students communicate their understanding of characteristics and life processes of organisms, reproduction and development, ecosystems and organisms' interactions with the environment, and factors relating to human health. They demonstrate understanding of properties of light and relationships between physical properties of materials, apply and communicate their understanding of electricity and energy in practical contexts and demonstrate an understanding of magnetic and gravitational forces and motion. Students communicate their understanding of the solar system and of Earth's structure, physical characteristics, resources, processes, cycles and history. They have a beginning ability to interpret results in the context of a simple experiment, reason and draw conclusions from descriptions and diagrams and evaluate and support an argument.
550	**High International Benchmark** *Students apply their knowledge and understanding of the sciences to explain phenomena in everyday and abstract contexts.* Students demonstrate some understanding of plant and animal structure, life processes, life cycles and reproduction. They also demonstrate some understanding of ecosystems and organisms' interactions with their environment, including understanding of human responses to outside conditions and activities. Students demonstrate understanding of some properties of matter, electricity and energy and magnetic and gravitational forces and motion. They show some knowledge of the solar system, and of Earth's physical characteristics, processes and resources. Students demonstrate elementary knowledge and skills related to scientific inquiry. They compare, contrast and make simple inferences, and provide brief descriptive responses combining knowledge of science concepts with information from both everyday and abstract contexts.
475	**Intermediate International Benchmark** *Students have basic knowledge and understanding of practical situations in the sciences.* Students recognise some basic information related to characteristics of living things, their reproduction and life cycles and their interactions with the environment, and show some understanding of human biology and health. They also show some knowledge of properties of matter and light, electricity and energy and forces and motion. Students know some basic facts about the solar system and show an initial understanding of Earth's physical characteristics and resources. They demonstrate ability to interpret information in pictorial diagrams and apply factual knowledge to practical situations.
400	**Low International Benchmark** *Students have some elementary knowledge of life and physical and Earth science.* Students demonstrate knowledge of some simple facts related to human health, ecosystems and the behavioural and physical characteristics of animals. They also demonstrate some basic knowledge of energy and the physical properties of matter. Students interpret simple diagrams, complete simple tables and provide short written responses to questions requiring factual information.

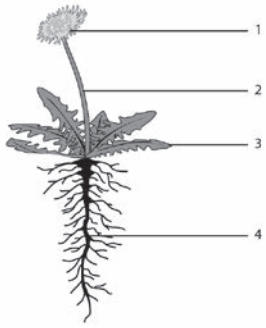
Further information about the types of scientific skills and strategies demonstrated by students who performed at each of the international benchmarks, along with examples of the types of responses provided by students at each of the benchmarks, is provided in Appendix 3.

At Year 4, students at the Advanced benchmark in science demonstrated the ability to apply their knowledge and understanding of scientific processes and relationships in beginning scientific inquiry.

As an example, Box 4.2 shows a type of item in the *life sciences* that Year 4 students at the Advanced international benchmark could answer correctly. This constructed response item required students to identify four major plant structures in a diagram and describe the function of most of the structures. This item was relatively difficult for students in most countries and was answered correctly by only 21 per cent of the students across countries on average. Eighty per cent of students in Singapore answered correctly, but in no other country did more than 42 per cent of students answer correctly. In Australia, only 10 per cent of students answered this item correctly.

Box 4.2 Advanced international benchmark – Example item

The diagram shows a flowering plant. Four of its parts are numbered.



In the table below, write the name of each part, and state its function.

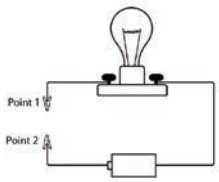
Part Number	Name of Part	Function of Part
1	flower	produces seeds
2	stem	transports water and food.
3	leaf	makes food for the plant
4	root	absorbs water, minerals, and nutrients into the plant

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

Box 4.3 shows a light bulb connected to a battery in an electrical circuit and students needed to identify the iron nail to complete the circuit. This elementary knowledge of physical science exemplifies the Low international benchmark. With an international average of 83 per cent correct across the Year 4 countries, this item was relatively easy for students in most countries. In Australia, 74 per cent of Year 4 students answered this question correctly.

Box 4.3 Low international benchmark – Example item

The following picture shows a lightbulb connected to a battery in an electrical circuit. Which of the following objects connected to Points 1 and 2 will allow the bulb to glow?



● iron nail
Ⓑ plastic spoon
Ⓒ rubber band
Ⓓ wooden stick

International student achievement in science

This section reports the TIMSS 2011 science results as average scores and distributions on the TIMSS scales (Year 4), each of which has a range of 0–1000. The TIMSS science achievement scales were established in TIMSS 1995 to have a mean of 500 and a standard deviation of 100 at each year level, and were designed to remain constant from assessment to assessment.

Figure 4.1 shows the distributions of student achievement for 50 countries that participated in TIMSS 2011 in Year 4, including the average scale score with its associated standard error, and the ranges in performance for the middle half of the students (25th to 75th percentiles) as well as the extremes (5th and 95th percentiles). The average age of students in each of the countries is also shown.

As indicated in Chapter 3 of this report, the TIMSS Year 4 target population is defined as the year level that represents four years of schooling, counting from the first year of ISCED Level 1. In Australia, this is defined as Year 4 in all states.

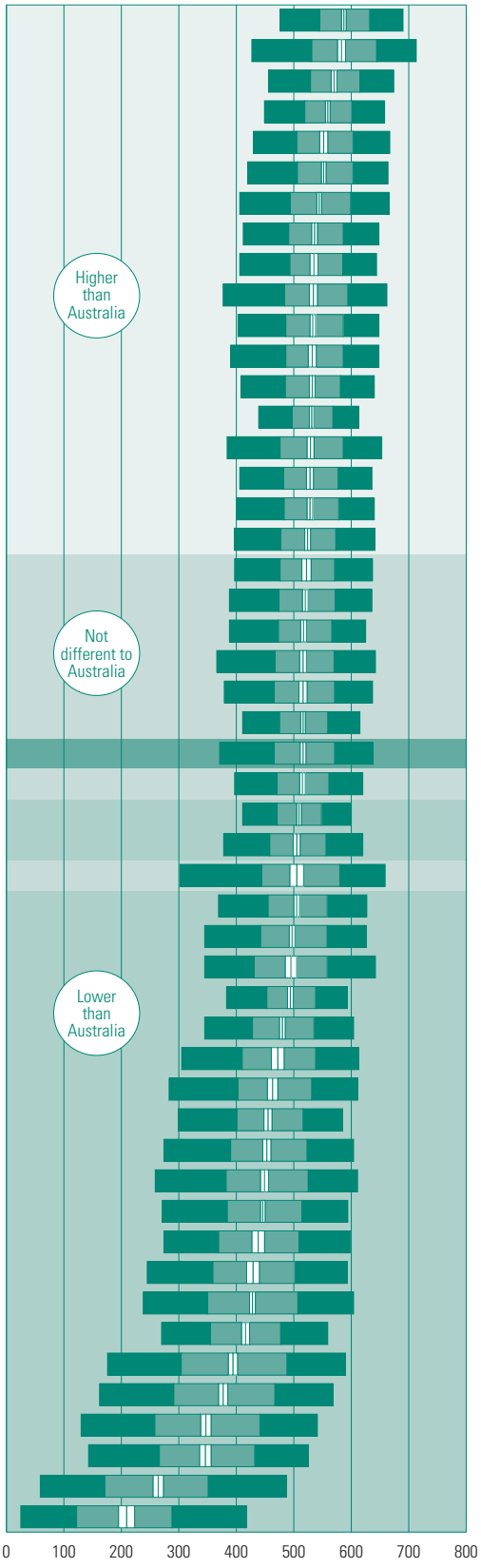
Korea and Singapore were the top-performing countries of TIMSS 2011, scoring well in excess of the High International Benchmark of 550. The scores for these countries were not significantly different to each other but were significantly higher than all other countries. The next highest performing country was Finland, which had higher achievement than all remaining countries.

Australia's average score of 516 score points was also significantly higher than that of 23 other countries, including New Zealand. It was, however, significantly lower than the average score for 18 other countries, including the United States, England and the Slovak Republic, as well as the participating Asian countries Korea, Singapore, Japan, Chinese Taipei and Hong Kong.

The results reveal substantial differences in achievement in science between the highest and lowest performing countries (see Appendix 4 for multiple comparison tables of countries' average achievement). The scores for the top two countries, Korea and Singapore, were three-quarters of a standard deviation higher than the scale midpoint, while the score for Yemen, at 209, was almost three standard deviations lower than the scale midpoint. Figure 4.1 also shows the range of achievement within countries, with 286 score points separating the 5th and 95th percentiles for Singapore, but more than 400 score points separating the highest and lowest achievers in Qatar (414 points), Oman (406 points) and Kuwait (411 points). Australia's gap between high and low achievers, of 267 score points, was mid-range, similar to that of England (269 points) and the United States (260 points). The country with the narrowest range was the Netherlands, with only 174 score points.

Figure 4.1 also shows the average age at the time of testing in each country. Within Australia, school starting age varies between states; across 50 countries there is even greater variation. The average age varies by about one year, from 9.7 years in Italy and Norway, and 9.8 years in Malta, to almost 11 years in the Russian Federation, Finland and Denmark. Students in one of the highest achieving countries, Korea, are relatively young (10.4 years), and Australian Year 4 students are of a similar age (10.0 years).

	Mean Score	SE	Average age at time of testing	Gap 95th – 5th percentiles
Korea	587	2.0	10.4	214
Singapore	583	3.4	10.4	286
Finland	570	2.6	10.8	218
Japan	559	1.9	10.5	209
Russian Federation	552	3.5	10.8	237
Chinese Taipei	552	2.2	10.2	244
United States	544	2.1	10.2	260
Czech Republic	536	2.5	10.4	236
Hong Kong	535	3.8	10.1	238
Hungary	534	3.7	10.7	285
Sweden	533	2.7	10.7	245
Slovak Republic	532	3.8	10.4	258
Austria	532	2.8	10.3	232
Netherlands	531	2.2	10.2	174
England	529	2.9	10.2	269
Germany	528	2.9	10.4	230
Denmark	528	2.8	11.0	239
Italy	524	2.7	9.7	244
Portugal	522	3.9	10.0	240
Slovenia	520	2.7	9.9	248
Northern Ireland	517	2.6	10.4	237
Serbia	516	3.1	10.8	276
Ireland	516	3.4	10.3	258
Croatia	516	2.1	10.7	204
Australia	516	2.8	10.0	267
Lithuania	515	2.4	10.7	223
Belgium	509	2.0	10.0	189
Spain	505	3.0	9.8	242
Romania	505	5.9	10.9	357
Poland	505	2.6	9.9	258
New Zealand	497	2.3	9.9	281
Kazakhstan	495	5.1	10.4	297
Norway	494	2.3	9.7	210
Chile	480	2.4	10.1	259
Thailand	472	5.6	10.5	308
Turkey	463	4.5	10.1	328
Georgia	455	3.8	10.0	286
Iran	453	3.7	10.2	330
Bahrain	449	3.5	10.4	352
Malta	446	1.9	9.8	323
Azerbaijan	438	5.6	10.2	324
Saudi Arabia	429	5.4	10.0	348
United Arab Emirates	428	2.5	9.8	366
Armenia	416	3.8	10.0	289
Qatar	394	4.3	10.0	414
Oman	377	4.3	9.9	406
Kuwait	347	4.7	9.7	411
Tunisia	346	5.3	10.0	382
Morocco	264	4.5	10.5	428
Yemen	209	7.3	11.2	393



Note: See Reader's Guide for interpretation of graphs

Figure 4.1 1 Distribution of science achievement, by country

Performance at the international benchmarks

In addition to the mean scores, it is useful to use the international benchmarks described previously, to gain further insight into student achievement. Figure 4.3 shows the proportion of students in each country at each of the international benchmarks.

The countries are ordered by the proportion of students reaching the intermediate proficiency standard, which is the minimum proficient standard set for TIMSS in mathematics and science.

The countries with the largest percentages of students reaching the Advanced international benchmark were also countries with the highest average science achievement. Korea, Finland and Japan again head the table (Figure 4.2) with between 14 and 30 per cent of their Year 4 students proficient at the Advanced benchmark, and between five and ten per cent of their students reaching only the Low benchmark or not achieving this level at all. Figure 4.2 also provides useful information about the distribution of achievement in each country. Of interest is the other of the four highest achieving countries, Singapore. Singapore achieved an outstanding 33 per cent of students at the Advanced benchmark, but also had 11 per cent of its students at the Low benchmark or not achieving at even this basic level.

Between 11 and 15 per cent of the students in England, the United States and Hungary also achieved the Advanced benchmark, and between 19 and 24 per cent of their students were at the Low international benchmark or did not reach that level.

Only seven per cent of Australian students achieved at the Advanced international benchmark, with a further 28 per cent at the High international benchmark and 36 per cent at the Intermediate international benchmark. Of concern are the 20 per cent of Australian Year 4 students achieving at the Low international benchmark and the nine per cent of Australian students not even achieving this level. A similar proportion of students can be seen from Low to Advanced benchmarks in New Zealand, however, 14 per cent of these students did not reach the Low benchmark.

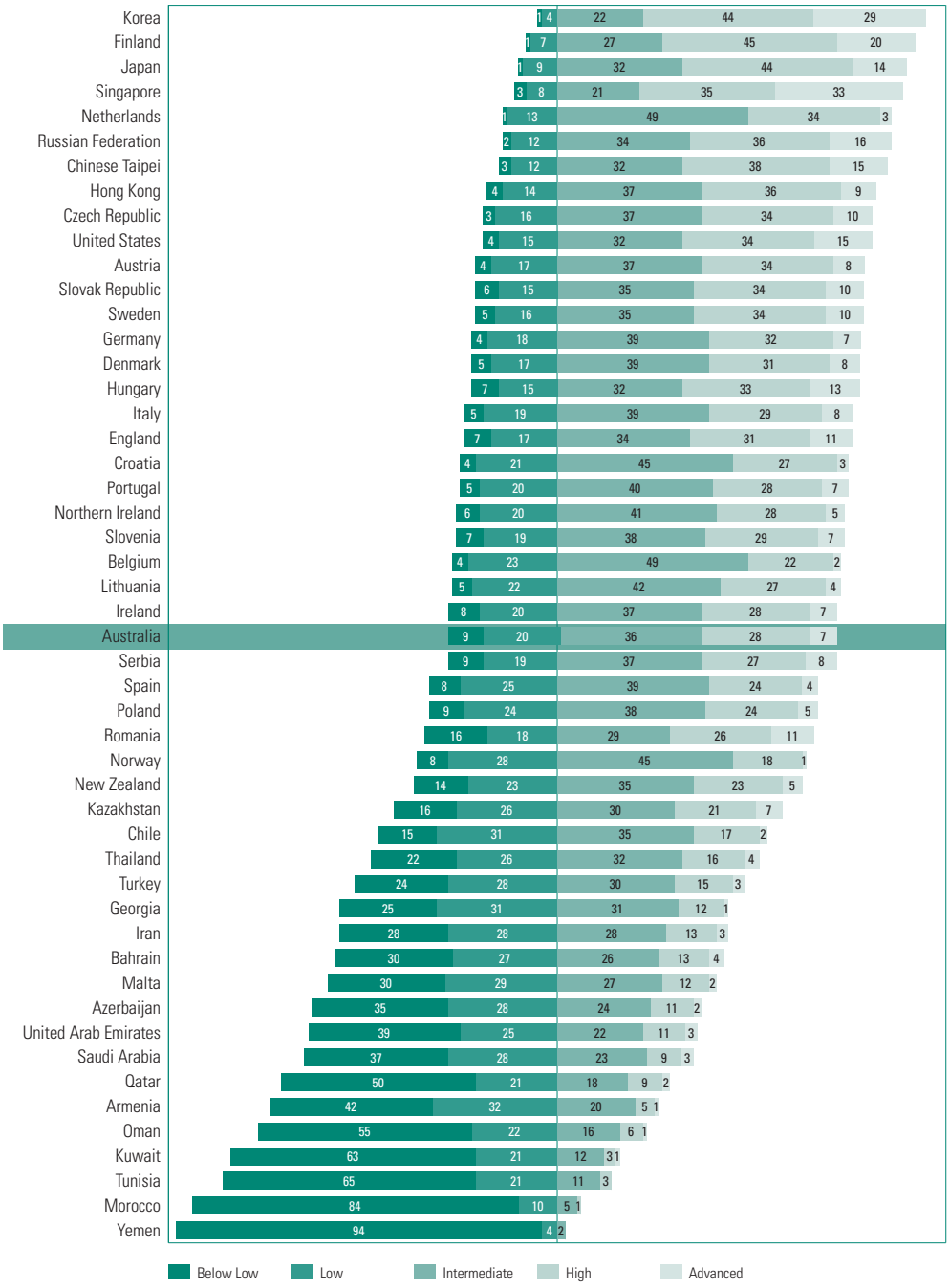


Figure 4.2 Percentages of students at the international benchmarks for science, by country

Trends in international science achievement

For Year 4, there are 29 countries with data from 1995, 2003 or 2007 that can be compared to their 2011 science results. Internationally, during 1995–2011 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 2011 were Iran, Portugal, Singapore and Slovenia, with an average achievement increase of 56 points or more.

In TIMSS 2011, Australia's average scale score for science achievement (516) was significantly lower than in 2007 (527). The average scale score for TIMSS 2011 was also lower than 1995 and 2003 but the differences did not reach statistical significance. As shown in Figure 4.3, Australia, England

and New Zealand all recorded a decline from 2007, while the United States showed an increase from TIMSS 2003 (536 points) to TIMSS 2011 (544 points).

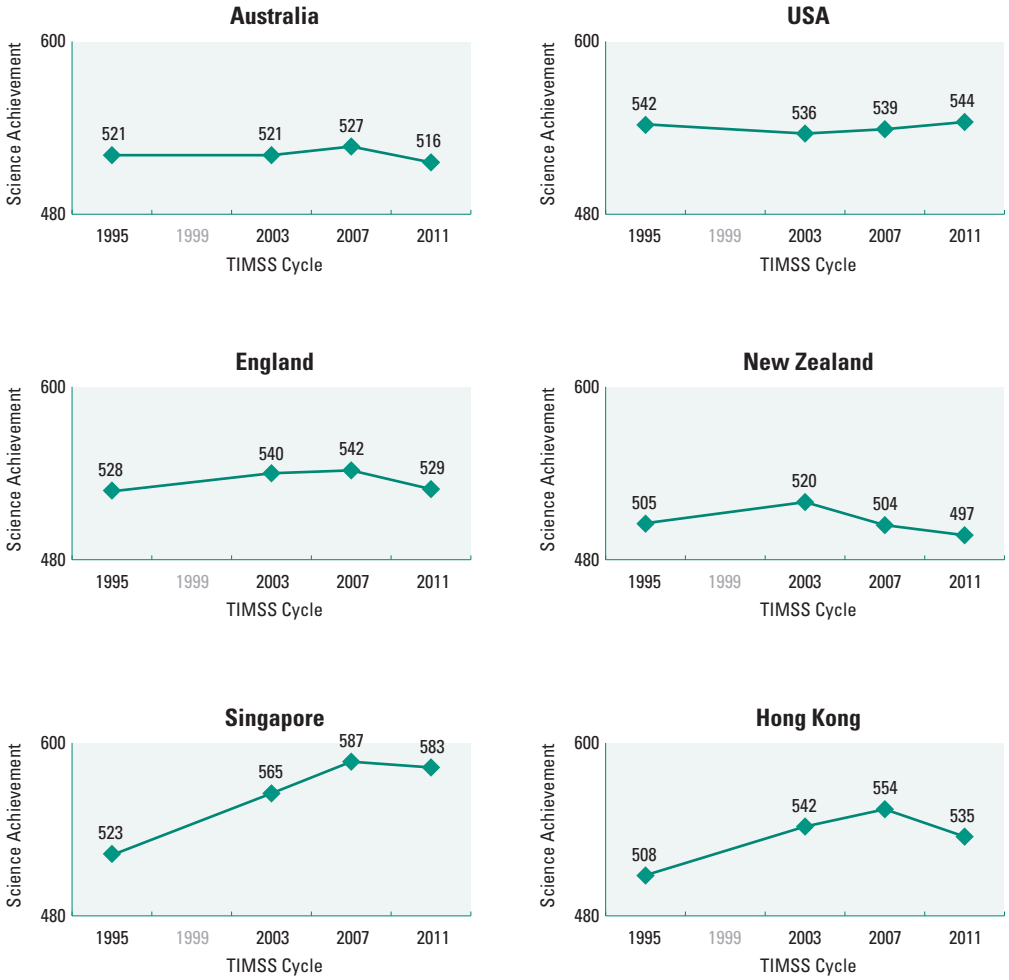


Figure 4.3 Relative trends in science achievement, by country

The proportion of students at the Advanced and High benchmarks has decreased significantly since TIMSS 1995. The proportion at the Intermediate and Low benchmarks is the same as in 1995.

Table 4.3 displays each country's relative position to Australia in each TIMSS cycle. Australia's relative position in 2011 was lower than the previous cycle (TIMSS 2007), even taking into account the fact that new countries have joined TIMSS in the latest cycle. Australia was still outperformed in 2011 by all of the Asian countries and by England and the United States. In TIMSS 2007, the relative position of the Czech Republic and Denmark was significantly lower than that of Australia, but by TIMSS 2011 both the Czech Republic and Denmark had scored significantly higher than Australia in science. However, the Czech Republic and Denmark performed at a significantly lower level, and Hungary, Sweden, Austria, the Slovak Republic, the Netherlands, Germany and Italy all performed at a level similar to Australia in TIMSS 2007 – but all outperformed Australia in TIMSS 2011. Hong Kong and Hungary both scored significantly lower than Australia in 1995, but Hong Kong has since scored significantly higher than Australia in each of the subsequent cycles (2003, 2007 and 2011), and Hungary scored much the same as Australia for 2003 and 2007 but significantly higher than Australia in TIMSS 2011.

Table 4.3 Relative trends in science achievement

	Position relative to Australia 2011	Position relative to Australia 2007	Position relative to Australia 2003	Position relative to Australia 1995
Korea	↑	-	-	↑
Singapore	↑	↑	↑	●
Finland	↑	-	-	-
Japan	↑	↑	↑	↑
Chinese Taipei	↑	↑	↑	-
Russian Federation	↑	↑	●	-
United States	↑	↑	↑	●
Czech Republic	↑	↓	-	↑
Hong Kong	↑	↑	↑	↓
Hungary	↑	●	●	↓
Sweden	↑	●	-	-
Austria	↑	●	-	↑
Slovak Republic	↑	●	-	-
Netherlands	↑	●	●	●
England	↑	↑	↑	●
Denmark	↑	↓	-	-
Germany	↑	●	-	-
Italy	↑	●	●	-
Portugal	●	-	-	↓
Slovenia	●	↓	↓	↓
Northern Ireland	●	-	-	-
Australia				
Croatia	●	-	-	-
Ireland	●	-	-	↓
Serbia	●	-	-	-
Lithuania	●	↓	●	-
Belgium (Flemish)	↓	-	-	-
Poland	↓	-	-	-
Romania	↓	-	-	-
Spain	↓	-	-	-
New Zealand	↓	↓	●	↓
Kazakhstan	↓	●	-	-
Norway	↓	↓	↓	↓
Chile	↓	-	-	-
Thailand	↓	-	-	-
Turkey	↓	-	-	-
Georgia	↓	↓	-	-
Iran	↓	↓	↓	↓
Bahrain	↓	-	-	-
Malta	↓	-	-	-

Azerbaijan	↓	-	-	-
Saudi Arabia	↓	-	-	-
United Arab Emirates	↓	-	-	-
Armenia	↓	↓	↓	-
Qatar	↓	↓	-	-
Oman	↓	-	-	-
Kuwait	↓	↓	-	-
Tunisia	↓	↓	↓	-
Morocco	↓	↓	↓	-
Yemen	↓	↓	-	-

↑ Score significantly higher than Australia
↓ Score significantly lower than Australia
● Score not significantly different to that of Australia
- Did not participate in this cycle

Science achievement by gender

Figure 4.4 shows the gender differences in Year 4 science achievement in TIMSS 2011. It presents achievement separately for males and females, the proportion of each of the population and the difference between scores. The accompanying graph shows the size of the achievement difference between male and female students and whether that difference is statistically significant. The countries are presented in order of increasing size of the difference between males and females in science achievement. Overall, there was little achievement difference between females and males (the international average scores were 487 and 485, respectively). Of the 50 countries at Year 4, 23 had no significant gender differences in science achievement. Of the 27 remaining countries, 16 had relatively small differences favouring male students, and three had relatively small differences favouring females. Eight countries had relatively larger differences favouring female students (the United Arab Emirates, Bahrain, Tunisia, Qatar, Yemen, Oman, Saudi Arabia and Kuwait). In Australia, along with England, New Zealand and Ireland, there were no significant gender differences in science achievement at Year 4.

	Females				Males				Difference (absolute value)	SE
	% of students	SE of %	Mean	SE	% of students	SE of %	Mean	SE		
Australia	49	1.0	516	3.1	51	1.0	516	3.7	0	3.9
Romania	48	0.9	505	6.9	52	0.9	506	5.7	0	4.7
Finland	49	0.8	570	2.9	51	0.8	570	3.0	0	3.0
Ireland	49	2.3	516	4.0	51	2.3	516	4.6	1	5.5
New Zealand	49	0.8	496	3.0	51	0.8	497	2.6	1	3.2
England	48	1.0	529	3.3	52	1.0	528	3.3	1	3.1
Lithuania	48	0.8	514	2.4	52	0.8	515	3.0	1	2.6
Russian Federation	49	1.0	553	3.5	51	1.0	552	3.8	1	2.4
Northern Ireland	49	1.3	517	3.2	51	1.3	516	3.2	1	3.8
International Average	49	0.2	487	0.6	51	0.2	485	0.6	2	
Denmark	51	0.7	527	3.3	49	0.7	529	3.1	2	3.0
Iran	49	2.9	452	5.8	51	2.9	454	5.7	2	8.8
Serbia	48	0.9	514	3.6	52	0.9	517	3.7	3	3.9
Sweden	49	1.0	532	3.0	51	1.0	535	3.2	4	3.0
Norway	51	1.1	492	2.5	49	1.1	496	3.2	4	3.1
Singapore	49	0.6	581	3.7	51	0.6	585	3.7	4	2.7
Turkey	48	0.6	465	5.0	52	0.6	461	4.7	4	3.8
Hungary	49	1.0	532	4.0	51	1.0	537	3.9	5	2.9
Croatia	50	0.8	514	2.5	50	0.8	518	2.5	5	2.7
Portugal	49	1.1	519	4.6	51	1.1	524	3.8	5	3.2
Armenia	47	0.8	419	4.0	53	0.8	414	4.3	5	3.4
Japan	49	0.5	556	2.7	51	0.5	561	2.1	5	2.8
Slovenia	48	0.8	517	2.8	52	0.8	523	3.4	6	3.2
Hong Kong	46	1.2	532	3.6	54	1.2	538	4.3	**6**	2.5
Poland	48	0.9	502	3.0	52	0.9	508	2.9	**6**	2.8
Malta	49	0.5	443	2.2	51	0.5	449	2.8	**6**	3.3
Chinese Taipei	47	0.6	548	2.6	53	0.6	555	2.4	**7**	2.3
Italy	50	0.7	520	3.2	50	0.7	528	3.0	**7**	2.9
Korea	48	0.4	583	2.4	52	0.4	590	2.3	**8**	2.3
Kazakhstan	48	0.8	490	5.1	52	0.8	498	5.5	**8**	3.0
Azerbaijan	47	0.8	442	6.3	53	0.8	434	5.7	**8**	4.0
Slovak Republic	49	0.9	528	4.3	51	0.9	536	3.6	**8**	2.7
Georgia	48	0.9	459	3.2	52	0.9	451	5.1	**9**	3.9
Morocco	48	0.8	268	5.1	52	0.8	259	4.9	**9**	4.4
Spain	49	0.8	500	2.8	51	0.8	510	3.7	**10**	2.8
Thailand	49	0.9	476	5.7	51	0.9	467	6.6	10	5.0
United States	51	0.5	539	2.3	49	0.5	549	2.1	**10**	1.5
Netherlands	52	1.0	526	2.4	48	1.0	537	2.6	**10**	2.1
Belgium (Flemish)	50	0.9	503	2.6	50	0.9	514	2.3	**11**	2.9
Chile	51	1.4	474	2.8	49	1.4	486	2.8	**12**	2.9
Germany	49	0.8	522	3.0	51	0.8	534	3.2	**12**	2.5
Austria	49	1.2	525	2.8	51	1.2	538	3.6	**12**	2.9
Czech Republic	48	1.2	529	2.9	52	1.2	544	2.7	**15**	2.6
United Arab Emirates	50	1.6	437	3.4	50	1.6	419	3.8	**18**	5.3
Bahrain	50	1.6	461	5.5	50	1.6	438	4.6	**23**	7.0
Tunisia	47	0.8	359	5.6	53	0.8	334	5.6	**25**	4.3
Qatar	47	3.4	408	5.1	53	3.4	382	5.7	**26**	6.5
Yemen	40	2.8	225	7.3	60	2.8	198	8.8	**27**	8.0
Oman	49	0.7	394	4.7	51	0.7	360	4.6	**34**	3.8
Saudi Arabia	52	1.5	453	4.7	48	1.5	405	9.9	**48**	11.0
Kuwait	54	1.6	371	5.5	46	1.6	319	7.1	**53**	8.6

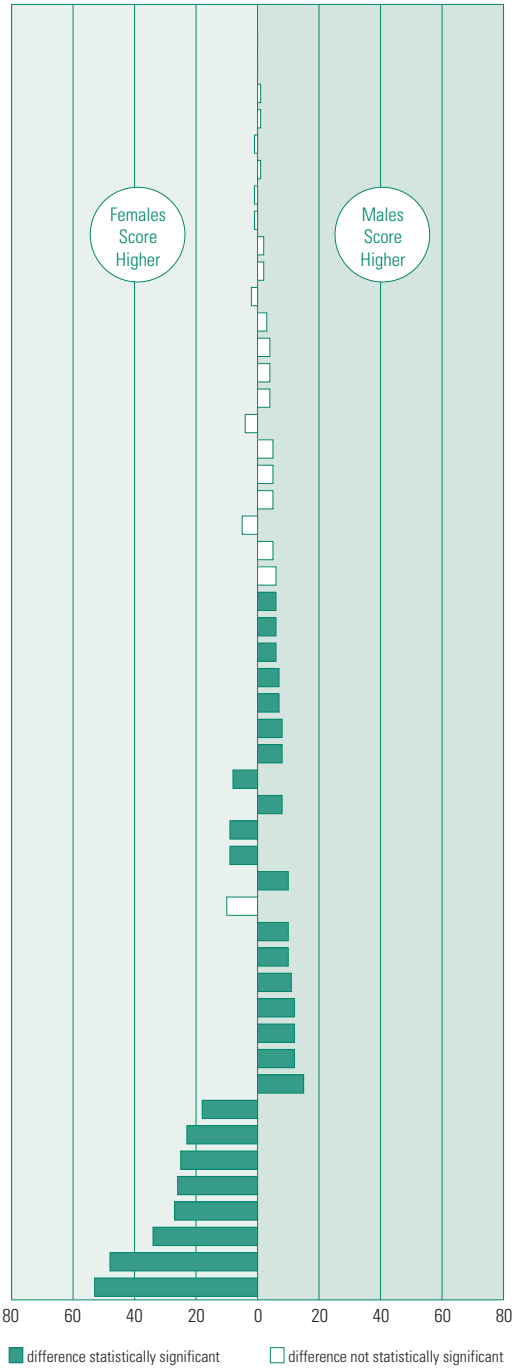


Figure 4.4 Gender differences in science achievement, by country

Whilst there were no gender differences in science achievement at Year 4 in Australia, the range of scores was greater for Year 4 males (278) than for Year 4 females (254) (see Figure 4.5). Figure 4.5 also illustrates the weaker performance of some Year 4 males when compared to that of females; five per cent of Year 4 males scored below 365 (the 5th percentile), while the corresponding 5th percentile for Year 4 females was 16 scale points higher, at 381.

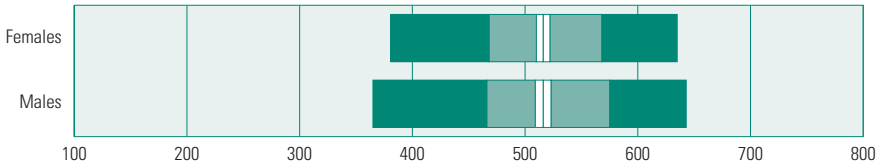


Figure 4.5 Distribution of science achievement within Australia, by gender

Performance at the international benchmarks by gender

Figure 4.6 illustrates the similarities in science achievement at Year 4 in Australia in terms of performance at the international benchmarks. Seven per cent of female students achieved the Advanced international benchmark in TIMSS 2011, while eight per cent of male students achieved this high standard in science. At the other end of the achievement scale, 27 per cent of female students and 29 per cent of male students did not reach the Intermediate benchmark, however as indicated by Figure 4.5, there was a greater proportion of males not achieving the Low benchmark.

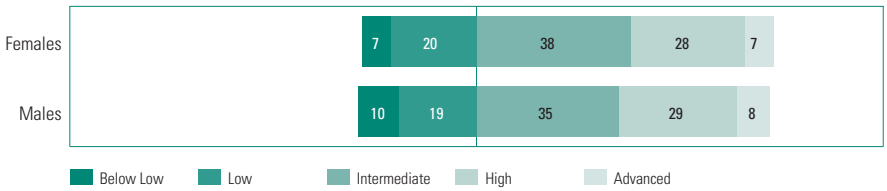


Figure 4.6 Percentages of Australian students at the international benchmarks for science, by gender

Trends in science achievement by gender

As mentioned previously, there is already gender equity in science achievement in many countries, but there are also countries where overall achievement is less than it might be if males and females performed at the same high level. Countries in which Year 4 female students performed consistently below male students (i.e. in 2011 and on at least two other TIMSS assessments) include Austria, the Czech Republic and the United States, while in Georgia and Tunisia female students had higher achievement than males on two of the cycles. Armenia, Japan and New Zealand had gender differences in earlier cycles of TIMSS but not in 2011. In Australia, although there is some variation across the cycles, there were no significant differences in the average sciences scores of male and female students from 1995 through to 2011.

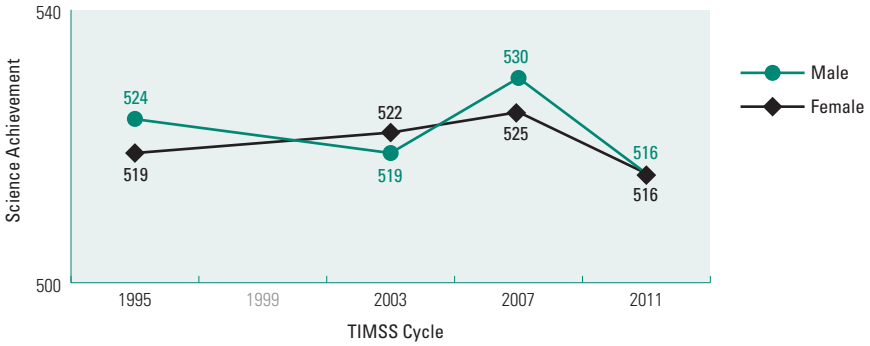


Figure 4.7 Trends in science achievement within Australia, 1995-2011, by gender

Science achievement by state

Figure 4.8 presents the distribution of science performance for each of the Australian states for TIMSS 2011. To place the state results in perspective, the mean and distributions for Australia as a whole, and for Korea, the highest achieving country in the TIMSS science assessment, are also included in this figure. The states are shown in order of the highest mean score for science.

Figure 4.8 should be read in conjunction with Table 4.4 which presents the multiple comparisons of mean science performance between states and indicates which are significantly different to each other.

The largest range of student performance was seen in the Northern Territory and Western Australia, with the range from the 5th to 95th percentile of around 290 score points. The range of performance for the highest achieving state, the Australian Capital Territory, was the narrowest of all the states, at 238 points, while the distributions for the next highest achievers, Victoria and New South Wales, were 260 and 271 score points, respectively. In contrast, the range from 5th to 95th percentile for Korea was 214 score points.

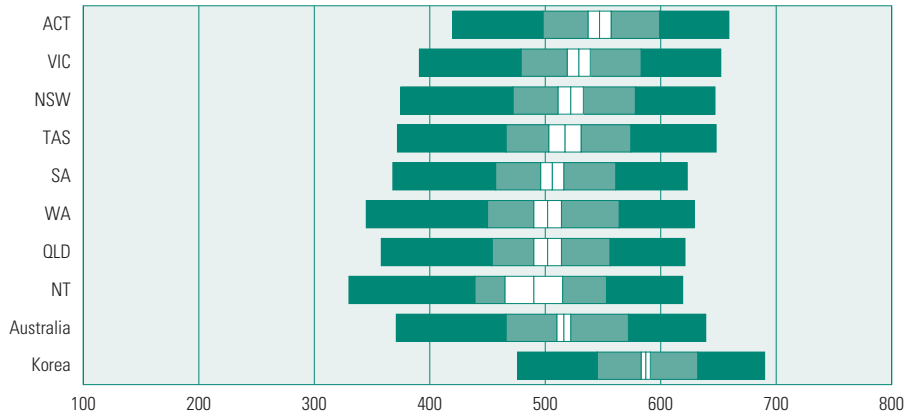


Figure 4.8 Distribution of science achievement, by state

Table 4.4 shows that the variation of average scores across states was moderately large, being 56 score points (equal to a little more than half a standard deviation) between the Australian Capital Territory and the Northern Territory. The average science score of students in the Australian Capital Territory was significantly higher than that of students in all other states. The performance of students in New South Wales and Victoria were not significantly different to each other, with students in both of these jurisdictions scoring significantly higher than students in all remaining states, with the exception of Tasmania.

Table 4.4 Multiple comparisons of average science achievement, by state

STATE	Mean	SE	ACT	VIC	NSW	TAS	SA	WA	QLD	NT
ACT	547	5.0		▲	▲	▲	▲	▲	▲	▲
VIC	529	4.9	▼		●	●	▲	▲	▲	▲
NSW	522	5.5	▼	●		●	▲	▲	▲	▲
TAS	518	7.3	▼	●	●		●	●	●	●
SA	506	5.1	▼	▼	▼	●		●	●	●
WA	502	6.1	▼	▼	▼	●	●		●	●
QLD	501	5.9	▼	▼	▼	●	●	●		●
NT	491	12.7	▼	▼	▼	●	●	●	●	

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

▲ Average performance statistically significantly higher than in comparison state.

● No statistically significant difference from comparison state.

▼ Average performance statistically significantly lower than in comparison state

Gender difference in science achievement by state

Figure 4.9 shows the gender differences in science achievement at Year 4 for the Australian states and territories. As may be expected, given the lack of a gender difference for Australia overall, there were no significant differences between the average science scores of male and female students in any of the states. While no differences reached statistical significance, the size of the gap between males and females varies from 11 score points in Western Australia to 14 score points in South Australia.

	Female		Male		
	Mean	SE	Mean	SE	Diff
WA	508	8.1	497	7.1	-11
NT	494	14.1	490	12.9	-4
TAS	518	8.1	518	9.8	0
QLD	502	4.0	504	8.5	2
VIC	528	6.9	530	5.0	2
NSW	523	6.4	522	6.7	-1
ACT	545	6.6	550	6.0	5
SA	498	6.6	512	6.0	14
International Average	487	0.6	485	0.6	-2

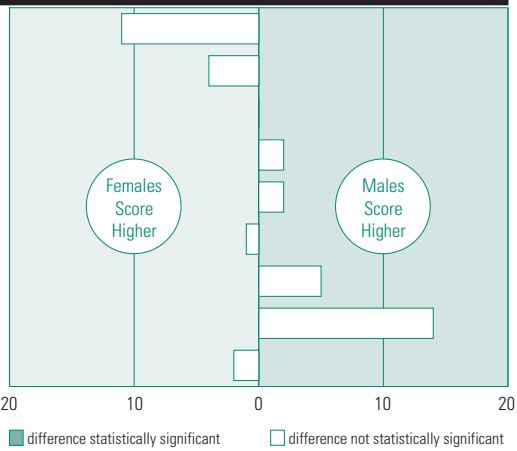


Figure 4.9 Gender differences in science achievement, by state

Performance at the international benchmarks by state

Figure 4.10 show the proportion of students in each state at each of the international benchmarks for science, along with the percentages for the international median, Australia as a whole and Korea (the highest scoring country), for comparison.

The Australian Capital Territory was the highest performing state, with 13 per cent of students reaching the Advanced international benchmark, just over half (52%) reaching the High international benchmark and 84 per cent achieving at least the Intermediate benchmark. In Korea,

however, 73 per cent of students achieved at least the High international benchmark and 95 per cent achieved at least the Intermediate benchmark.

The next best achieving states were Victoria and New South Wales, in which ten per cent and nine per cent respectively achieved the Advanced international benchmark. Forty-one per cent of students in Victoria reached the High benchmark while 38 per cent of students in New South Wales attained this level. Around three quarters of students in Victoria and New South Wales achieved at least the Intermediate international benchmark (77 per cent of students in Victoria and 74 per cent students in New South Wales).

In each of the other states, fewer than ten per cent of students achieved at the Advanced international benchmark. In the Northern Territory, 40 per cent of students did not achieve the Intermediate benchmark, while 34 per cent of students in Queensland did not attain this minimum standard of proficiency.

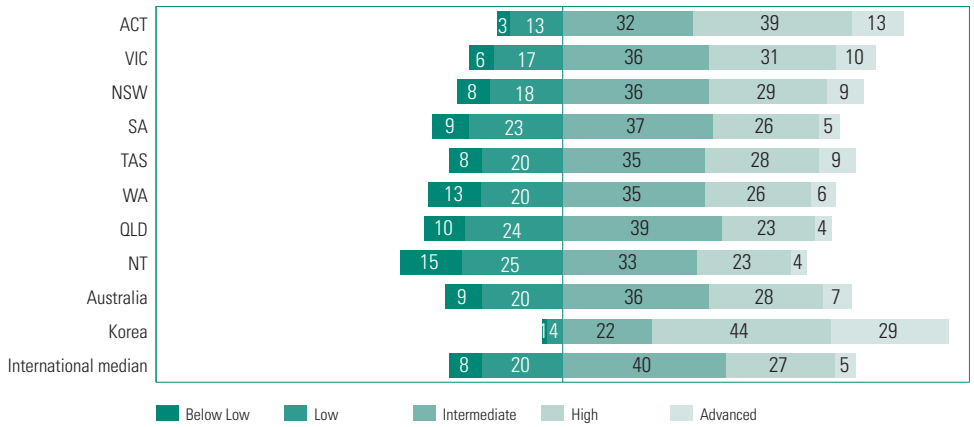


Figure 4.10 Percentages of students at the international benchmarks for science, by state

Figure 4.11 shows the proportion of students by gender in each state at each of the international benchmarks in science. Whilst there are no significant gender differences in the average science scores in any states, the differences in proportions at each benchmark for some states are interesting.

In Tasmania, only seven per cent of females compared to 11 per cent of males achieved the Advanced international benchmark. However, 32 per cent of male students in Tasmania, compared to 24 per cent of female students, did not achieve the Intermediate international benchmark. In South Australia, only three per cent of female students and 6 per cent of male students achieved the Advanced international benchmark. Thirty-four per cent of male students achieved at the High benchmark compared to 26 per cent of female students, while 70 per cent of male students and 64 per cent of female students achieved at least the Intermediate international benchmark.

In the Australian Capital Territory, the highest performing state, the proportion of male students who did not reach the Intermediate international benchmark was similar to the proportion of female students who did not reach this minimum proficiency standard. This was also evident in Victoria. In all other states, greater proportions of male students compared to female students failed to achieve this standard, with proportions ranging from 27 per cent in New South Wales to 42 per cent in the Northern Territory.

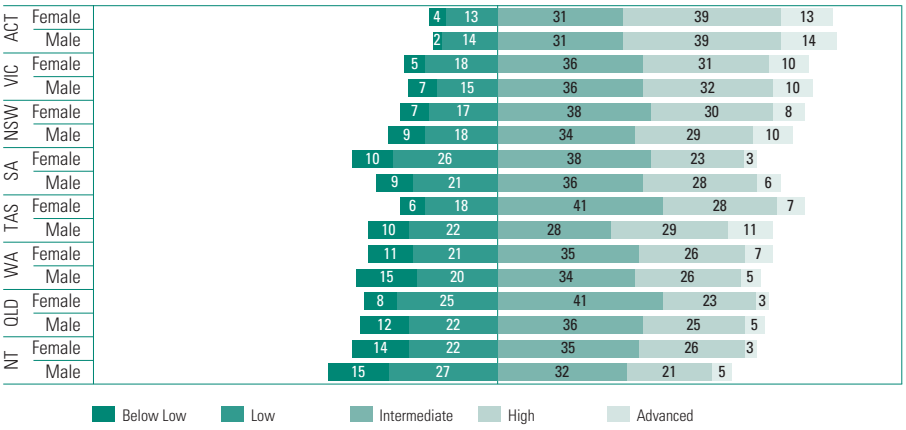


Figure 4.11 Percentages of students at the international benchmarks for science, by gender within state

Trends in science achievement by state

Table 4.5 provides the average scores in Year 4 science for each state for each TIMSS cycle (1995, 2003, 2007 and 2011) and also an indication of the statistical significance of the difference between TIMSS 2011 and each previous cycle. The results show that there has been little change in scores for most of the states in science achievement at Year 4 since 1995.

The Australian Capital Territory showed a significant improvement between 2007 and 2011, but no differences between the most recent cycle of TIMSS and those conducted in 2003 and 1995. New South Wales, on the other hand had a significant decrease of 16 score points since 2007, with no differences between performance in 2011 and the earlier cycles (2003 and 1995).

For Western Australia, the average science score in 2011 was significantly lower than that recorded in 1995, but no differences between 2011 and the 2003 or 2007 cycles reached statistical significance. In all other states, there were no statistically significant changes in average science performance between 2011 and the previous cycles.

Table 4.5 Trends in science achievement, by state

	TIMSS 2011		TIMSS 2007		2011 – 2007 difference	TIMSS 2003		2011 – 2003 difference	TIMSS 1995		2011 – 1995 difference
	Mean	**SE**	**Mean**	**SE**	-	Mean	SE	-	Mean	SE	-
ACT	547	5.0	527	8.6	▲	547	9.7	-	557	6.0	-
NSW	522	5.5	538	6.1	▼	526	10.1	-	522	6.1	-
VIC	529	4.9	544	8.3	-	528	6.8	-	529	10.7	-
QLD	501	5.9	501	6.0	-	513	7.7	-	503	7.6	-
SA	506	5.1	512	10.5	-	515	8.5	-	519	7.1	-
WA	502	6.1	512	4.9	-	502	7.3	-	527	6.2	▼
TAS	518	7.3	533	6.0	-	517	11.6	-	523	8.7	-
NT	491	12.7	503	9.9	-	503	13.8	-	512	11.2	-

▲ Difference is a statistically significant improvement over time.
▼ Difference is a statistically significant decrease over time.

Science achievement by books in the home

In this section, the focus is on the number of books in the homes of students, as an indicator of educational resources that are available to students, and thus as a proxy for a student's educational and social background, as discussed in Chapter 2. This section looks at the science achievement of children in Year 4 according to their self-reports of the number of books in their homes. For Australia, this has been grouped to represent *a few books* – 25 or fewer books, *average number of books* – between 26 and 200 books and *many books* – more than 200 books.

Internationally, a larger proportion of Korean students (65%), compared to students in other participating countries, reported having more than 100 books in their homes. Australia followed with 41 per cent, Sweden with 39 per cent, Finland and New Zealand with 38 per cent and 34 per cent of students in England reporting having more than 100 books in their homes.

Table 4.6 provides the percentage of students in each category, and the average achievement score for students in each group. The majority of the Australian students (59%) reported having *average number of books* and only 19 per cent reported having *many books* at home. The students who have the most books in the home also have the highest levels of achievement, scoring 22 points, on average, higher than students with an *average number of books* in the home, and 67 score points higher than those with *a few books* in the home.

Table 4.6 Mean science achievement within Australia, by number of books in the home

	% of Students	Mean	SE	Gap 95th – 5th percentiles
Many books	19	545	5.0	280
Average number of books	59	523	2.9	244
A few books	22	478	3.3	257

Figure 4.12 shows the distribution of scores in science for students in each category. The group who report having *many books* in the home has the largest gap between the 5th and 95th percentiles, at 280 score points. The spread of scores between the 5th and 95th percentiles was almost the same for students in the group who report having *average number of books* (244 score points) and *a few books* (257 score points) in the home. Each group's average scale score was around that of the Intermediate benchmark.

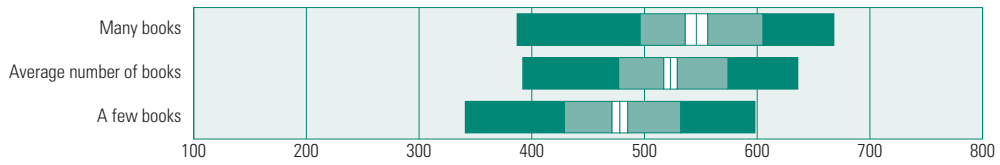


Figure 4.12 Distribution of science achievement within Australia, by number of books in the home

Examining the proportion of students at each of the benchmarks (Figure 4.13) gives a good idea of the capacity of students in each group. 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 seven 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 though, while having a home with many books (or by implication a home environment that values literacy, the acquisition of knowledge, and general academic support), the relationship is not definitive. Around 18 per cent of students in the group who reported having *many books* in the home did not achieve the Intermediate benchmark, with 12 per cent achieving the Low benchmark and six per cent of students not even achieving this very basic level. However the influence of books in the home is clear, as this group of students still performs better than students in the middle category, those with between 26 and 200 books in the home. Of this

group, around 18 per cent of students achieved the Low benchmark, and around six per cent of students failed to achieve this level. While of the students who reported having *few books* in the home just 29 per cent achieved the Low benchmark, and a further 17 per cent of students did not achieve even this basic level.

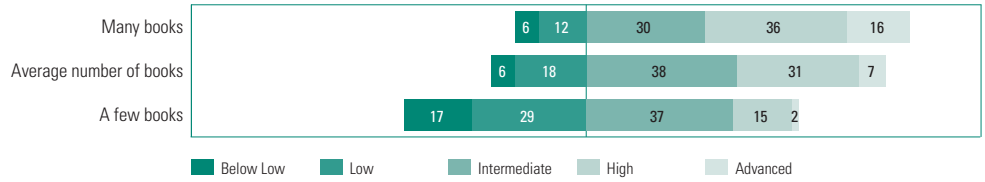


Figure 4.13 Percentages of Australian students at the international benchmarks for science, by number of books in the home

Science achievement by Indigenous background

The educational 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 mathematics and science, while PISA has provided this for achievement for 15-year-olds. As shown in Table 4.7, seven per cent of the TIMSS sample at Year 4 self-identified as Indigenous. These students attained an average score in science of 458 score points, half a standard deviation lower than the average score for non-Indigenous Australian students and below the Intermediate benchmark (set at 475 points). To get some idea of what this means in practical terms, the score for Indigenous students indicates that many have an elementary or basic knowledge of science, with some basic knowledge of practical issues in the sciences. For non-Indigenous students, the tendency is more towards being able to apply their knowledge and understanding to explain unknown phenomena.

Table 4.7 Mean science achievement within Australia, by Indigenous background

	% of students	Mean	SE	Gap 95th – 5th percentiles
Non-Indigenous	93	522	2.6	256
Indigenous	7	458	7.7	276

Figure 4.14 presents the distribution of achievement for Indigenous and non-Indigenous students in Australia. The spread of scores from 5th to 95th percentile was slightly larger for Indigenous students, at 276 score points compared to 256 for non-Indigenous students.

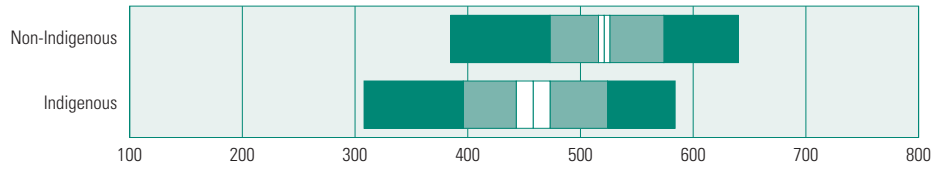


Figure 4.14 Distribution of science achievement within Australia, by Indigenous background

Figure 4.15 presents the proportion 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 proportion of Indigenous students who did not achieve the Intermediate international benchmark was twice that of non-Indigenous students, 53 per cent compared to 26 per cent.

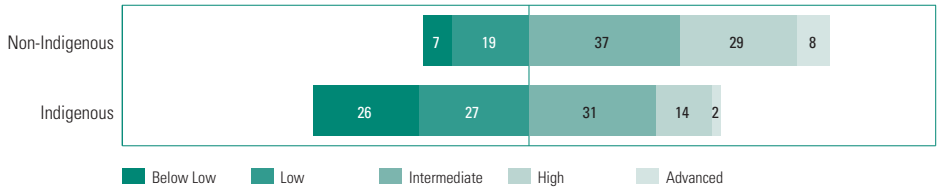


Figure 4.15 Percentages of Australian students at the international benchmarks for science, by Indigenous background

Figure 4.16 shows the trends in achievement of Indigenous students from 1995 to 2011. 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 2011 and previous cycles. For non-Indigenous students, however, the mean score for science achievement in TIMSS 2011 was significantly lower than in TIMSS 2007. This change has resulted in a decrease in the gap in science performance between Indigenous and non-Indigenous students in TIMSS 2011.

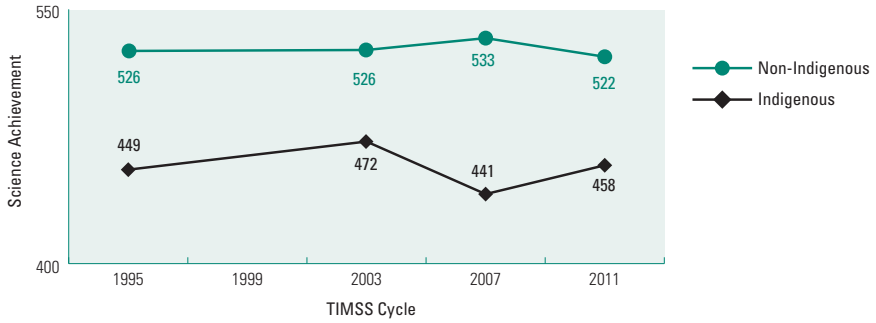


Figure 4.16 Trends in science achievement within Australia, 1995-2011, by Indigenous background

Science achievement by language background

Table 4.8 shows the mean scores and associated standard errors for science at Year 4 for those students whose language background is predominantly English and for those students for whom this was not the case. One in five students in the TIMSS Year 4 sample indicated that they spoke English at home only 'sometimes' or 'never' and were thus classified as having a language background other than English (LBOTE). At the Year 4 level, students who 'always' spoke English at home achieved 24 score points higher on average than students with a language background other than English, a statistically significant difference.

Table 4.8 Mean science achievement within Australia, by language background

	% of students	Mean	SE	Gap 95th – 5th percentiles
Speak English at home	80	522	2.6	260
LBOTE	20	498	5.6	274

Figure 4.17 shows the distribution of scores for students by their language background. The spread of scores between the 5th and 95th percentile was quite similar for the two groups of students: 260 score points for students with an English-speaking background and 274 score points for those students from a language background other than English.

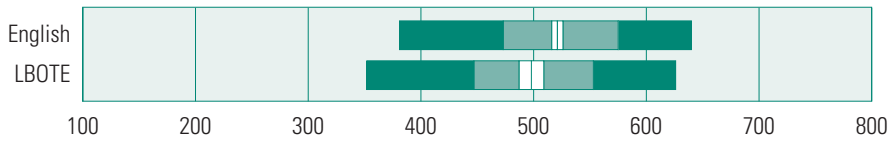


Figure 4.17 Distribution of science achievement within Australia, by language background

The distribution of scores for Year 4 students speaking a language other than English at home in science is reflected in the proportions of student achieving at each of the international benchmarks (Figure 4.18). At the top end of achievement, eight per cent of English-background students and five per cent of students from a language background other than English reached the Advanced benchmark. At the lower levels of achievement, 37 per cent of students from a non-English speaking background compared to 26 per cent from an English-speaking background did not achieve the Intermediate benchmark.

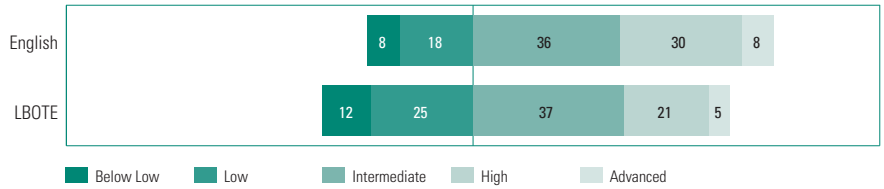


Figure 4.18 Percentages of Australian students at the international benchmarks for science, by language background

Science achievement by geographic location of the school

As described in previous chapters, school addresses were coded to the broad categories of the MCEETYA School's Geographic Location Classification (see Reader's Guide) so that student achievement in science could be examined by geographic location.

The average performance of students attending schools in metropolitan, provincial and remote areas is presented in Table 4.9. Students attending schools in metropolitan areas scored 13 score points higher on average than students attending schools in provincial areas, and 61 score points, on average, higher than students in remote schools. Students attending schools in provincial areas scored, on average, 48 score points higher than students attending schools in remote areas. It should be noted that students in remote schools made up only one per cent of the TIMSS sample and that the standard error associated with their estimated average science score was quite large, however, all differences in performance did reach statistical significance.

Table 4.9 Mean science achievement within Australia, by geographic location

	% of students	Mean	SE	Gap 95th – 5th percentiles
Metropolitan	72	520	3.1	264
Provincial	27	507	5.9	269
Remote	1	459	8.7	321

Figure 4.19 provides the spread of scores for science achievement by geographic location of school. The range of scores from 5th to 95th percentiles was not dissimilar between students attending school in provincial areas (269 score points) and metropolitan areas (264 score points). However, the spread of scores for science achievement for students attending remote schools was substantially greater than that of the other two groups, at 321 score points.

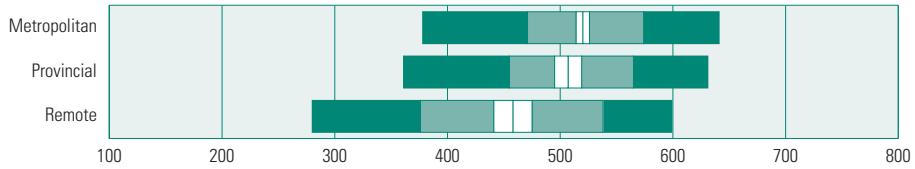


Figure 4.19 Distribution of science achievement within Australia, by geographic location

Figure 4.20 shows the proportion of students at each of the international benchmarks for science. Eight per cent of students in metropolitan schools achieved the Advanced international benchmark, and 36 per cent achieved at least the High benchmark, with 73 per cent achieving at least the Intermediate benchmark. In contrast, just three per cent of students attending schools in remote areas achieved the Advanced international benchmark, 21 per cent achieved at least the High benchmark and 52 per cent achieved the Intermediate benchmark.

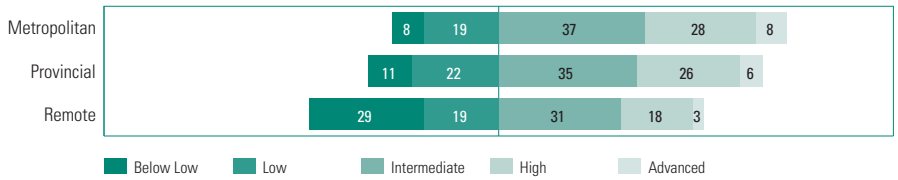


Figure 4.20 Percentage of Australian students at the international benchmarks for science, by geographic location

This chapter so far has reported on the science content achievement measured by TIMSS, examining achievement in terms of state, gender, number of books in the home, Indigenous background, language background and geographic location. The next section of this chapter examines achievement in the science content and cognitive domains.

Achievement in the TIMSS science content and cognitive domains

As outlined 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. At Year 4 the content domains are *life science, physical science* and *Earth Science.* The cognitive domain details the thinking processes that students need to employ in responding to the questions. The cognitive domains are *knowing, applying* and *reasoning.* Each item included in the TIMSS science assessment is associated with a single content domain and a single cognitive domain.

Science content domains

Generally, the TIMSS 2011 participants with the highest achievement overall also had the highest achievement in the content domains. However, many countries performed relatively higher in one or two of the content domains compared to their overall performance; and relatively lower in one or two others. For example, among the top-performing countries, Korea performed relatively better in *physical science* (597) and *Earth science* (603) than in science overall (587), and relatively less well in *life science* (571). Singapore performed relatively better in *life science* (597) and *physical science* (598), but relatively less well in *Earth Science* (541) and Finland performed equally well in all three domains.

Table 4.10 provides the scores for Australia, the states, by gender and by Indigenous background for achievement in the science content domains.

Australian students' average scores in each of the content domains in Year 4 science were similar to their science overall score (516 scale points). This was also the case for the states, gender and for Indigenous and non-Indigenous students.

The Australian Capital Territory – the highest performing state in overall science achievement – was also the highest performing across the three content domains. Male and female students performed similarly across each content domain. Non-Indigenous students scored significantly higher than Indigenous students in *Earth science*, *life science* and *physical science*.

Table 4.10 Relative mean achievement in the science content domains, for Australia and by state, gender and Indigenous background

	Science overall		Earth Science		Absolute difference from overall science score	Life Science		Absolute difference from overall science score	Physical science		Absolute difference from overall science score
	Mean	SE	Mean	SE		Mean	SE		Mean	SE	
Australia	516	2.8	520	3.5	4	516	3.1	0	514	3.2	2
ACT	547	5.0	555	6.2	8	548	6.1	1	547	5.8	0
NSW	522	5.5	526	6.3	4	522	5.8	0	521	5.9	1
VIC	529	4.9	533	6.1	4	528	5.5	0	527	5.5	1
QLD	501	5.9	503	6.9	3	500	7.1	0	497	7.2	3
SA	506	5.1	511	5.1	6	507	4.5	1	505	4.8	1
WA	502	6.1	506	5.5	4	504	5.3	1	501	5.8	1
TAS	518	7.3	525	7.8	7	520	5.8	2	518	7.4	1
NT	491	12.7	491	15.5	0	490	14.2	0	488	14.1	3
Female	516	3.1	517	4.8	1	519	3.4	3	512	3.3	4
Male	516	3.7	524	3.5	8	514	3.6	2	518	4.1	2
Non-Indigenous	522	2.6	526	3.5	4	522	2.9	0	520	3.0	2
Indigenous	458	7.7	459	7.8	1	460	7.8	2	458	8.6	0

Note: No statistical differences are calculated between the mean of the overall scale score and the cognitive domains or the content domains. This is because the data in the content domains underpin or contribute to the data in the overall science score.

Science cognitive domains

Among the top performing countries at Year 4, there was no consistent pattern of strength and weakness in the cognitive domains, with some countries performing better in *reasoning* than in science overall, while others performed better in *applying* or *knowing*. In only four countries was performance in each of the three cognitive domains the same as in science overall: Australia, Belgium and New Zealand.

Table 4.11 presents the average achievement in science by cognitive domains for Australian Year 4 students overall, and for various subgroups.

Performance in each of the three cognitive domains was similar to performance in science overall at all levels, by state, by gender and for Indigenous and non-Indigenous students.

As per the content domains, the Australian Capital Territory was also the highest performing across the three cognitive domains. Male and female students performed similarly in each cognitive domain and non-Indigenous students scored higher than their Indigenous peers in *knowing*, *applying* and *reasoning*.

Table 4.11 Relative mean achievement in the science cognitive domains, for Australia and by state, gender and Indigenous background

	Science overall		Knowing		Absolute difference from overall science score	Applying		Absolute difference from overall science score	Reasoning		Absolute difference from overall science score
	Mean	SE	Mean	SE		Mean	SE		Mean	SE	
Australia	516	2.8	517	2.8	1	513	3.0	4	518	3.4	5
ACT	547	5.0	551	5.1	4	548	5.5	3	549	6.1	1
NSW	522	5.5	523	5.3	2	519	5.9	4	523	5.1	4
VIC	529	4.9	532	5.4	3	528	5.4	4	532	5.8	4
QLD	501	5.9	502	5.6	1	497	6.1	5	502	7.1	6
SA	506	5.1	508	5.1	2	503	5.6	5	508	6.1	5
WA	502	6.1	504	5.4	1	500	6.1	4	506	6.4	6
TAS	518	7.3	521	6.7	3	518	7.1	3	525	6.1	7
NT	491	12.7	491	13.3	0	487	13.3	5	492	12.9	5
Female	516	3.1	516	3.1	0	514	3.6	2	521	3.9	7
Male	516	3.7	521	3.6	5	514	3.6	6	517	3.8	2
Non-Indigenous	522	2.6	524	2.5	2	519	2.8	4	524	3.1	5
Indigenous	458	7.7	460	9.0	2	456	9.7	4	462	9.0	6

Note: No statistical differences are calculated between the mean of the overall scale score and the cognitive domains or the content domains. This is because the data in the cognitive domains underpin or contribute to the data in the overall science score.

The next chapter focuses on students' attitudes towards learning and experiences, as well as home influences on learning.

Chapter

5 Student Attitudes and Home Influences

Key findings:

- Students who indicated that they like reading, mathematics or science scored higher on average in the cognitive assessments than did other students.
- Students who felt confident in reading, mathematics or science scored higher on average in the cognitive assessments than did other students.
- Among Australian students, female students were more likely to like reading and were less likely to feel *not confident* in reading than their male peers, while male students liked learning mathematics to a greater degree and expressed greater confidence with mathematics than their female peers. There was no difference between male and female students in the degree to which they liked learning science or felt confident with science.
- Fewer Indigenous students liked or felt confident in reading, compared to their non-Indigenous peers. Likewise, more Indigenous students were more likely to be *not confident* with science than their non-Indigenous peers. However, there were no significant differences in the proportions of Indigenous and non-Indigenous students who liked learning mathematics and science, or felt confident with mathematics.
- A lack of motivation to read was associated with lower achievement in reading and the difference in achievement between those who were motivated and those who were not was greater among males and Indigenous students.
- Australia was one of the countries with the highest proportions of students with *many resources* for learning in the home.
- Students whose parents *often* engaged their child in early literacy and numeracy activities at home had higher achievement than students whose parents only *sometimes* engaged them in such activities.
- Attending a pre-primary education program was associated with higher reading, mathematics and science achievement.
- Students whose parents *like* reading had higher reading achievement than those students whose parents *somewhat like* reading or *do not like* reading.
- Students whose parents expected that their child would complete university study (either undergraduate or postgraduate) scored higher in reading, mathematics and science than students whose parents expected them to complete some other form of post-secondary study, or who thought that their child would end their education with secondary school.

This chapter examines student-level factors, such as home background and student activities and attitudes that are potentially related to student achievement. In particular, this chapter presents detailed information about students' attitudes towards reading, mathematics and science, the level of motivation they feel towards reading, their level of confidence with reading, mathematics and

science and their resources for learning at home. Further information about the early learning experiences students had before starting school, attendance of preschool, parents' or guardians' own attitudes towards reading, and their educational expectations for their children are reported.

In all TIMSS and PIRLS studies, background data such as that described above is collected from students. PIRLS also includes a Parent survey, and as the two studies were carried out together for this cycle, the PIRLS Parent questionnaire was modified to include some questions about the student's early numeracy experiences as well as early literacy experience.

Students' attitudes towards reading, mathematics and science

Previous cycles of PIRLS and TIMSS, as well as extensive research (for example, Hattie, 2009) have shown strong positive relationships between student attitudes towards reading, mathematics and science and their achievement in these domains. Therefore, developing positive attitudes towards reading, mathematics and science is an important goal of the curriculum in many countries. To summarise information about progress towards these goals, TIMSS and PIRLS examined how much students enjoy reading and learning mathematics and science, the level of motivation they report when engaging in reading and their self-confidence in reading and learning mathematics and science.

Students like reading

The Students Like Reading scale summarises students' responses to eight questions about how much they participate in and enjoy reading. Students were asked to indicate whether they 'agreed a lot', 'agreed a little', 'disagreed a little' or 'disagreed a lot' to the following statements:

- I read only if I have to (reverse coded)
- I like talking about what I read with other people
- I would be happy if someone gave me a book as a present
- I think reading is boring (reverse coded)
- I would like to have more time for reading
- I enjoy reading

Students were also asked how often ('every day or almost every day', 'once or twice a week', 'once or twice a month' or 'never or almost never') they did the following activities outside of school time:

- I read for fun
- I read things that I choose myself.

Responses to these two sets of questions were combined to create the Students Like Reading scale. Students who *like reading* had a score of at least 11.0, which is the point on the scale corresponding to 'agreeing a lot' with three of the first six statements and 'agreeing a little' with the other three, as well as reporting that they read for fun and read things they choose themselves 'every day or almost every day', on average. Students who *do not like reading* had scores no higher than 8.2, which is the scale point corresponding to 'disagreeing a little' with three of the first six statements and 'agreeing a little' with the other three, as well as reporting that they read for fun and read things they choose themselves only 'once or twice a month', on average. All other students were assigned to the *somewhat like reading* category.

Table 5.1 presents the percentage of students in each category of the Students like Reading scale, together with the average reading achievement for each category, for Australia and the international average.

Table 5.1 The Students Like Reading scale and student achievement in reading, Australia and the international average

	Like reading				Somewhat like reading				Do not like reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	30	0.9	565	2.7	52	0.8	518	2.8	19	0.7	494	4.0	9.9	0.1
International Average	28	0.2	542	0.5	57	0.1	506	0.5	15	0.1	488	0.8		

In Australia, the percentages of students in each of the three categories were similar to that of the international average, with 30 per cent of Australian students indicating that they *like reading* (28% internationally) and 19 per cent that *do not like reading* (15% internationally). The percentage of students liking reading ranged from 17 per cent (in Croatia and Qatar) to 46 per cent (Portugal). England, the United States, New Zealand and Indonesia all had percentages close to that of Australia and the international average (26%, 27%, 32% and 32%, respectively).

As expected, students who *like reading* had significantly higher average reading achievement than those who only *somewhat like reading*; while students who reported that they *do not like to read* had the lowest average reading achievement. This pattern was found across participating countries on average, as well as in each individual country, including Australia.

Gender

Table 5.2 presents the percentage of Australian males and females in each category of the Students like Reading scale, together with the students' average reading achievement for each category.

While similar proportions of male and female students, just above 50 per cent, *somewhat like reading*, more female students *like reading* (36% compared to 23%), while more male students *do not like reading* (25% compared to 13% of females). Correspondingly, the average Students Like Reading scale score was higher for female students (10.3) than male students (9.5).

Table 5.2 The Students Like Reading scale and student achievement in reading, by gender

	Like reading				Somewhat like reading				Do not like reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	36	1.4	565	3.6	51	1.3	523	3.3	13	0.8	508	5.8	10.3	0.1
Males	23	1.0	565	3.8	52	1.2	514	3.4	25	1.2	486	4.5	9.5	0.1

Interestingly, while the average reading achievement for male and female students who *like reading* was the same (565), female students who *do not like reading* had higher achievement than male students who *do not like reading* (508 compared to 486). For both male and female students, those who *like reading* had higher reading achievement than those who *do not like reading*. However, the effect was much more pronounced for male students than for female students (a difference of 79 scale points compared to 57 scale points).

Indigenous background

Table 5.3 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Students Like Reading scale, together with the average reading achievement for students in each category.

The percentage of Indigenous students who *like reading* was significantly lower, at 22 per cent, than the percentage of non-Indigenous students who *like reading* (30 per cent). However, there was not a significant difference in the percentage of Indigenous and non-Indigenous students who *do not like reading* (20 and 19 per cent). For both Indigenous and non-Indigenous students, those who *like reading* had higher reading achievement than those who *do not like reading*, a difference of around 70 scale points for both groups.

Table 5.3 The Students Like Reading scale and student achievement in reading, by Indigenous background

	Like reading				Somewhat like reading				Do not like reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	30	0.9	569	2.7	51	0.9	523	2.9	19	0.8	499	4.0	10.0	0.1
Indigenous	22	2.2	515	11.7	58	3.4	472	7.8	20	2.4	441	10.1	9.6	0.1

Students motivated to read

Year 4 students' levels of motivation (including aspects of both internal and external motivation) towards reading were gauged using their responses to the following items:

- I like to read things that make me think
- It is important to be a good reader
- My parents like it when I read
- I learn a lot from reading
- I need to read well for my future
- I like it when a book helps me imagine other worlds.

Students were asked to indicate whether they 'agreed a lot', 'agreed a little', 'disagreed a little' or 'disagreed a lot', and the responses were combined to form the Students Motivated to Read scale.

Students who were *motivated to read* had a score of 8.7, which is the point on the scale corresponding to 'agreeing a lot' with three of the six statements and 'agreeing a little' with the other three, on average.

Students who were *not motivated to read* had scores of no higher than 6.8, which is the scale point corresponding to 'disagreeing a little' with three of the six statements and 'agreeing a little' with the other three, on average.

All other students were categorised as *somewhat motivated to read*.

Table 5.4 presents the percentage of students in each category of the Students Motivated to Read scale, together with the average reading achievement for each category, for Australia and internationally.

Table 5.4 The Students Motivated to Read scale and student achievement in reading, Australia and the international average

	Motivated to read				Somewhat motivated to read				Not motivated to read				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	71	1.0	532	2.7	23	0.9	527	3.2	7	0.5	493	5.7	9.7	0.1
International Average	74	0.1	518	0.4	21	0.1	503	0.7	5	0.1	474	1.3		

In Australia, the percentages of students were similar to that of the international average, with 71 per cent of Australian students indicating that they were *motivated to read* (74% internationally) and only seven per cent indicated that they were *not motivated to read* (5% internationally). Georgia and Indonesia had the highest percentages of students *motivated to read* (92% and 91% respectively) while Hong Kong had the lowest (52%). The United States, Canada and New Zealand had percentages similar to that of Australia (71%, 72% and 72%, respectively).

In Australia, and internationally, students who were *motivated* or *somewhat motivated to read* had higher reading achievement than those who were *not motivated to read*.

Gender

Table 5.5 presents the percentage of Australian males and females in each category of the Students Motivated to Read scale, together with the average reading achievement for each category. Both male and female students are fairly *motivated to read*, with around 74 per cent of female students and 68 per cent of male students indicating that they were *motivated to read* and a further 22 and 23 per cent *somewhat motivated to read*. While there was no significant difference in reading achievement between those who were *motivated to read* and those who were *somewhat motivated to read*, those who were *not motivated to read* had lower reading achievement than those who were *motivated* or *somewhat motivated*, and this difference was greater among male students than female students.

Table 5.5 The Students Motivated to Read scale and student achievement in reading, by gender

	Motivated to read				Somewhat motivated to read				Not motivated to read				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	74	1.2	538	3.5	22	1.1	534	4.0	4	0.4	510	9.8	9.9	0.1
Males	68	1.2	525	3.1	23	1.1	520	4.6	9	0.8	486	6.6	9.5	0.1

Indigenous background

Table 5.6 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Students Motivated to Read scale, together with the average reading achievement for each category.

The percentages of Indigenous students *motivated*, *somewhat motivated* and *not motivated to read* were similar to that of non-Indigenous students – around 70 per cent were *motivated to read*, around 23 per cent were *somewhat motivated to read* and around 7 per cent were *not motivated to read*. While there was no significant difference in reading achievement between those who were *motivated to read* and those who were *somewhat motivated to read*, those who were *not motivated to read* had lower reading achievement than those who were *motivated* or *somewhat motivated*, and this difference was greater among Indigenous students than non-Indigenous students.

Table 5.6 The Students Motivated to Read scale and student achievement in reading, by Indigenous background

	Motivated to read				Somewhat motivated to read				Not motivated to read				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	71	1.0	536	2.7	22	1.0	532	3.4	7	0.5	499	6.3	9.7	0.1
Indigenous	68	2.5	478	6.4	24	2.2	481	12.6	8	1.8	429	12.9	9.7	0.1

Student confidence in reading

Regardless of how much students like or are motivated read (or learn mathematics and science), students' confidence in their ability in these areas is based to some extent on their past experience in learning the subjects. This, in turn, is likely to be determined by the perceived difficulty of the subject as well as the individual student's own learning ability.

Students' confidence in their reading ability was gauged using their responses to the following seven statements:

- I usually do well in reading
- Reading is easy for me
- Reading is harder for me than for many of my classmates (reverse coded)
- If a book is interesting, I don't care how hard it is to read
- I have trouble reading stories with difficult words (reverse coded)
- My teacher tells me I am a good reader
- Reading is harder for me than any other subject (reverse coded).

Students indicated whether they 'agreed a lot', 'agreed a little', 'disagreed a little' or 'disagreed a lot' to these statement and their responses were combined to create the Students Confident in Reading scale.

Students who were categorised as *confident* in reading had a score of at least 10.6, which is the point on the scale corresponding to 'agreeing a lot' with four of the seven statements and 'agreeing a little' with the other three, on average. Students who were *not confident* in reading had scores no higher than 7.9, which is the scale point corresponding to 'disagreeing a little' with four of the seven statements and 'agreeing a little' with the other three, on average. All other students were categorised as *somewhat confident* in reading.

Table 5.7 presents the percentage of students in each category of the Students Confident in Reading scale, together with the average reading achievement for students in each category, for Australia and internationally.

Table 5.7 The Students Confident in Reading scale and student achievement in reading, Australia and the international average

	Confident in reading				Somewhat confident in reading				Not confident in reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	37	0.9	568	2.4	53	0.8	515	2.5	10	0.6	451	5.4	10.1	0.0
International Average	36	0.2	547	0.4	53	0.1	502	0.4	11	0.1	456	0.8		

In Australia, the percentages of students were similar to that of the international average, with 37 per cent of students indicating that they were *confident* readers (36% internationally) and only 10 per cent that indicated that they were *not confident* (11% internationally). Across participating countries, the highest percentages of students that are *confident* in reading were found in Israel (49%) and Finland (48%), while Morocco had the lowest percentage of students that were *confident* in reading (17%). England and the Netherlands had a similar proportion of *confident* readers as Australia (37%), while New Zealand was lower (27%) and the United States and Canada were higher (40 and 41%).

Among Australian students, and across participating countries on average, there was a positive association at Year 4 between reading performance and self-confidence. Australian Year 4 students who were *confident* in reading had the highest average reading performance score (568 points), followed by students who were *somewhat confident* in reading (515 points), while students who were *not confident* in reading had the lowest average score (451 points).

Gender

Table 5.8 presents the percentage of Australian females and males in each category of the Students Confident in Reading scale, together with the average reading achievement for each category. Both male and female students had similar levels of confidence, with only a slightly higher percentage of male students indicating that they were *not confident* readers. For both female and male students, those who were *confident* readers had a much higher reading achievement (by over 100 scale points) than those who were *not confident* readers. This difference was greater for male students (120 scale points) than for female students (108 scale points).

Table 5.8 The Students Confident in Reading scale and student achievement in reading, by gender

	Confident in reading				Somewhat confident in reading				Not confident in reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	39	1.3	571	3.5	53	1.3	522	2.9	8	0.8	463	8.2	10.2	0.1
Males	36	1.1	564	2.8	52	1.1	508	3.3	12	0.9	444	6.5	9.9	0.1

Indigenous background

Table 5.9 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Students Confident in Reading scale, together with the average reading achievement for each category. A greater percentage of non-Indigenous students than Indigenous students (38% to 27%) indicated that they were *confident* in reading, while the percentage of students *not confident* in reading was slightly higher for Indigenous students than non-Indigenous students.

For both Indigenous and non-Indigenous students, those who were *confident* readers had significantly higher reading achievement (over 100 scale points) than those who were *not confident* readers.

Table 5.9 The Students Confident in Reading scale and student achievement in reading, by Indigenous background

	Confident in reading				Somewhat confident in reading				Not confident in reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	38	0.9	569	2.4	52	0.8	520	2.6	10	0.6	458	5.3	10.1	0.0
Indigenous	27	3.0	530	8.1	56	3.2	469	7.6	17	1.6	408	8.7	9.6	0.1

Students like learning mathematics

To investigate how students feel about mathematics, a scale was created based on students' responses to five statements about mathematics:

- I enjoy learning mathematics
- I wish I did not have to study mathematics (reverse coded)
- Mathematics is boring (reverse coded)
- I learn many interesting things in mathematics
- I like mathematics.

Students were asked to indicate their level of agreement with each statement using the categories 'agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot' and their responses were combined to create the Students Like Learning Mathematics scale.

Students who *like learning mathematics* had a score of at least 10.1, which is the point on the scale corresponding to 'agreeing a lot' with three of the five statements and agreeing a little with the other two, on average. Students who *do not like learning mathematics* had a score of no higher than 8.1, which is the scale point corresponding to 'disagreeing a little' with three of the five statements and 'agreeing a little' with the other two, on average. All other students were assigned to the *somewhat like learning mathematics* category.

Table 5.10 shows the percentage of students in each of the three groups and the average mathematics achievement of students in each group, for both Australian students and the international average.

Table 5.10 The Students Like Learning Mathematics scale and student achievement in mathematics, Australia and the international average

	Like learning mathematics				Somewhat like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	45	1.2	535	3.5	33	0.9	508	3.6	22	0.9	495	3.8	9.7	0.1
International Average	48	0.2	509	0.5	36	0.1	478	0.6	16	0.1	466	0.9		

Across countries the percentage of students who *like learning mathematics* ranged from 23 per cent (Korea) to 76 per cent (Georgia). England, the United States and New Zealand had percentages similar to that of Australia (44%, 45% and 47%, respectively). Interestingly, some of the highest performing countries had the smallest percentages of students reporting positive attitudes towards learning mathematics, including Chinese Taipei, Japan and Korea. This tendency of smaller

percentages of students in some East Asian countries to report positive attitudes is consistent with findings from previous TIMSS assessments. It has been suggested by the authors of the international report that the relatively low percentages of students who *like learning mathematics* in these countries may partially result from the high level of difficulty of the mathematics being studied, and also that these countries have a cultural tradition of serious attitudes toward learning.

On average across participating countries, 48 per cent of Year 4 students were in the *like learning mathematics* category, substantially more than in the *do not like learning mathematics* category (16%). The remaining Year 4 students (36%, on average) *somewhat like learning mathematics*.

In Australia, the percentages of students who indicated that they *like* or *somewhat like learning mathematics* were similar to that of the international average (45% and 33%, respectively). However a slightly greater number of Australian students (22%) indicated that they *do not like learning mathematics*, compared to the international average of 16 per cent.

On average internationally and in almost all TIMSS 2011 countries, including Australia, students who *like learning mathematics* had higher average mathematics achievement than those who only *somewhat like learning mathematics*. In turn, those students who do *not like learning mathematics* had the lowest average mathematics achievement.

Gender

Table 5.11 presents the percentage of Australian males and females in each category of the Students like Learning Mathematics scale, together with the students' average mathematics achievement for each category. The proportion of male students who *like learning mathematics* was slightly higher than the proportion of female students who *like learning mathematics*, with a subsequently higher proportion of female students who *somewhat like learning mathematics*. However, there was no significant difference in the percentages of male and female students that *do not like learning mathematics*. Interestingly, while there was no difference in the average mathematics achievement of male and female students in the *somewhat like* and *do not like learning mathematics* categories, male students who *like learning mathematics* scored higher on average on the mathematics assessment than did female students who *like learning mathematics*.

Table 5.11 The Students Like Learning Mathematics scale and student achievement in mathematics, by gender

	Like learning mathematics				Somewhat like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	43	1.6	527	4.2	35	1.2	508	4.1	22	1.1	496	4.4	9.7	0.1
Males	48	1.3	542	4.0	31	1.2	507	5.3	21	1.1	494	5.4	9.8	0.1

Indigenous background

Table 5.12 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Students like Learning Mathematics scale, together with the students' average mathematics achievement. There were no significant differences in the percentages of Indigenous and non-Indigenous students who *like*, *somewhat like* and *do not like learning mathematics*. Indigenous students had lower mathematics achievement than non-Indigenous students in all three categories of the Students like Learning Mathematics scale but the gap widens slightly from 56 scale points for students who *like learning mathematics* to 68 and 65 scale points (respectively) for students who only *somewhat like learning mathematics* and *do not like learning mathematics*.

Table 5.12 The Students Like Learning Mathematics scale and student achievement in mathematics, by Indigenous background

	Like learning mathematics				Somewhat like learning mathematics				Do not like learning mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	45	1.3	539	3.5	33	1.0	514	3.4	22	1.0	500	3.7	9.7	0.1
Indigenous	43	2.4	483	9.7	37	3.4	445	11.6	20	3.0	435	13.0	9.8	0.1

Student confidence with mathematics

To investigate students' beliefs about their abilities in mathematics, TIMSS created a Student Confidence with Mathematics scale, based on students' responses to seven statements about their mathematics ability:

- I usually do well in mathematics
- Mathematics is harder for me than for many of my classmates (reverse coded)
- I am just not good at mathematics (reverse coded)
- I learn things quickly in mathematics
- 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 (reverse coded).

Students were asked to indicate their level of agreement with each statement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') and their responses combined to create the Student Confidence with Mathematics scale.

Students who were *confident* with mathematics had a score of at least 10.6, which is the point on the scale corresponding to 'agreeing a lot' with four of the seven statements and 'agreeing a little' with the other three, on average.

Students who were *not confident* with mathematics had scores no higher than 8.5, which is the scale point corresponding to 'disagreeing a little' with four of the seven statements and 'agreeing a little' with the other three, on average.

All other students were categorised as *somewhat confident* with mathematics.

Table 5.13 shows the percentage of students in each group and the average mathematics achievement of students in each group, for both Australian students and the international average.

Table 5.13 The Student Confidence with Mathematics scale and student achievement in mathematics, Australia and the international average

	Confident with mathematics				Somewhat confident with mathematics				Not confident with mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	38	0.9	550	3.5	41	0.9	507	3.1	21	0.7	478	4.3	10.1	0.0
International Average	34	0.1	527	0.5	46	0.1	484	0.5	21	0.1	452	0.7		

In many countries the majority of Year 4 students were *not confident* about their mathematics ability. Poland had the highest percentage of students *confident* with mathematics (49%) while

Japan and Korea had the lowest (9% and 11%, respectively). Students in the United States were of similar confidence as Australian students, with 40 per cent expressing confidence with mathematics, while students in England and New Zealand were less confident with only 33 per cent and 25 per cent (respectively) expressing confidence with mathematics. Similar to the results for the Students Like Learning Mathematics scale, students in some of the highest performing countries expressed the least confidence.

Internationally, on average, 34 per cent of the Year 4 students expressed confidence in their mathematics ability. Average mathematics achievement was highest for the *confident* Year 4 students and lowest (by 75 points) for the students who were *not confident* (21% of the international sample). Similarly, in Australia, on average, 38 per cent of students indicated that they were *confident* about their mathematics ability, while 21 per cent indicated that they were *not confident*.

Gender

Table 5.14 presents the percentage of Australian males and females in each category of the Student Confidence with Mathematics scale, together with the average mathematics achievement for each category. In Australia, male Year 4 students tend to be more confident with mathematics than their female peers. Forty-two per cent of male students were *confident* with mathematics compared to 33 per cent of female students, while 24 per cent of female students and 18 per cent of male students were *not confident* with mathematics. This was reflected in the higher average scale score of male students (10.3, compared to 9.9 for female students). However, there was no difference in the average mathematics achievement of female and male students in each of the categories.

Table 5.14 The Student Confidence with Mathematics scale and student achievement in mathematics, by gender

	Confident with mathematics				Somewhat confident with mathematics				Not confident with mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	33	1.3	546	5.1	43	1.3	508	3.5	24	1.2	479	4.8	9.9	0.1
Males	42	1.1	553	4.2	40	1.0	505	4.5	18	0.9	477	5.8	10.3	0.1

Indigenous background

Table 5.15 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Student Confidence with Mathematics scale, together with the average mathematics achievement for students in each category. The percentages of Indigenous and non-Indigenous students that felt *confident*, *somewhat confident* or *not confident* with mathematics were quite similar, with only a few percentage points separating them. Indigenous students had lower mathematics achievement than non-Indigenous students in all three categories of the Confident in Learning Mathematics scale but the gap widens slightly from 57 scale points for students who express confidence with mathematics to 74 scale points for students who are only *somewhat confident* with mathematics and narrows again to 60 scale score points for students who are *not confident* with mathematics.

Table 5.15 The Student Confidence with Mathematics scale and student achievement in mathematics, by Indigenous background

	Confident with mathematics				Somewhat confident with mathematics				Not confident with mathematics				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	38	0.9	554	3.4	41	0.9	513	3.0	21	0.8	482	4.1	10.1	0.0
Indigenous	38	2.8	497	10.5	45	2.9	440	7.4	17	1.8	422	15.9	10.2	0.1

Students like learning science

As for reading and mathematics, a Students Like Learning Science scale was created based on students' responses to five statements about learning science:

- I enjoy learning science
- I wish I did not have to study science (reverse coded)
- Science is boring (reverse coded)
- I learn many interesting things in science
- I like science.

Students were asked to indicate whether they 'agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot' with these statements, and their responses were combined to create the Students Like Learning Science scale. Students were then assigned to one of three groups, based on their scale score.

Students who *like learning science* had a score of at least 9.7, which is the point on the scale corresponding to 'agreeing a lot' with three of the five statements and 'agreeing a little' with the other two, on average.

Students who *do not like learning science* had a score of no higher than 7.6 which is the scale point corresponding to 'disagreeing a little' with three of the five statements, and 'agreeing a little' with the other two, on average.

All other students were assigned to the *somewhat like learning science* category.

Table 5.16 shows the percentage of students at each level of the index and the average science achievement of students at each level, for both Australian students and the international average.

Table 5.16 The Students Like Learning Science scale and student achievement in science, Australia and the international average

	Like learning science				Somewhat like learning science				Do not like learning science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	55	1.0	529	2.8	31	0.7	506	3.9	14	0.7	496	5.2	10	0.1
International Average	53	0.2	504	0.5	35	0.1	469	0.7	12	0.1	461	1.1		

In Australia, the percentages of students who indicated that they *like learning science* were similar to that of the international average, with 55 per cent of students indicating that they *like learning science* (53% internationally) and 14 per cent (12% internationally) indicating that they *do not like learning science*. The remainder of students (31% in Australia and 35% internationally) *somewhat like*

learning science. Turkey and Tunisia had the highest percentage of students that *like learning science* (73% and 72% respectively) while Azerbaijan had the lowest (33%). New Zealand and the United States had proportions of students who *like learning science* that were similar to Australia's (55% and 56%, respectively) while the percentage of students in England was somewhat lower (44%).

In Australia, as was found across participating countries on average, students who *like learning science* had higher average science achievement than those who only *somewhat* or *do not like learning science*. This difference was statistically significant in Australia.

Gender

Table 5.17 presents the percentage of Australian males and females in each category of the Students Like Learning Science scale, together with the students' average science achievement for each category. The percentages of male and female students that *like*, *somewhat like* and *do not like learning science* were similar, with only a few percentage points separating them. For both males and females, the students who *like learning science* scored significantly higher on average on the science assessment than those who only *somewhat* or *do not like learning science.* Interestingly, the effect of whether a student likes or dislikes learning science on science achievement appears to be stronger for male students, with a gap of 43 achievement scale points between male students that like and dislike learning science, compared to a gap of only 22 scale points for female students.

Table 5.17 The Students Like Learning Science scale and student achievement in science, by gender

	Like learning science				Somewhat like learning science				Do not like learning science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	55	1.4	524	3.0	32	1.2	509	5.2	13	0.9	502	5.9	10.0	0.1
Males	56	1.3	533	4.1	30	0.8	502	4.2	14	1.0	491	7.9	10.0	0.1

Indigenous background

Table 5.18 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Students Like Learning Science scale, together with the average science achievement of students in each category. The percentages of Indigenous and non-Indigenous students who *like*, *somewhat like* and *do not like learning science* were similar, with only a few percentage points separating them. Indigenous students scored significantly lower in science than non-Indigenous students in all three categories of the Students Like Learning Science scale. Among Indigenous and non-Indigenous students alike, those who *like science* scored higher on average on the science assessment than those who only *somewhat like science*. Among non-Indigenous students, those who *like science* also scored higher on average than those who *do not like science*, but among Indigenous students there was no significant difference between the average science achievement of students in these two groups.

Table 5.18 The Students Like Learning Science scale and student achievement in science, by Indigenous background

	Like learning science				Somewhat like learning science				Do not like learning science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	56	1.0	533	2.9	31	0.8	512	4.0	13	0.7	502	4.6	10.0	0.1
Indigenous	52	3.0	477	7.8	30	2.3	436	11.4	18	2.0	449	15.3	9.8	0.2

Student confidence with science

Similar to the scales created for reading and mathematics, a scale was also created to gauge students' levels of confidence in their abilities in science lessons.

Students were asked to indicate their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') to the following statements:

- I usually do well in science
- Science is harder for me than for many of my classmates (reverse coded)
- I am just not good at science (reverse coded)
- I learn things quickly in science
- My teacher tells me I am good at science
- Science is harder for me than any other subject (reverse coded).

Students' responses to these items were combined to create the Student Confidence with Science scale, and students were then categorised as belonging to one of three groups based on their scale score.

Students who were *confident* with science had a score of at least 10.1, which is the point on the scale corresponding to 'agreeing a lot' with three of the six statements and 'agreeing a little' with the other three, on average.

Students who were *not confident* with science had scores no higher than 8.3, which is the scale point corresponding to 'disagreeing a little' with three of the six statements and 'agreeing a little' with the other three, on average.

All other students were categorised as *somewhat confident* with science.

Table 5.19 shows the percentage of students at each level of the index and the average science achievement of students at each level, for both Australian students and the international average. In Australia, the percentages of students who indicated that they were *confident* in their science ability were similar to that of the international average, with 42 per cent of students indicating that they were *confident* and 22 per cent in the *not confident* group.

Across the participating countries the proportion of students who were *confident* with science ranged from 15 and 17 per cent in Korea and Japan (two of the highest scoring countries in science) to 62 per cent in Croatia. Students in the United States were slightly more confident than those in Australia, with 48 per cent in the *confident* with science group, while the percentages of students in England and New Zealand who were *confident* were somewhat lower (33% and 28%, respectively).

On average across participating countries and among Australian students, those who were *confident* with science had significantly higher average science scores than those who were *somewhat confident* and both of these groups (the *confident* and *somewhat confident*) had higher science achievement than those who were *not confident* with science.

Table 5.19 The Student Confidence with Science scale and student achievement in science, Australia and the international average

	Confident with science				Somewhat confident with science				Not confident with science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	42	1.0	535	3.2	36	0.9	516	3.4	22	0.9	484	4.4	9.9	0.0
International Average	43	0.2	514	0.5	36	0.1	480	0.6	21	0.1	446	0.8		

Gender

Table 5.20 presents the percentage of Australian males and females in each category of the Student Confidence with Science scale, together with the average science achievement for students in each category. The percentages of female and male students that felt *confident*, *somewhat confident* or *not confident* with science were similar, with only a few percentage points separating them. There was also very little difference in average science achievement between male and female students in each of the categories. For both male and female students, confidence with science was associated with higher science achievement – those who were *confident* had higher average science scores than those who were only *somewhat confident*, and both the *confident* and *somewhat confident* students had higher science achievement than those who were *not confident* with science.

Table 5.20 The Student Confidence with Science scale and student achievement in science, by gender

	Confident with science				Somewhat confident with science				Not confident with science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	42	1.5	533	3.4	37	1.3	515	4.2	21	1.2	486	5.6	9.9	0.1
Males	42	1.2	538	4.3	36	1.1	517	4.5	22	1.2	482	5.3	9.9	0.1

Indigenous background

Table 5.21 presents the percentage of Australian Indigenous and non-Indigenous students in each category of the Student Confidence with Science scale, together with the average science achievement for students in the three categories. A significantly higher proportion of Indigenous students (31%) compared to non-Indigenous students (21%) indicated that they were *not confident* with science. In all three categories of the Student Confidence with Science scale, Indigenous students scored lower on the science assessment than non-Indigenous students, with this gap widening slightly from 54 scale points for students who were *confident* in learning science to 69 scale points for students who were *not confident* with science.

Table 5.21 The Student Confidence with Science scale and student achievement in science, by Indigenous background

	Confident with science				Somewhat confident with science				Not confident with science				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Non-Indigenous	42	1.0	539	3.3	37	0.9	521	3.3	21	0.9	492	4.0	9.9	0.1
Indigenous	39	3.5	485	9.3	30	2.8	462	8.3	31	3.2	423	12.1	9.7	0.2

The next section of this chapter relies on responses to the Home questionnaire, which was completed by parents or guardians of the TIMSS and PIRLS Year 4 students.

However, as participation by the parents was voluntary, the responding sample was smaller (only 53% of parents responded) and, to some extent, less representative than the full student sample. The sample of students whose parents or guardians responded had a greater proportion of students from Victoria than the full sample, and a smaller proportion of students from the Northern Territory. There was a slightly higher number of female students, a lower proportion of students that speak a language other than English at home and a lower proportion of students from schools in remote locations in this sample. Students whose parents or guardians completed

the Home questionnaire were also more likely to come from homes with greater number of books, with only 35 per cent of students with fewer than 10 books in the home, compared to 65 per cent of students with more than 200 books in the home. As many of these attributes are associated with achievement, consequently, students in this sample also had higher achievement than those whose parents did not complete the questionnaire.

Given the smaller sample size, and some appearance of statistical bias, it is recommended that some caution be exercised when interpreting results that are linked to data from the Home questionnaire.

Educational resources in the home

The presence or absence of educational resources in the home reflects potential advantage or disadvantage for students that may either reflect the ability of parents to provide materially for their children or possibly indicate differences in practical and psychological support for academic achievement. These resources may be physical, such as books or an internet connection, or in the form of more intangible attributes such as parental education or occupation. Past cycles of TIMSS and PIRLS have found a strong relationship between parental education and/or occupation and student achievement. Parental education, in particular, is both an indicator of socio-economic status (SES) and also an indicator of educational capital in the form of positive attitudes towards learning and higher expectations of their children. The number of books in the home has also been found to be strongly related to achievement, not just in reading, but also for mathematics and science.

The Home Resources for Learning scale[1] combines students' and parents' responses to the following questions:

- Number of books in the home
- Number of children's books in the home
- Availability of two home supports for study (their own room, and an Internet connection)
- Highest level of education of either parent
- Highest level of occupation of either parent

Students with *many resources* had a score of at least 11.9, which is the point on the scale corresponding to students reporting that they had more than 100 books in the home and two home study supports, and parents reporting that they had more than 25 children's books in the home, and that at least one parent had finished university and that at least one parent had a professional occupation, on average.

Students with *few resources* had a score no higher than 7.3, which is the scale point corresponding to students reporting that they had 25 or fewer books in the home and neither of the home study supports, and parents reporting that they had 10 or fewer children's books in the home, that neither parent had gone beyond upper-secondary education and that neither parent had a business, clerical or professional occupation, on average.

All other students were assigned to the *some resources* category.

Table 5.22 shows the percentage of students at each level of the Home Resources for Learning scale and the average reading, mathematics and science achievement of students at each level, for both Australian students and the international average. In Australia, 41 per cent of students were assigned to the *many resources* category, while less than one per cent were assigned to the *few*

1 This scale, along with others in this chapter, was based on the responses of parents to the Home Questionnaire. The Home Questionnaire was only administered by countries which participated in PIRLS, and responses are not available for those countries which participated in TIMSS only (12 countries). The data for the international average presented in the tables is for all PIRLS participants (percentages in categories and average reading achievement), while the mathematics and science achievement scores are based on the average for those countries which participated in both TIMSS and PIRLS.

resources category. The remainder, 59 per cent of Australian students, were assigned to the *some resources* category. Australia's average scale score of 11.5 is higher than the international average (anchored at 10), indicating that students in Australia tend to have more educational resources in the home than students in other participating countries.

Australia had one of the highest percentages of students in the *many resources* category, along with the Scandinavian countries and New Zealand and Canada (37 and 35%, respectively). Indonesia, Azerbaijan, Morocco and Colombia had the lowest (0–1%). From Table 5.22 it can be seen that internationally, on average, just over 70 per cent of Year 4 students were assigned to the *some resources* category, while just under 20 per cent, on average, were in the *many resources* category and nine per cent were in the *few resources* category, with over 120 points difference in the average reading, mathematics and science scores of those with *many resources* compared to those with *few resources*.

Australian students in the *many resources* category also had higher reading, mathematics and science achievement (around 55 scale points higher) than those in the *some resources* category.

Table 5.22 The Home Resources for Learning scale and student achievement in reading, mathematics and science, Australia and the international average

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
	Many resources							
Australia	41	1.5	575	3.2	566	3.6	565	3.0
International Average	18	0.2	571	0.7	555	0.9	559	0.9
	Some resources							
Australia	59	1.5	520	2.5	510	3.2	509	3.5
International Average	73	0.2	510	0.4	497	0.6	495	0.6
	Few resources							
Australia	<1	0.2	~	~	~	~	~	~
International Average	9	0.1	448	1.4	436	1.8	428	2.0

A tilde (~) indicates insufficient data to report achievement reliably.

Gender

Table 5.23 presents the percentage of Australian males and females in each category of the Home Resources for Learning scale, together with the average reading, mathematics and science achievement for students in each category. Similar proportions of male and female students fall into each of the categories of the Home Resources for Learning scale, with around 40 per cent assigned to the *many resources* category and nearly 60 per cent assigned to the *some resources* category.

Table 5.23 The Home Resources for Learning scale and student achievement in reading, mathematics and science, by gender

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
	Many resources							
Females	40	1.7	581	4.5	559	4.8	560	4.6
Males	41	2.0	568	4.6	573	5.5	569	5.3
	Some resources							
Females	59	1.7	525	3.1	505	4.1	506	4.0
Males	58	1.9	515	3.7	516	3.8	513	3.9
	Few resources							
Females	1	0.2	~	~	~	~	~	~
Males	1	0.2	~	~	~	~	~	~

A tilde (~) indicates insufficient data to report achievement reliably.

Early literacy and numeracy experiences

The early literacy and numeracy experiences of children in the years before formal education starts can provide important building blocks for later literacy and numeracy learning. It is becoming increasingly evident that participation in numeracy and literacy activities before entering primary school is hugely beneficial for school achievement.

Early literacy activities before beginning primary school

The Early Literacy Activities scale summarises parents' responses to nine questions about the types of early literacy activities their children may have participated in at home before they began formal schooling.[2]

Parents were asked to indicate how often – on a three point Likert-type scale ranging from 'often', 'sometimes' to 'never or almost never' – their children participated in the following activities with parents or someone else in the household:

- Read books
- Tell stories
- Sing songs
- Play with alphabet toys (e.g. blocks with letters of the alphabet)
- Talk about things you had done
- Talk about things you had read
- Play word games
- Write letters or words
- Read aloud signs and labels

2 As indicated earlier in this chapter, the response rates to the Home questionnaire meant that data was available for only a proportion of the full student sample. In some cases, this has resulted in estimates for certain student subgroups, Indigenous students in particular, that are not particularly reliable and so these results are not reported here.

Students assigned to the *often* category had a score of at least 10.7, which is the point on the scale corresponding to parents reporting that they (or someone else in the household) had 'often' done five of the nine literacy activities with them and 'sometimes' done the other four, on average.

Students assigned to the *never or almost never* category had a score no higher than 6.2, which is the scale point corresponding to parents reporting that they had 'never or almost never' done five of the nine literacy activities and 'sometimes' done the other four, on average.

All other students were assigned to the *sometimes* category.

Table 5.24 shows the percentage of students in each category of the Early Literacy Activities scale and the average reading achievement of students in each category, both for Australian students and the international average.

In Australia, over 50 per cent of the students had parents who *often* engaged them in early literacy activities, while only one per cent had parents who *never or almost never* engaged them in such activities. The remainder, 46 per cent of Australian students, had parents who only *sometimes* engaged them in early literacy activities.

Table 5.24 The Early Literacy Activities scale and student achievement in reading, Australia and the international average

	Often				Sometimes				Never or almost never				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	52	1.4	555	3.0	46	1.3	528	3.4	1	0.3	~	~	10.8	0.1
International Average	37	0.2	529	0.5	60	0.2	506	0.5	3	0.1	430	2.6		

Internationally, across the countries at Year 4, 37 per cent of the students had parents who *often* engaged them in early literacy activities, and an additional 60 per cent had parents who *sometimes* engaged them in early literacy activities. Russian Federation and Northern Ireland had the highest percentage of students whose parents *often* engaged them in early literacy activities (61% and 59% respectively). Somewhat surprisingly, one of the highest achieving countries, Hong Kong, had the lowest proportion of parents who said they *often* engaged their children in such activities, although a further 80 per cent of parents said they did so *sometimes*. Such results show that these scales are often difficult to interpret cross-culturally, although they work well within countries. New Zealand and Canada had percentages of students whose parents *often* engaged in early literacy activities with them that were similar to Australia's (55% and 51%, respectively).

In Australia (as well as internationally, including Hong Kong) students whose parents had *often* engaged them in early literacy activities had higher reading achievement than those whose parents only *sometimes* engaged them in literacy activities.

Gender

Table 5.25 presents the percentage of Australian males and females in each category of the Early Literacy Activities scale, together with the students' average reading achievement. Table 5.25 shows that, in Australia, there was no difference in the frequency with which males and females participated in early literacy activities, with just over half of both male and female students having parents that *often* engaged in such activities with their children. For both female and male students, students whose parents had *often* engaged in early literacy activities had higher reading achievement at Year 4 than those who had only *sometimes* engaged in such activities.

Table 5.25 The Early Literacy Activities scale and student achievement in reading, by gender

	Often				Sometimes				Never or almost never				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	53	2.0	560	4.2	46	1.9	532	4.1	1	0.3	~	~	10.9	0.1
Males	51	1.8	549	3.8	47	1.5	524	4.4	2	0.6	~	~	10.7	0.1

Early numeracy activities before beginning primary school

Parents or guardians were also asked about the types of early numeracy activities their children may have participated in at home before beginning school. Parents were asked to indicate how often ('often', 'sometimes' or 'never or almost never') they or someone else in the home participated in the following activities with the TIMSS and PIRLS students:

- Say counting rhymes or sing counting songs
- Play with number toys (e.g. blocks with numbers)
- Count different things
- Play games involving shapes (e.g. shape sorting toys, puzzles)
- Play with building blocks or construction toys
- Play board games or card games.

The Early Numeracy Activities scale was constructed from the responses to these six items, and students assigned to one of three groups based on their parents' scale score.

Students assigned to the *often* category had a score of at least 10.3, which is the point on the scale corresponding to parents reporting that they had 'often' done three of the six numeracy activities and 'sometimes' done the other three, on average.

Students assigned to the *never or almost never* category had a score no higher than 6.9, which is the scale point corresponding to parents reporting that they had 'never or almost never' done three of the six numeracy activities and 'sometimes' done the other three, on average.

All other students were assigned to the *sometimes* category.

Table 5.26 shows the percentage of students in each category of the Early Numeracy Activities scale and the average mathematics achievement of students in each category, both for Australian students and the international average.

Table 5.26 The Early Numeracy Activities scale and student achievement in mathematics, Australia and the international average

	Often				Sometimes				Never or almost never				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	61	1.2	540	3.7	36	1.2	520	4.1	3	0.4	488	13.4	10.7	0.1
International Average	49	0.2	510	0.7	45	0.2	493	0.7	6	0.1	460	1.8		

Internationally, across the countries at the Year 4, 49 per cent of the students had parents who *often* engaged them in early numeracy activities, and an additional 45 per cent had parents who *sometimes* engaged them in early numeracy activities. Hungary and the Czech Republic had the

highest percentage of students whose parents *often* engaged them in early numeracy activities (both 75%) while Morocco had the lowest (18%).

In Australia, 61 per cent of the students had parents who *often* engaged in early numeracy activities with them, while three per cent had parents who *never or almost never* engaged them in such activities. The remainder, 36 per cent of Australian students, had parents who only *sometimes* engaged them in early numeracy activities.

Australian students whose parents had *often* or *sometimes* engaged them in early numeracy activities had higher mathematics scores than those whose parents *never or almost never* engaged them in numeracy activities.

Gender

Table 5.27 presents the percentage of Australian males and females in each category of the Early Numeracy Activities scale, together with their average mathematics achievement. Similar percentages of male and female students had parents who engaged them in early numeracy activities, with just under two-thirds of both male and female students having parents who *often* engaged in such activities with them. For female students, students whose parents had *often* engaged in early numeracy activities had higher mathematics achievement at Year 4 than those who had only *sometimes* engaged in such activities. For male students, students whose parents had *often* or *sometimes* engaged in early numeracy activities had higher mathematics achievement at Year 4 than those who *never or almost never* engaged in such activities.

Table 5.27 The Early Numeracy Activities scale and student achievement in mathematics, by gender

	Often				Sometimes				Never or almost never				Average scale score	SE
	% of students	SE of %	Average Mathematics Achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE		
Females	60	1.7	536	4.3	38	1.7	510	5.4	2	0.5	529	16.8	10.6	0.1
Males	63	1.6	545	4.6	34	1.5	534	4.7	3	0.8	465	17.4	10.7	0.1

Early literacy skills

The Early Literacy Tasks scale summarises parents' responses to a set of questions about the early literacy skills their children displayed before beginning formal schooling. Parents were asked how well ('very well', 'moderately well', 'not very well' or 'not at all') their children could do the following:

- Recognise most of the letters of the alphabet
- Read some words
- Read sentences
- Write letters of the alphabet
- Write some words.

Students who could do early literacy tasks *very well* had a score of at least 11.5, which is the point on the scale corresponding to parents reporting that their children could do three literacy tasks 'very well' and the other two 'moderately well', on average.

Students who could do early literacy tasks *not well* had a score no higher than 8.9, which is the scale point corresponding to parents reporting that their children could do three tasks 'not very well' and the other two 'moderately well', on average.

All other students were assigned to the *moderately well* category.

Table 5.28 shows the percentage of students in each category of the Early Literacy Tasks scale and the average reading achievement of students in each category, both for Australian students and the international average.

Table 5.28 The Early Literacy Tasks scale and student achievement in reading, Australia and the international average

	Very well				Moderately well				Not well				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	17	0.9	571	3.8	44	1.1	544	3.2	39	1.1	526	3.6	9.7	0.0
International Average	26	0.1	537	0.6	42	0.2	511	0.5	32	0.2	489	0.7		

In Australia, only 17 per cent of the students could perform early literacy activities *very well* when they entered primary school, while around 39 per cent performed these tasks *not well*. The remaining 44 per cent of Australian students were in the *moderately well* group, according to their parents' reports.

Internationally, on average, 26 per cent of students had parents that reported their children could perform early literacy activities *very well*, a proportion significantly higher than the proportion in Australia. Trinidad and Tobago had the highest percentage of students whose parents reported that they could perform early literacy tasks *very well* when they began primary school (49%) while the Slovak Republic had the lowest (9%). New Zealand had a similar percentage as Australia (18%).

Internationally, and in Australia, students whose parents had reported that they performed *very well* on these literacy tasks had higher average reading achievement than those whose parents reported that their child performed *moderately well*. Those students whose parents reported that their child did not perform well on these tasks when they entered school had significantly lower achievement than those who performed early numeracy tasks *very well* or *moderately well*.

Gender

Table 5.29 presents the percentage of Australian males and females in each category of the Early Literacy Tasks scale, together with the students' average reading achievement. A higher percentage of female students than male students (20% compared to 14%) had parents who reported that their child performed *very well* on early literacy tasks prior to entering primary school. Correspondingly, more male students than female students (43% to 36%) were reported as not performing well on the early literacy tasks. This difference is reflected in a slightly higher average scale score of 9.8 for female students, compared to 9.5 for male students. For both male and female students, those whose parents reported that they performed *very well* on the early literacy tasks had higher reading achievement than those who performed *moderately well* or *not well*. For male students, those who performed early literacy tasks *moderately well*, according to their parents, had higher reading scores on average than those who were reported to have performed *not well*. For female students this difference was not significant.

Table 5.29 The Early Literacy Tasks scale and student achievement in reading, by gender

	Very well				Moderately well				Not well				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	20	1.2	569	5.7	45	1.3	546	4.6	36	1.3	537	4.3	9.8	0.1
Males	14	0.9	574	6.3	44	1.8	542	3.9	43	1.6	518	5.1	9.5	0.1

Early numeracy skills

Parents were also asked how well their children could perform a range of early numeracy tasks before beginning formal education. Parents were asked to indicate whether their child could:

- Count by himself/herself – 'up to 100 or higher', 'up to 20', 'up to 10' or 'not at all'
- Recognise different shapes (e.g. square, triangle, circle) – 'more than 4 shapes', '3–4 shapes', '1–2 shapes' or 'none'
- Recognise the written numbers from 1 to 10 – 'all 10 numbers', '5-9 numbers', '1–4 numbers' or 'none'
- Write the numbers from 1 to 10 – 'all 10 numbers', '5–9 numbers', '1–4 numbers' or 'none'
- Do simple addition – 'yes' or 'no'
- Do simple subtraction – 'yes' or 'no'.

The Early Numeracy Tasks scale was then constructed to summarise parents' responses to these six items, and students assigned to one of three groups based on their parents' scale score.

Students who were able to do early numeracy tasks *very well* had a score of 12.5, which is the point on the scale corresponding to parents reporting that their children could demonstrate all tasks at the highest level (responded in the highest category) and do simple addition and subtraction.

Students who are able to do early numeracy tasks *not well* had a score no higher than 6.4, which is the scale point corresponding to parents reporting that their children could demonstrate all skills at the most basic level (responded in the second lowest category) and could not do simple addition or subtraction, on average.

All other students were assigned to the *moderately well* category.

Table 5.30 shows the percentage of students in each category of the Early Numeracy Tasks scale and the average mathematics achievement of students in each category, both for Australian students and the international average.

Internationally, on average, 25 per cent of students' parents reported that their children could perform early numeracy activities *very well*. Chinese Taipei and Hong Kong had the highest percentage of students whose parents reported that they performed *very well* on early numeracy tasks prior to entry into primary school (64% and 63%, respectively) while Northern Ireland had the lowest (6%).

In Australia, the majority of students (82%) had parents who reported that their child entered primary school being able to perform numeracy tasks *moderately well*. Thirteen per cent were reported as performing *very well* on these tasks (which was significantly lower than the international average) and only five per cent of students had parents who reported that they did not perform well on the numeracy tasks.

Table 5.30 The Early Numeracy Tasks scale and student achievement in mathematics, Australia and the international average

	Very well				Moderately well				Not well				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	13	0.7	565	7.4	82	0.9	530	3.3	5	0.5	473	7.2	9.3	0.0
International Average	25	0.2	524	0.8	71	0.2	492	0.6	4	0.1	451	2.5		

Internationally, and in Australia, students whose parents reported that they performed *very well* on these numeracy tasks had higher mathematics achievement on average than those whose parents who reported that their child performed *moderately well*. Those students whose parents reported

that their child did not perform well on these tasks when they entered school had significantly lower achievement who those who performed *very well* or *moderately well*.

Gender

Table 5.31 presents the percentage of Australian males and females in each category of the Early Numeracy Tasks scale, together with the students' average mathematics achievement. A higher percentage of female students than male students (84% compared to 79%) performed *moderately well* on early numeracy tasks before they entered primary school, according to their parents' reports. For both male and female students, those performed *very well* on the early literacy tasks had higher reading achievement than those who did not perform well. This effect appears to be stronger among male students (with a difference of 104 score points) than among female students (a difference of 76 score points).

Table 5.31 The Early Numeracy Tasks scale and student achievement in mathematics, by gender

	Very well				Moderately well				Not well				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	12	1.0	555	11.6	84	1.2	525	4.0	5	0.7	479	13.2	9.2	0.1
Males	15	1.0	574	8.7	79	1.2	537	3.9	6	0.8	470	10.0	9.3	0.1

Preschool attendance

Attending pre-primary education (preschool, kindergarten or an early childhood education program) helps to prepare children for primary school. Previous cycles of PIRLS have shown a relationship between attending a pre-primary education program and higher reading achievement in Year 4.

Table 5.32 shows the percentage of Year 4 students whose parents reported that their children had attended preschool for three or more years, between one and three years, for less than one year or not at all and the average reading, mathematics and science achievement of students in these groups, both for Australian students and the international average.

Internationally, just over 10 per cent of students did not attend any preschool, while just over 40 per cent attended more than three years of preschool. Across the countries, Hungary had the highest percentage of students attending pre-primary education for three years or more (86%) while the Netherlands and Saudi Arabia had the lowest (both 3%). Canada was similar to Australia (17%) while in New Zealand the percentage is closer to the international average, at 38 per cent.

In Australia, the majority of students (55%) had attended between one and three years of pre-school. Twenty-six per cent had had one year or less and five per cent had never attended pre-school, while around 15 per cent had had three years or more. While the proportion of students who had not attended any preschool was half that of the international average (5% compared to 11%), a greater proportion internationally had attended more than three years of preschool.

Table 5.32 Preschool attendance and student achievement in reading, mathematics and science, Australia and the international average

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
	3 years or more							
Australia	15	1.0	550	5.1	546	8.5	541	6.4
International Average	42	0.2	519	0.7	507	0.9	505	0.9
	Less than 3 years, but more than 1 year							
Australia	55	1.4	547	3.3	535	3.6	534	3.2
International Average	36	0.2	513	0.5	498	0.7	497	0.8
	1 year or less							
Australia	26	1.2	531	3.2	523	3.2	524	4.2
International Average	11	0.1	493	1.1	479	1.4	478	1.4
	Did not attend							
Australia	5	0.5	520	8.0	505	9.0	506	9.0
International Average	11	0.1	475	1.5	457	1.9	454	1.9

Note: The percentage of students presented has been taken from the PIRLS data. Percentages may vary slightly from the TIMSS data because of differences in participating countries and student absenteeism.

Internationally and in Australia, students who had attended at least one year of pre-school had higher achievement than those who attended less than one year of pre-school (for reading achievement) or did not attend at all (for mathematics and science achievement).

Parental influences on learning

Parents are the first influences on children's own attitudes and beliefs about education, which can then influence children's achievement in school. Therefore, the behaviours modelled by parents (such as reading), the attitudes they express (through conversations about schooling) and their educational aspirations for their children could all be expected to influence student achievement.

Parents like reading

Parents' own attitudes towards reading may be an important influence on how their children approach reading and learning to read, for example through modelling of the parents' behaviour and also through the home environment (whether there are many books available for reading). The Parents Like Reading scale summarises parents' responses to how often they read for enjoyment ('every day or almost every day', 'once or twice a week', 'once or twice a month', 'never or almost never') as well as their agreement with the following seven statements:

- I read only if I have to (reverse coded)
- I like talking about what I read with other people
- I like to spend my spare time reading
- I read only if I need information (reverse coded)
- Reading is an important activity in my home
- I would like to have more time for reading
- I enjoy reading.

Parents were asked to indicate whether they 'agreed a lot', 'agreed a little', 'disagreed a little' or 'disagreed a lot' with these statements.

Students whose parents *like* reading had a score of at least 10.9, which is the point on the scale corresponding to parents 'agreeing a lot' with four of the seven statements and 'agreeing a little' with the other three, as well as reading for enjoyment 'every day or almost every day', on average.

Students whose parents *do not like* reading had scores no higher than 7.9, which is the scale point corresponding to parents 'disagreeing a little' with four of the seven statements, 'agreeing a little' with the other three, as well as reading for enjoyment only 'once or twice a month', on average.

All other students were assigned to the parents *somewhat like* reading category.

Table 5.33 shows the percentage of students in each category of the Parents Like Reading scale and the average reading achievement of students in each category, both for Australian students and the international average.

Table 5.33 The Parents Like Reading scale and student achievement in reading, Australia and the international average

	Parents like reading				Parents somewhat like reading				Parents do not like reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	48	1.6	557	3.5	42	1.5	532	3.2	9	0.7	497	5.9	10.7	0.1
International Average	32	0.2	535	0.5	57	0.2	507	0.5	11	0.1	487	0.9		

In Australia, 48 per cent of students had parents who *like* reading, while 42 per cent had parents who *somewhat like* reading. Only nine per cent had parents that *do not like* reading. Australia's average scale score of 10.7 was higher than that of the international average (anchored at 10). The proportion of students with parents who *like* reading in Australia was higher than the international average of 32 per cent and close to those countries with the highest percentages, such as Sweden and New Zealand (52% and 51%, respectively). Hong Kong had the lowest percentage of students whose parents reported liking reading (14%).

In Australia and internationally, students whose parents *like* reading had higher reading achievement than those students whose parents *somewhat like* reading or *do not like* reading.

Gender

Table 5.34 presents the percentage of Australian males and females in each category of the Parents Like Reading scale, together with the average reading achievement for students in each category. Similar proportions of male and female students had parents who *like*, *somewhat like* or *do not like* reading, with around 50 per cent having parents that *like* reading. For both male and female students, those whose parents *like* reading had higher reading achievement on average than those whose parents reported not liking reading.

Table 5.34 The Parents Like Reading scale and student achievement in reading, by gender

	Parents like reading				Parents somewhat like reading				Parents do not like reading				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Females	45	1.7	566	4.8	46	1.7	535	4.3	9	0.9	503	9.4	10.7	0.1
Males	51	2.5	549	5.1	39	2.1	529	4.5	10	1.0	492	9.2	10.8	0.1

Conversations about school

Another way in which parents can influence student attitudes about school is by their level of interest and participation in their child's schooling. Therefore, the Student and Home questionnaires asked about conversations that parents held with their child about school. Students and parents were asked about the frequency ('every day', 'once or twice a week', 'once or twice a month' or 'never') with which:

- Parents asked about what their child learned at school
- Parent and child discuss schoolwork
- Parents ensure that their child sets aside time for homework
- Parents check that their child has done their homework.

Table 5.35 presents the percentages of Australian students and parents who indicated that these conversations took place *every day*, *once or twice a week*, *once to twice a month* or *never*. Table 5.35 shows parents were more likely to report having these conversations at least *once or twice a month*. Homework discussions were reported as occurring *every day* by around two-thirds of both students and parents. However, while 64 per cent of parents reported discussing schoolwork *every day*, only 38 per cent of students reported having these discussions *every day*.

Table 5.35 Student and parent reports of conversations about school

	Every day		Once or twice a week		Once or twice a month		Never	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Student								
Parents ask what was learned at school	59	1.2	27	1.0	7	0.5	6	0.5
Parent and child discuss schoolwork	38	1.4	37	1.1	12	1.1	12	0.9
Parents make sure child sets aside time for homework	67	1.4	20	0.9	5	0.6	9	0.7
Parent checks child has done homework	67	1.3	23	1.1	4	0.6	7	0.6
Parent								
Parents ask what was learned at school	68	1.2	27	1.1	4	0.4	1	0.3
Parent and child discuss schoolwork	64	1.3	32	1.2	2	0.3	1	0.2
Parents make sure child sets aside time for homework	65	1.3	29	1.2	3	0.3	4	0.5
Parent checks child has done homework	61	1.2	33	1.1	3	0.4	3	0.5

Parental expectations for education

Parents' aspirations for their children can also have an influence on their children's academic achievement. Researchers (e.g. Hong & Ho, 2005) have found that parents' aspirations for their children's education strongly predict the student's own educational aspirations, which, in turn, strongly predict student achievement. Therefore, the TIMSS and PIRLS Home questionnaire asked about the highest level of education that parents expected their child to achieve.

Table 5.36 shows the percentage of students according to the level of education their parents expect their child to complete and the average reading, mathematics and science achievement

of students according to expected level of education, both for Australian students and the international average.

In Australia, 42 per cent of students had parents who expected their child to complete a university degree, while an additional 18 per cent expect their child to complete a post-graduate degree. Twenty-five per cent of students had parents who expected them to complete a post-secondary qualification like a TAFE certificate or diploma, while 15 per cent expected their child to go no further than upper-secondary schooling.

Across the countries there was considerable variation in parental expectations. On average, internationally, 65 per cent of students had parents who expected them to complete a university undergraduate or post-graduate degree. The United Arab Emirates and Qatar had the highest percentage of students with parents who expected them to complete a university undergraduate or postgraduate degree (90% and 91%, respectively) while Germany and the Netherlands had the lowest (29% and 35%, respectively). New Zealand had a similar proportion of students with parents expecting their children to attend university to Australia (67%), although the proportion of students with parents who expected their child to complete a postgraduate degree was higher (26%).

Table 5.36 Parental expectations for education and student achievement in reading, mathematics and science, Australia and the international average

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
	Postgraduate degree							
Australia	18	1.1	572	5.1	564	7.4	555	6.7
International Average	31	0.2	541	0.6	528	0.8	524	0.8
	University but not postgraduate degree							
Australia	42	1.5	567	3.3	556	3.8	554	3.0
International Average	34	0.2	522	0.5	509	0.7	505	0.7
	Postsecondary but not university							
Australia	25	1.2	511	4.3	502	4.0	505	4.3
International Average	16	0.1	493	0.8	482	1.0	479	1.1
	Upper secondary education or less							
Australia	15	0.9	491	4.9	485	5.9	487	6.0
International Average	19	0.2	461	0.9	449	1.2	443	1.3

Note: The percentage of students presented has been taken from the PIRLS data. Percentages may vary slightly from the TIMSS data because of differences in participating countries and student absenteeism.

In Australia, and on average across participating countries, having a parent with expectations that their child would complete a university degree was associated with higher achievement. Students whose parents expected them to complete either an undergraduate or a postgraduate degree scored higher on average in reading, mathematics and science than students whose parents expected them to complete non-university qualifications, or no post-secondary qualifications at all.

Gender

Table 5.37 shows the percentage of male and female students according to the level of education their parents expected their child to complete. As can be seen from these results, a greater proportion of Year 4 male students in Australia had parents who expected them to complete post-secondary education but not university (such as a TAFE diploma or certificate)

compared to their female peers. Correspondingly, a greater proportion of Year 4 female students had parents who expected them to complete a university degree. There were no significant differences in the proportions of male and female students whose parents expected them to complete other qualifications.

Table 5.37 Parental expectations for education, by gender

	Females		Males	
	% of students	SE of %	% of students	SE of %
Postgraduate degree	18	1.4	18	1.6
University but not postgraduate degree	45	1.6	39	2.2
Postsecondary but not university	23	1.5	28	1.7
Upper secondary education or less	15	1.2	15	1.4

The next chapter focuses on the teachers and schools of the TIMSS and PIRLS 2011 students.

Chapter

6 Teachers and Schools

Key findings:

- The majority of Year 4 students in Australia were taught by female teachers, and teachers aged between 30 and 50.
- The proportion of Year 4 students in Australia who had teachers with post-graduate qualifications is far greater than the average across countries participating in TIMSS and PIRLS.
- Having a teacher with a specialisation in language or reading theory or primary education (with or without a specialisation in science) was associated with better performance in reading and science (respectively) for Australian students. There was no similar relationship found between the qualification of mathematics teachers and students' performance in the TIMSS mathematics assessment.
- Year 4 students whose teachers were satisfied with their careers performed better in reading, mathematics and science than students whose teachers were not as satisfied.
- Far greater proportions of Australian Year 4 students had access to computers to use in their reading, mathematics and science classes than was the case internationally, but this had no impact on their performance in these subjects.
- Only three-quarters of Australian Year 4 students were being taught mathematics by teachers who were *very confident* of teaching mathematics, however only 43 per cent of students were being taught science by teachers who expressed that they were *very confident* teaching science. As well, just 51 per cent of students had teachers who classed themselves as *very well prepared* to teach science, and this declined to under 50 per cent in the areas of physical science and Earth science.
- The economic makeup of schools had an impact on the performance of students, with students in schools with more affluent than disadvantaged students scoring higher in reading, mathematics and science than students in schools with more disadvantaged than affluent students.
- The proportion of a school's student population who spoke English as their first language did not appear to have an influence on average student achievement in reading, mathematics or science.
- Resource shortages in the areas of reading, mathematics and science were quite rare among Australian schools, but did show a relationship with student performance – students in schools that were not affected by resource shortages in reading, mathematics or science had achievement scores that were higher on average than students in schools that were somewhat affected by such shortages.

This chapter examines the context for Year 4 students' learning in Australia – the schools that they attended and the teachers who were teaching them at the time of the testing. The chapter presents

teachers' reports about their background characteristics, education and training in teaching reading, mathematics and science, and about how well-prepared they feel to teach these subjects.

The chapter draws on data collected for TIMSS and PIRLS 2011 through background questionnaires: one completed by teachers and one by the principals of the schools. The unit for sampling of students within schools was their Year 4 class (their homeroom or main class), and the teachers responsible for teaching these students reading, mathematics and science were asked to complete a questionnaire. In many cases, the same teachers were responsible for teaching all three subjects, and so only one teacher questionnaire per sampled class was required. Where the classes had different reading, mathematics and science teachers, questionnaires were sought from each teacher who taught the TIMSS and PIRLS class these subjects. The teachers' responses to the questionnaire were not necessarily representative of all Year 4 teachers, as TIMSS and PIRLS are essentially student assessments and surveys, not surveys of teachers. The teachers surveyed were simply the teachers of a representative sample of students assessed as part of TIMSS and PIRLS 2011. The school questionnaires, however, should be representative of Australian schools as a whole due to the sampling procedures followed (see Chapter 1). In Australia, responses were obtained from over 70 per cent of teachers of the Year 4 students and 95 per cent of the principals of the Year 4 students.

It is important to note that the data shown are the percentages of students whose teachers or principals reported on various characteristics; that is, the student is the unit of analysis so that it is possible to describe the classroom contexts of the students.

Teachers

This section presents information about the background characteristics of Year 4 reading, mathematics and science teachers, including their age, gender, qualifications and years of experience.

Age and gender

Across Australia, 21 per cent of Year 4 students were taught reading, mathematics or science by teachers between the ages of 30 and 39 years, while 23 per cent were taught these subjects by teachers aged 40 to 49 (see Table 6.1).

The proportions in this table suggest that the majority of Year 4 students are being taught reading, mathematics and science by teachers in their thirties to fifties, with very few being taught by younger (and presumably less experienced) teachers. While this indicates that Year 4 students may well be benefiting from having more experienced teachers, it does raise questions about the replenishment of the teaching force.

There was some variation across the states and territories in terms of the ages of the teaching force – for example, no students in Tasmania were being taught reading, mathematics or science by a teacher under the age of 25, whereas more than one in ten students in the Australian Capital Territory and New South Wales had teachers in this age group.

Table 6.1 Age of teachers of Year 4 students in Australia, by state

	UNDER 25		25–29		30–39		40–49		50–59		60 OR MORE	
	% of students with teachers this age	SE of %	% of students with teachers this age	SE of %	% of students with teachers this age	SE of %	% of students with teachers this age	SE of %	% of students with teachers this age	SE of %	% of students with teachers this age	SE of %
Reading												
ACT	14	7.2	6	5.9	42	8.0	14	6.9	17	7.7	7	1.9
NSW	14	6.2	6	3.4	21	7.1	18	7.0	40	6.2	2	2.1
VIC	6	3.2	17	5.5	9	4.2	26	7.6	34	8.6	8	4.9
QLD	2	2.5	10	5.2	26	8.1	26	8.5	35	9.4	0	0.1
SA	2	2.0	11	3.2	30	8.6	14	6.3	38	6.9	4	3.2
WA	3	2.5	13	6.1	29	9.4	36	7.6	13	6.0	6	3.2
TAS	-	-	4	2.7	15	7.6	30	10.6	37	9.2	15	7.4
NT	5	4.7	10	5.9	14	7.1	46	10.0	22	5.6	3	2.6
AUS	7	2.3	11	2.3	21	3.6	23	3.6	34	3.7	4	1.5
Mathematics												
ACT	14	7.2	14	7.6	35	5.7	16	7.3	17	7.4	3	2.0
NSW	11	5.5	9	4.0	23	7.0	16	6.3	38	6.6	2	2.2
VIC	5	3.0	17	6.1	9	4.2	27	7.9	33	8.6	8	5.0
QLD	2	2.4	10	5.0	26	8.0	25	8.1	37	9.2	0	0.1
SA	2	1.9	11	3.2	30	8.5	14	6.3	38	6.8	4	3.2
WA	3	2.4	14	6.1	29	9.6	38	7.8	13	5.8	3	2.5
TAS	-	-	4	2.8	15	7.6	30	10.6	36	9.3	15	7.4
NT	5	4.6	10	5.9	20	10.4	40	11.0	22	5.5	3	2.6
AUS	6	2.0	12	2.4	21	3.6	23	3.7	34	3.6	4	1.5
Science												
ACT	14	7.2	6	5.9	43	8.0	14	6.8	17	7.6	5	0.4
NSW	11	5.7	6	3.5	20	7.1	19	7.5	42	6.8	2	2.2
VIC	5	3.0	17	5.5	10	5.0	25	7.8	34	8.6	8	5.0
QLD	2	2.5	10	5.2	29	7.8	26	8.5	32	9.2	0	0.1
SA	2	2.1	12	3.4	30	8.5	11	4.9	41	7.6	5	3.4
WA	3	2.4	13	6.0	32	8.5	33	7.8	13	5.9	5	3.2
TAS	-	-	4	2.8	15	7.6	30	10.6	36	9.3	15	7.4
NT	5	4.6	10	5.9	13	7.1	47	10.0	22	5.5	3	2.6
AUS	6	2.1	11	2.3	21	3.7	23	3.7	34	3.9	4	1.5

Table 6.2 shows the proportion of Year 4 students taught reading, mathematics and science by female or male teachers. On average across Australia, the distribution of male and female teachers in these subjects remains similar to that reported in previous cycles of TIMSS – the vast majority of Year 4 students are taught by female teachers – 77 per cent in reading, 78 per cent in mathematics and 80 per cent in science.

There was some variation across the states and territories however, with over 90 per cent of students in Victoria, Tasmania and the Northern Territory being taught by a female teacher, compared to between 60 and 70 per cent of students in New South Wales, for example.

Table 6.2 Gender of teachers of Year 4 students in Australia, by state

	Students taught reading by a female teacher		Students taught reading by a male teacher		Students taught mathematics by a female teacher		Students taught mathematics by a male teacher		Students taught science by a female teacher		Students taught science by a male teacher	
	%	SE of %	%	SE of %	%	SE of %	%	SE of %	%	SE of %	%	SE of %
ACT	79	7.9	21	7.9	80	7.8	20	7.8	81	7.8	19	7.8
NSW	64	8.0	36	8.0	66	7.6	34	7.6	70	7.3	30	7.3
VIC	95	2.3	5	2.3	93	3.3	7	3.3	95	3.1	5	3.1
QLD	73	7.9	27	7.9	74	7.8	26	7.8	73	7.9	27	7.9
SA	79	7.9	21	7.9	80	7.7	20	7.7	85	6.3	15	6.3
WA	78	7.9	22	7.9	78	7.9	22	7.9	80	7.9	20	7.9
TAS	92	4.9	8	4.9	92	5.0	8	5.0	92	5.0	8	5.0
NT	95	4.6	5	4.6	95	4.6	5	4.6	95	4.6	5	4.6
AUS	77	3.4	23	3.4	78	3.3	22	3.3	80	3.2	20	3.2

Qualifications

The general qualifications of the Year 4 reading, mathematics and science teachers in Australia, and across countries participating in TIMSS and PIRLS at Year 4, are presented in Table 6.3.

Table 6.3 Teachers' formal education, Australia and the international average

	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 %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Reading teachers								
Australia	64	3.3	29	3.1	5	1.8	1	1.1
International average	26	0.3	53	0.4	15	0.3	6	0.2
Mathematics teachers								
Australia	65	3.2	29	3.1	5	1.7	1	0.8
International average	22	0.3	57	0.4	15	0.3	6	0.2
Science teachers								
Australia	65	3.3	27	2.9	7	2.2	1	1.1
International average	23	0.3	57	0.4	15	0.3	6	0.2

Over 60 per cent of Year 4 students in Australia were being taught by a teacher with a postgraduate qualification. This proportion compares very favourably with the international average of around one-quarter of students across participating countries having teachers with postgraduate qualifications.

Reading

Table 6.4 presents more details about the qualifications of reading teachers, regarding the areas of study they followed in their teaching preparation.

Table 6.4 Year 4 teachers' reading qualifications and student achievement in reading, Australia and the international average

	Language						Pedagogy/Teaching Reading						Reading Theory					
	Area emphasised		Area emphasised		Area not emphasised		Area emphasised		Area emphasised		Area not emphasised		Area emphasised		Area emphasised		Area not emphasised	
	% of students	SE of %	Average reading achievement	SE	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	Average reading achievement	SE
Australia	75	3.4	537	3.7	515	4.4	62	4.1	534	4.5	527	4.8	28	4.2	539	5.6	528	3.6
International average	72	0.5	513	0.5	510	1.3	62	0.5	513	0.6	511	1.0	33	0.5	514	0.8	512	0.6

Over 60 per cent of Australian Year 4 students were taught reading by a teacher whose emphasis was on Pedagogy or Teaching Reading in their studies, while 75 per cent were taught by teachers who had focused on Language (presumably there was overlap between these two groups). These proportions were quite similar to the international average.

In terms of Australian students' performance in the PIRLS reading assessment, those with teachers whose emphasis was on Language or Reading Theory in their studies tended to score higher than students whose teachers had not emphasised these areas in their teacher preparation.

Mathematics

The specialised qualifications of the Year 4 mathematics teachers, in terms of their relevant majors, along with the average mathematics scores of their students, are presented in Table 6.5.

Table 6.5 Year 4 teachers' mathematics qualifications and student achievement in mathematics, Australia and the international average

	Major in primary education and major (or specialisation) in mathematics				Major in primary education but no major (or specialisation) in mathematics				Major in mathematics but no major in primary education				All other majors			
	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE
Australia	14	2.8	517	13.2	81	3.2	521	3.8	1	0.8	~	~	4	1.1	463	8.6
International average	28	0.5	490	1.4	46	0.4	501	0	10	0.3	457	3.1	10	0.3	486	2.0

Just 80 per cent of the Australian students who participated in TIMSS and PIRLS were being taught mathematics by teachers who had majored in primary education but had no specialisation (or second major) in mathematics.

While internationally students whose teachers had a major in primary education (with or without a specialisation or major in mathematics) performed better on average than students whose teachers had other qualifications, this was not the case for Australian students. There was no association between the major or specialisation of Australian primary mathematics teachers and the performance of their students in the TIMSS mathematics assessment (bearing in mind that responses were only available from around 70% of teachers).

Science

The major areas of study of Year 4 science teachers in Australia, and on average across participating countries, are presented in Table 6.6, alongside the average science scores of their students.

Table 6.6 Year 4 teachers' science qualifications and student achievement in science, Australia and the international average

	Major in primary education and major (or specialisation) in science				Major in primary education but no major (or specialisation) in science				Major in science but no major in primary education				All other majors			
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE
Australia	9	2.4	515	9.2	84	2.8	520	3.8	2	1.1	~	~	4	1.2	479	11.3
International Average	25	0.4	482	1.5	48	0.4	489	1.3	12	0.3	462	2.4	10	0.3	479	1.9

The vast majority of Australian Year 4 students (84%) were being taught science by teachers who had no specialisation or major in science but who held qualifications in primary education. Around one in every ten students had a teacher with a major or specialisation in science (with or without a primary education major).

Both internationally (on average) and among Australian students, those who had teachers with primary education qualifications (with or without specialisation in science) tended to perform better in the science assessments than those without primary education qualifications.

Years of experience

The number of years of teaching experience teachers have is, for the most part, related to their age. Given the average age of Year 4 teachers in Australia (reported in a previous section), we might expect to find that the Year 4 teaching force has quite a deal of experience. The level of experience of teachers of Year 4 reading, mathematics and science is presented in the following tables.

Reading

Around two in every three Australian students were being taught reading by teachers who had at least 10 years teaching experience (the Australian average was 17 years, see Table 6.7). This was quite similar to the international average – just over 70% of students had teachers with ten or more years' experience, with an average of 17 years.

Table 6.7 Year 4 reading teachers' years of experience and student achievement in reading, Australia and the international average

	20 years or more				10 to 20 years				5 to 10 years				Less than 5 years				Average years of experience	SE
	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE		
Australia	42	4.0	530	5.1	22	3.5	533	5.7	19	2.9	529	6.3	17	3.2	534	7.2	17	1.0
International average	41	0.5	517	0.8	31	0.5	511	0.9	16	0.4	510	1.4	12	0.3	507	1.7	17	0.1

Among Australian Year 4 students, there was no significant association between the years of experience and the reading performance of their students, while internationally (on average), students with teachers with 20 or more years experiences tended to outperform other students.

Mathematics

Around two in every three Australian students were being taught mathematics by teachers with at least 10 years teaching experience (the Australian average was 17 years). These percentages were similar to the international average (just over 70% of students had teachers with ten or more years experience, with an average of 17 years).

Table 6.8 Year 4 mathematics teachers' years of experience and student achievement in mathematics, Australia and the international average

	20 years or more				10 to 20 years				5 to 10 years				Less than 5 years				Average years of experience	SE
	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE		
Australia	41	3.8	517	6.0	23	3.4	524	6.6	19	2.8	510	10.0	17	3.1	524	9.4	17	0.9
International average	41	0.5	498	0.9	30	0.5	490	1.0	16	0.4	486	1.6	13	0.3	486	2.0	17	0.1

As was found for reading, there was no significant association between the years of teaching experience and the mathematics performance of Australian Year 4 students, while internationally (on average), students with teachers with 20 or more years experience scored higher on average than other students in the mathematics assessment.

Science

Two-thirds of Australian Year 4 students were being taught Science by a teacher with at least 10 years teaching experience, with an average of 17 years of experience.

Again, this was similar to the results on average internationally, as well as the results for teachers of reading and mathematics in Australia (in Australian primary schools, many students are taught these three subjects by the same teacher).

Table 6.9 Year 4 science teachers' years of experience and student achievement in science, Australia and the international average

	20 years or more				10 to 20 years				5 to 10 years				Less than 5 years				Average years of experience	SE
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE		
Australia	41	4.1	519	5.5	24	3.7	524	6.3	19	2.8	510	10.5	16	3.1	518	8.3	17	0.9
International average	40	0.5	494	1.1	30	0.5	485	1.1	16	0.4	483	1.6	14	0.4	482	1.8	17	0.1

Again, there were no significant differences in Australian student performance in the science assessment that were associated with the years of experience of their teachers. Internationally, however, students with teachers with the greatest amount of experience (20 years or more) tended to outperform students with teachers with fewer years of teaching experience.

Professional development

Beyond their initial qualifications, many education systems (Australia's included) require registered teachers to participate in ongoing professional development, to ensure that students receive up-to-date instruction methods and information.

Tables 6.10 through 6.12 present the proportions of Year 4 students whose teachers reported participating in various forms of professional development in the past two years.

Reading

More than half of the Australian Year 4 students were taught by teachers who had spent some time in professional development focussed on reading in the past two years (57%), while a further 30 per cent had teachers who had spent a substantial period of time (16 or more hours) in such professional development. There were, however, no significant reading performance differences between Year 4 students based on the hours of professional development their teachers had undertaken.

Table 6.10 Participation in professional development in reading in the past two years and student achievement in reading, Australia and the international average

	16 hours or more				Some time (but less than 16 hours)				No time				% of students whose teachers read children's books at least once a month for professional development	SE of %
	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE		
Australia	30	4.0	525	5.1	57	3.8	532	4.7	13	3.2	546	10.9	72	3.7
International average	24	0.5	512	1.1	50	0.5	513	0.7	25	0.5	513	1.1	73	0.5

Mathematics

Greater proportions of Australian Year 4 students, compared to the international average, had teachers who participated in each of the five areas of professional development in mathematics teaching that were examined (Table 6.11).

Within Australia, greater proportions of students had teachers who participated in professional development focused on mathematics content, pedagogy/instruction or curriculum issues than in mathematics assessment.

Table 6.11 Participation in professional development in mathematics in the past two years, Australia and the international average

	Teacher's area of professional development									
	Mathematics content		Mathematics pedagogy/ instruction		Mathematics curriculum		Integrating Information Technology into mathematics		Mathematics assessment	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	66	3.7	65	4.0	62	3.7	51	4.3	49	3.6
International average	44	0.5	46	0.5	41	0.5	33	0.5	37	0.5

Science

Fewer Australian Year 4 students were being taught by teachers who had participated in science-related professional development in the past two years (around 30%), compared to professional development in reading (over 80%) or mathematics (almost 60%). Science-related professional development was more likely to focus on science curriculum than on integrating Information Technology into science instruction or on assessment of science.

Table 6.12 Participation in professional development in science in the past two years, Australia and the international average

	Teacher's area of professional development									
	Science content		Science pedagogy/ instruction		Science curriculum		Integrating Information Technology in science		Science assessment	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	32	3.2	33	3.2	38	3.8	26	2.9	26	2.8
International average	35	0.5	34	0.5	34	0.5	28	0.5	27	0.4

General Teaching Scales

The reading, mathematics and science teachers of the Year 4 TIMSS and PIRLS participants were required to complete a questionnaire that contained questions about their instructional attitudes and practices, as well as the background information presented in the sections above. Some of these items contributed to scales about teaching in general, while others focused more on particular subjects (reading, mathematics or science).

Teachers collaborate to improve instruction

Teachers were asked how often ('daily or almost daily', 'one to three times per week', 'two or three times per month' or 'never or almost never') they had the following types of interactions with fellow teachers:

- Discuss how to teach a particular topic
- Collaborate in planning and preparing instructional materials
- Share what I have learned about my teaching experiences
- Visit another classroom to learn more about teaching
- Work together to try out new ideas.

Their responses to these items were combined to create the Teachers Collaborate to Improve Instruction scale, a measure of the extent of collaboration teachers experienced at their school. Students were then assigned to one of three groups based on their teacher's scale score.

Students assigned to the *very collaborative* category had teachers with a score of at least 11.0 which corresponds to having interactions with other teachers 'one to three times per week' in each of three of the five areas above and 'two or three times per month' in the other two areas, on average.

Students assigned to the category *somewhat collaborative* category had teachers with a score no higher than 7.3 (7.2 in reading) which is the scale point corresponding to their teachers having interactions 'never or almost never' in three of the five areas and 'two or three times per month' in the other two, on average.

All other students were assigned to the *collaborative* category.

Table 6.13 presents the proportions of students in each of these three categories, along with their average performance in the reading, mathematics and science assessments.

Table 6.13 The Collaborate to Improve Teaching scale and student achievement in reading, mathematics and science, Australia and the international average

	Very collaborative				Collaborative				Somewhat collaborative				Average Scale Score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Reading														
Australia	44	3.7	532	4.5	44	3.9	532	4.6	12	2.6	526	7.4	10.3	0.2
International average	35	0.5	513	0.8	54	0.5	512	0.6	11	0.3	510	1.9		
Mathematics														
Australia	43	3.7	525	5.8	44	3.9	517	5.7	12	2.6	509	8.0	10.3	0.2
International average	36	0.5	493	0.9	53	0.5	491	0.7	11	0.3	488	2.0		
Science														
Australia	43	3.4	520	5.4	44	3.9	520	5.4	13	2.8	515	8.5	10.3	0.2
International average	35	0.5	487	1.0	53	0.5	487	0.7	12	0.3	479	2.1		

In Australia, just over 40 per cent of Year 4 students were being taught by teachers who were *very collaborative* according to their responses, compared to about 35 per cent of students internationally. A further 44 per cent of Australian students were being taught by teachers who were classified as *collaborative* (about 53% internationally) and around 12 per cent had teachers who were *somewhat collaborative* (about 11%, internationally).

Students with more collaborative teachers did not perform significantly differently to students with less collaborative teachers in any of the subject areas, either within Australia or on average internationally.

Instruction to engage students in learning

Another measure of the quality of teaching the TIMSS and PIRLS students were exposed to focused on the extent to which teachers made an effort to engage students in the classroom. Teachers were asked to indicate how regularly ('every or almost every lesson', 'about half the lessons', 'some lessons' or 'never') they did the following while teaching the TIMSS and PIRLS class(es):

- Summarise what students should have learned from the lesson

- Relate the lesson to students' daily lives
- Use questioning to elicit reasons and explanations
- Encourage all students to improve their performance
- Praise students for good effort
- Bring interesting materials to class.

The scale was then composed of the responses to these items, and students classified into three groups based on the scale score of their teachers.

Students whose teachers made efforts to engage them *most lessons* had a score of at least 9.1, which is the point on the scale corresponding to teachers reporting that they did three of the six activities 'every or almost every lesson' and the other three activities in 'about half the lessons', on average.

Students whose teachers made efforts to engage them in *some lessons* had a score no higher than 6.0 (5.9 in reading), which is the scale point corresponding to teachers reporting that they used three of the six practices in 'some' lessons and the other three in 'about half the lessons', on average.

All other students had teachers who used engagement practices in a*bout half the lessons*.

Table 6.14 The Engaging Students in Learning scale and student achievement in reading, mathematics and science, Australia and the international average

	Most lessons				About half the lessons				Some lessons				Average Scale Score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Reading														
Australia	77	3.3	534	3.2	22	3.3	523	4.7	0	0.2	~	~	10	0.1
International average	71	0.5	513	0.5	27	0.5	509	1.1	2	0.1	~	~		
Mathematics														
Australia	77	3.5	522	4.0	23	3.5	510	6.1	0	0.2	~	~	10	0.1
International average	69	0.5	492	0.6	30	0.5	488	1.0	2	0.1	~	~		
Science														
Australia	78	3.4	522	3.6	22	3.4	511	7.3	0	0.2	~	~	10.1	0.1
International average	71	0.5	487	0.6	27	0.4	484	1.2	2	0.1	~	~		

Over three-quarters of Australian Year 4 students had teachers for reading, mathematics or science who, according to the teachers' responses to the set of items above, made an effort to engage their interest during *most lessons*. Very few students were in classes in which teachers made efforts to engage them in only *some lessons.* These results were similar to the international average.

Australian students in reading classes in which the teacher made an effort to engage students most of the time performed better in the reading assessment (with an average score of 534) than students in classes in which efforts to engage students happened about half of the time (523). In mathematics and sciences classes, however, there were no significant differences in the average assessment scores of Australian students whose teachers engaged them in *most lessons* or *about half of the lessons*.

Teacher Career 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 their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') to the following six statements:

- I am content with my profession as a teacher
- I am satisfied with being a teacher at this school
- I had more enthusiasm when I began teaching than I have now (reverse coded)
- I do important work as a teacher
- I plan to continue as a teacher for as long as I can
- I am frustrated as a teacher (reverse coded).

Their responses were combined to create the Teacher Career Satisfaction scale.

Students whose teachers were *satisfied* had a score of at least 10.1 (10.0 in reading), which is the point on the scale corresponding to their teachers 'agreeing a lot' with three of the six statements and 'agreeing a little' to the other three, on average.

Students whose teachers were *less than satisfied* had a score no higher than 6.6 (6.5 in reading), corresponding to teachers 'disagreeing a little' with three of the six statements and 'agreeing a little' with the other three, on average.

All other students had *somewhat satisfied* teachers.

Table 6.15 The Teacher Career Satisfaction scale, reported by teachers, and student achievement in reading, mathematics and science, Australia and the international average

	Satisfied				Somewhat Satisfied				Less than Satisfied				Average Scale Score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Reading														
Australia	53	3.9	536	3.3	41	3.8	528	4.8	6	1.5	512	9.4	9.9	0.2
International average	54	0.5	516	0.6	40	0.5	509	0.8	5	0.2	511	1.9		
Mathematics														
Australia	56	4	528	4.4	37	3.8	509	5.4	7	1.7	505	13.8	10.0	0.2
International average	54	0.5	494	0.7	41	0.5	487	0.8	5	0.2	486	2.1		
Science														
Australia	53	3.8	526	4.1	41	3.7	512	5.4	6	1.7	505	10.3	10.0	0.2
International average	54	0.5	490	0.7	41	0.5	483	0.9	5	0.2	483	2.1		

Internationally, on average, and within Australia, over 50 per cent of the Year 4 students had teachers who were *satisfied* with their careers, with about 40 per cent being *somewhat satisfied*. The average scale score for teachers of reading, mathematics and science in Australia was around 10, which was the centrepoint for the scale (and thus the international average).

Year 4 students whose reading teachers were *satisfied* outperformed students whose teachers were *less than satisfied* in reading, mathematics and science, while students with *satisfied* mathematics and science teachers outperformed students with *somewhat satisfied* teachers in these areas.

Teaching Reading

Time spent

According to the reports of Australian principals, over 1000 hours (1008) is spent on instruction during Year 4. Teachers reported spending over 350 hours on language instruction, over 100 on reading as part of language instruction and almost 200 on reading across the curriculum, including time spent on reading instruction.

Computer activities in reading

A far greater proportion of Australian Year 4 students, compared to the international average, had computers available for use during reading lessons (according to their teachers). Australian students were more likely to use the computers to look up information than to use instructional software focussing on developing reading skills and strategies. There were no significant differences in the reading performance of students who did have access to computers during their reading lessons and those who did not.

Table 6.16 Computer activities during reading lessons and student achievement in reading, Australia and the international average

	Computers available for reading lessons						Students whose teachers have them use computers at least monthly							
	Yes		Yes		No		To look up information		To read stories or other texts		To write stories or other texts		To develop reading skills and strategies with instructional software	
	% of students	SE of %	Average reading achievement	SE	Average reading achievement	SE	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	82	2.9	533	3.3	525	6.4	76	3.2	68	3.4	74	3.2	58	3.5
International average	45	0.5	513	0.9	513	0.6	38	0.5	32	0.5	32	0.5	29	0.5

Resources used

Internationally, the most commonly used reading resource was textbooks, used by almost three-quarters of teachers as the basis for their instruction. Among Australian teachers, however, this resource was rarely used as the basis for instruction, with only 14 per cent of teachers reporting their use. Instead, the resource most commonly used by Australian reading teachers were children's books (61%) and reading series (51%), with 80% of teachers using workbooks or worksheets as a supplement to their instruction.

Table 6.17 Resources used during reading lessons, Australia and the international average

	Students whose teachers use:																	
	a variety of children's books				textbooks				reading series				workbooks or worksheets				computer software for reading instruction			
	as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	61	4.0	39	4.1	14	2.7	48	3.6	51	4.2	41	4.2	16	2.6	80	3.1	18	3.2	66	4.2
International average	27	0.4	69	0.5	72	0.4	23	0.4	27	0.4	59	0.5	40	0.5	56	0.5	8	0.3	48	0.5

Teaching Mathematics

Time spent

Australian principals reported that over 1000 hours (1008) were devoted to teaching during Year 4, with teachers reporting spending around 230 hours teaching their students mathematics.

On average internationally, close to 900 hours of instruction were reported by principals (892), with teachers spending, on average, less than 200 hours (161) teaching mathematics to their students.

Activities done

The majority of Year 4 students, both internationally on average and within Australia, are required to explain their mathematics answers in almost every mathematics lesson. The next most common activity of those listed was working on problems, either as individuals or with classmates, with guidance from their teachers. Compared to the international average, fewer Australian students were working on problems (either on their own or in groups) with teacher guidance or spending time memorising rules, procedures or mathematical facts.

Table 6.18 Activities during mathematics lessons, Australia and the international average

	Students doing the following activities every or almost every lesson									
	work on problems (individually or with peers) with teacher guidance		work on problems together in whole class with direct teacher guidance		work on problems (individually or with peers) while teacher doing other tasks		memorising rules, procedures and facts		explain their answers	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	46	4.0	40	3.8	22	3.7	13	2.3	61	4.4
International average	55	0.5	45	0.5	16	0.4	37	0.5	62	0.5

Computer activities in mathematics

Australia was third amongst participating countries in terms of the percentage of Year 4 students who had access to computers during their mathematics lessons, with almost 8 in every 10 students having computers available to them. There were, however, no significant differences in the mathematics performance of students who did or did not have computers for use during their mathematics classes. The most common activity of those students who did use computers during mathematics was to practise skills and procedures, with 70 per cent of students being required to do this at least monthly by their mathematic teachers, compared to just over 30 per cent of students doing this on average internationally.

Table 6.19 Computer activities during mathematics lessons and student achievement in mathematics, Australia and the international average

	Computers available for mathematics lessons						Students whose teachers have them use computers at least monthly					
	Yes		Yes		No		To explore mathematics principles and concepts		To look up ideas and information		To practise skills and procedures	
	% of students	SE of %	Average maths achievement	SE	Average maths achievement	SE	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	79	2.8	521	4.1	517	7.3	60	3.3	56	3.5	70	3.3
International average	42	0.5	491	1.1	490	0.7	27	0.4	26	0.5	34	0.5

Resources used

Over half of the Australian Year 4 students had teachers who reported using concrete objects or materials to demonstrate or help students to understand mathematical procedures as the basis for their instruction, which was higher than the international average. Far fewer Australian Year 4 students were being taught mathematics using textbooks or workbooks or worksheets as the basis for instruction, compared to the international average, although these resources were used as supplements for instruction.

Table 6.20 Resources used during mathematics lessons, Australia and the international average

	Students whose teachers use:															
	Textbooks				Workbooks or worksheets				Concrete objects or materials that help students to understand quantities or procedures				Computer software for mathematics instruction			
	as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	25	3.5	46	3.8	11	1.9	87	2.2	56	4.0	44	4.0	12	2.4	77	3.3
International average	75	0.4	21	0.4	46	0.5	53	0.5	37	0.5	62	0.5	9	0.3	56	0.5

Teachers' confidence teaching mathematics

This scale summarises mathematics teachers' responses to the statements below about their levels of confidence in five aspects of teaching their mathematics classes:

- Answer students' questions about mathematics
- Show students a variety of problem solving strategies
- Provide challenging tasks for capable students
- Adapt my teaching to engage students' interest
- Help students appreciate the value of learning mathematics.

Teachers were asked to indicate whether they felt 'very confident', 'somewhat confident' or 'not confident' with each of these aspects and their responses were combined to create the Teachers'

Confidence Teaching Mathematics scale. Students were then assigned to one of three groups based on the scale score of their mathematics teachers.

Students assigned to the *very confident* category had teachers with a score of at least 9.2, which is the point on the scale corresponding to their teachers reporting that they are 'very confident' using three of the five strategies and 'somewhat confident' using the other two, on average.

All other students had *somewhat confident* teachers.

Table 6.21 presents the proportions of students in each of these two categories, along with their average mathematics achievement score.

Table 6.21 The Teachers' Confidence Teaching Mathematics scale and student achievement in mathematics, Australia and the international average

	Very confident				Somewhat confident				Average Scale score	SE
	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE		
Australia	76	3.0	524	4.0	24	3	509	6.0	10.2	0.1
International average	75	0.4	492	0.6	25	0.4	487	1.2		

Around three-quarters of Year 4 students, both internationally on average and within Australia, had teachers who were *very confident* in their ability to teach mathematics. Those students whose teachers were *very confident* tended to score significantly higher on the TIMSS mathematics assessment than students whose teachers were only *somewhat confident*.

How prepared teachers feel they are to teach mathematics

The mathematics teachers were asked how prepared they felt to teach a subset of the mathematics topics included in the TIMSS 2011 frameworks.

At Year 4, teachers were asked about 18 topics in mathematics, including 8 topics in *number*, 7 topics in *geometric shapes and measures* and 3 topics in *data display*. The proportions of students whose teachers were 'very well prepared' to teach these topics is presented in Table 6.22.

Table 6.22 Year 4 teachers feel well prepared to teach mathematics topics, Australia and the international average

	Students whose teachers feel 'very well prepared' to teach TIMSS mathematics topics							
	Overall mathematics (18 topics)		Number (8 topics)		Geometric shapes and measures (7 topics)		Data display (3 topics)	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	90	1.6	90	1.7	90	1.8	92	2
International average	83	0.3	87	0.3	82	0.3	74	0.4

Australian Year 4 mathematics teachers appeared to be quite confident in their capacity to teach the topics covered in the TIMSS assessment, with around 90 per cent of students having teachers who felt very well prepared to teach the relevant topics. Internationally, more students had teachers who felt very well prepared to teach *number* topics and fewer had teachers who felt very well prepared to teach *data display*. There were no differences for Australian students and teachers, however.

Teaching Science

Time spent

Australian principals reported that over 1000 hours (1008) were devoted to teaching during Year 4, with teachers reporting spending around 65 hours teaching their students science (far less time than was reported for either reading or mathematics).

On average internationally, close to 900 hours of instruction were reported by principals (892), with teachers spending, on average, less than 100 hours (86) teaching science to their students.

Emphasise scientific investigations

In previous cycles of TIMSS, the role of inquiry-based scientific learning has been explored by asking teachers to report the frequency with which they engaged in a range of inquiry-related activities in the science classroom. In TIMSS 2011, this approach was changed somewhat, and a new scale created. The Emphasise Science Investigation scale for Year 4 is based on teacher reports of how often, in teaching science, teachers ask students to engage in the following six activities:

- Observe natural phenomena such as the weather or a plant growing and describe what they see
- Watch me (the teacher) demonstrate an experiment or investigation
- Design or plan experiments or investigations
- Conduct experiments or investigations
- Give explanations about something they are studying
- Relate what they are learning in science to their daily lives.

Students were scored according to their teachers' responses to how often they used each of six instructional activities. Students with teachers who emphasised science investigation in *about half the lessons or more* had a score on the scale of at least 10.7, which corresponds to their teachers using all six activities in 'about half of the lessons', on average.

All other students had teachers who emphasised science investigation in *less than half the lessons*.

The proportions of students in each of these categories (based on their science teachers' reports) and their average science scores in the TIMSS 2011 assessment are presented in Table 6.23.

Table 6.23 The Emphasise Scientific Investigation scale and student achievement in science, Australia and the international average

	About half the lessons or more				Less than half the lessons					
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	Average Scale Score	SE
Australia	34	4.0	535	5.9	66	4.0	511	4.7	9.1	0.2
International average	40	0.5	488	0.9	60	0.5	484	0.9		

According to their teachers' responses, around three in every ten Australian Year 4 students had teachers who emphasised scientific investigations in *about half the lessons or more*.

While internationally, on average, there were no differences between the science assessment scores of those students whose teachers emphasised scientific investigations in *about half the lessons or more* and those who did so less often, a relationship was found among Australian students. Those students whose teachers emphasised scientific investigation in at least half of their lessons tended to outperform those students whose teachers emphasised this aspect less often.

Computer activities in science

As was found for reading and mathematics, Australia had one of the highest proportions of Year 4 students who had access to computers to use during their science lessons, with over three-quarters having a computer available for their use (compared to less than half of students on average, internationally). There was, however, no difference in the students' performance in the TIMSS science assessment based on whether they had access to a computer or not.

Table 6.24 Computer activities during science lessons and student achievement in science, Australia and the international average

	Computers available for science lessons						Students whose teachers have them do the following activities on computers at least monthly							
	Yes		Yes		No		To look up ideas and information		To do scientific procedures or experiments		To study natural phenomena through simulations		To practise skills and procedures	
	% of students	SE of %	Average science achievement	SE	Average science achievement	SE	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	77	3.4	520	4.5	519	6.0	72	3.8	42	3.4	48	4.2	38	3.5
International average	47	0.5	488	1.0	486	0.8	41	0.5	24	0.4	25	0.4	31	0.5

Given that more Australian students had computers available for use during their science lessons than on average across participating countries, it is not surprising that greater proportions of Australian students were more often required to perform certain tasks on computers, such as looking up ideas and information, conducting scientific procedures and experiments and studying natural phenomena through simulations, compared to international students.

Have a science laboratory

Within Australia, around 13 per cent of Year 4 students attended schools that had a science laboratory, while the average across participating countries was 36 per cent of students. Those students, both within Australia and across participating countries, who had access to a science laboratory in their school tended to score higher on the TIMSS science assessment than those students who did not have a science laboratory in their school.

Table 6.25 Schools have a science laboratory and student achievement in science, Australia and the international average

	School has a science laboratory				School does not have a science laboratory			
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE
Australia	13	2.4	535	7.4	87	2.4	514	2.9
International average	36	0.4	489	1.2	64	0.4	483	0.8

Resources used

Compared to the international average, far fewer Australian Year 4 students had teachers who used textbooks or workbooks and worksheets as the basis for their teaching in science lessons (although more than three-quarters of Australian students had teachers who used workbooks or worksheets as a supplement). More than half of Australian Year 4 students' teachers used science equipment and materials as a basis for instruction, which was a greater proportion than on average across participating countries.

Table 6.26 Resources used during science lessons, Australia and the international average

	Students whose teachers use:															
	Textbooks				Workbooks or worksheets				Science equipment and materials				Computer software for science instruction			
	as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement		as basis for instruction		as a supplement	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	12	2.4	34	3.6	16	3.2	76	3.7	53	4.4	46	4.4	7	2.3	59	4.4
International average	70	0.4	22	0.4	41	0.5	56	0.5	36	0.5	60	0.5	11	0.3	53	0.5

Teachers' confidence teaching science

Science teachers' confidence in their ability to instruct their classes in science was measured using a set of questions about different classroom strategies. Sciences teachers were asked how confident ('very confident', 'somewhat confident' or 'not confident') they felt doing the following in their science classes:

- Answer students' questions about science
- Explain science concepts or principles by doing science experiments
- Provide challenging tasks for capable students
- Adapt my teaching to engage students' interest
- Help students appreciate the value of learning science.

Their responses to these items were combined to create the Teachers' Confidence Teaching Science scale, and students were assigned to one of two groups based on the scale score of their science teachers.

Students with *very confident* teachers had a score on the scale of at least 9.9, which corresponds to teachers reporting that they are 'very confident' using three of the five strategies during science lessons and 'somewhat confident' in using the other two, on average.

All other students had *somewhat confident* teachers.

Around four in every ten Australian Year 4 students had a teacher who was *very confident* in teaching science, which was slightly lower than the international average (which was closer to six in every ten students).

There was, however, no relationship between the confidence levels of Year 4 science teachers as measured by this scale and students' performance on the TIMSS science assessment, either within Australia or internationally on average.

Table 6.27 The Teachers' Confidence Teaching Science scale and student achievement in science, Australia and the international average

	Very confident				Somewhat confident					
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	Average Scale score	SE
Australia	43	3.9	524	4.6	57	3.9	516	5.2	9.3	0.2
International average	59	0.5	487	0.7	41	0.5	485	1.0		

How prepared teachers feel they are to teach science

Science teachers were asked how well prepared they felt to teach 20 science topics from the TIMSS science framework, 6 topics from *life science*, 8 from *physical science* and 6 topics from *Earth science.*

A shown in Table 6.28 and in line with teacher confidence in teaching science (presented in Table 6.27), fewer Australian Year 4 students had teachers who felt very well prepared to teach the TIMSS science topics of *life science*, *physical science* and *Earth science*, as well as overall science than on average across participating countries.

Table 6.28 Year 4 teachers feel well prepared to teach science topics, Australia and the international average

	Students whose teachers feel 'very well prepared' to teach the TIMSS science topics							
	Overall science (20 topics)		Life science (6 topics)		Physical science (8 topics)		Earth science (6 topics)	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	51	3.2	60	4.1	47	3.7	49	3.5
International average	62	0.3	70	0.4	62	0.4	53	0.4

Schools

In Australia, there is great variety across schools in terms of environment, resources and student composition. In the achievement chapters, it was seen that almost three-quarters of Year 4 students attended schools in metropolitan areas, just over a quarter attended schools in provincial areas and only one per cent attended schools in remote areas. In terms of size, the average school size for Australian Year 4 students was 466 students. The smallest school had 44 students, while the largest had 2905 students. The following sections discuss student composition and school resources.

School socioeconomic composition

Acknowledging that the socioeconomic circumstances of students can impact on their readiness to learn, school principals in TIMSS and PIRLS were asked to report on the economic composition of their school, in particular by reporting what percentage (approximately) of students in the school come from economically disadvantaged homes and what percentage come from economically affluent homes.

Principals were asked to nominate a percentage from the following ranges: '0–10%', '11–25%', '26–50%' or 'more than 50%'. These categories were then collapsed further and schools assigned to one of three categories – *schools with more affluent than disadvantaged students* (25% or fewer from economically disadvantaged homes and more than 25% of students from affluent homes); *schools with more disadvantaged than affluent students* (more than 25% of student from disadvantaged homes and 25% or fewer from economically affluent homes); and *schools with neither more affluent nor more disadvantaged students* (all other response combinations).

Table 6.29 presents the proportions of students in each of these categories, along with their average reading, mathematics and science scores.

Table 6.29 Socioeconomic composition of schools and student achievement in reading, mathematics and science, Australia and the international average

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
Schools with more affluent than disadvantaged students								
Australia	32	3.9	556	3.9	544	4.8	542	4.5
International average (PIRLS)	35	0.5	530	0.9	-	-	-	-
International average (TIMSS)	36	0.5	-	-	508	1.0	505	1.0
Schools with neither more affluent nor more disadvantaged students								
Australia	41	4.0	526	3.6	517	4.8	518	4.2
International average (PIRLS)	35	0.6	515	0.8	-	-	-	-
International average (TIMSS)	35	0.6	-	-	494	1.0	489	1.0
Schools with more disadvantaged than affluent students								
Australia	27	3.4	500	5.7	486	6.0	486	5.7
International average (PIRLS)	30	0.5	490	1.0	-	-	-	-
International average (TIMSS)	30	0.5	-	-	470	1.2	463	1.3

Note: international averages are presented for PIRLS and TIMSS separately because different countries participate in each of these studies, leading to different estimates.

Just over 30 per cent of Australian Year 4 students were attending schools that their principals described as having more students from affluent backgrounds than from disadvantaged backgrounds, while a further 40 per cent were in schools in which the ratios of students from affluent backgrounds and disadvantaged backgrounds were fairly even. Just over one-quarter of Year 4 students in Australia attended schools in which disadvantaged students outnumbered affluent students.

Among Australian students, there was a relationship between student performance on the TIMSS and PIRLS assessments and the type of population of the schools they attended, with students at *schools with more affluent than disadvantaged students* scoring higher on average in reading, mathematics and science than students in schools with even proportions of affluent and disadvantaged students and students in *schools with more disadvantaged than affluent students*. Students in schools with even proportions of affluent and disadvantaged students also outperformed students in *schools with more disadvantaged than affluent students* in all three subject areas. A similar pattern was found in general across other participating countries, but not all.

Percentage of language of test speakers

According to principals, over sixty per cent (63%) of Year 4 students in Australia were attending schools in which more than 90 per cent of the student population spoke English (the language of testing in Australia) as their first language, just over 20 per cent attended schools in which more than half but less than 90 per cent of the students spoke English and 16 per cent were in schools in which half or less of the student body spoke English as their first language. These proportions did not vary greatly from the international average (see Table 6.30).

Table 6.30 Language background of schools' populations and student achievement in reading, mathematics and science, Australia and the international average

	% of students	SE of %	Average reading achievement	SE	Average mathematics achievement	SE	Average science achievement	SE
More than 90% of students speak English as their first language								
Australia	63	3.8	533	2.9	522	3.5	523	3.2
International average (PIRLS)	68	0.4	515	0.5	-	-	-	-
International average (TIMSS)	73	0.4	-	-	491	0.6	488	0.6
51%–90% of students speak English as their first language								
Australia	21	2.8	521	5.7	510	7.2	508	7.1
International average (PIRLS)	17	0.4	511	1.6	-	-	-	-
International average (TIMSS)	15	0.4	-	-	482	2.4	477	2.6
50% of students or less speak English as their first language								
Australia	16	3.1	516	9.0	505	10.2	502	9.7
International average (PIRLS)	14	0.3	490	2.2	-	-	-	-
International average (TIMSS)	13	0.3	-	-	471	3.2	457	3.4

Note: international averages are presented for PIRLS and TIMSS separately because different countries participate in each of these studies, leading to different estimates.

Internationally, a relationship between the language background of schools' student populations and student performance was found for reading, mathematics and science, with the highest scores generally being found amongst students attending schools in which more than 90 per cent of students spoke the language of the test (515 for reading, 491 for mathematics and 488 for science), followed by students in schools with more than half (but less than 90%) of students who spoke the test language (511 for reading, 482 for mathematics and 477 for science) and the lowest scores among students attending schools in which only half or less of the student body spoke the test language (490 for reading, 471 for mathematics and 457 for science).

However, there was no significant relationship between the proportion of a school's student population speaking English as their first language and the performance of Australian Year 4 students in any of the three subject areas.

What school resources are available to support learning?

To provide information about the level of school resources available to schools for reading, mathematics and science instruction and in particular about the impact of shortages of important resources, three scales were created based on principals' responses to questions about shortages affecting schools' general capacity to provide instruction, and to provide reading, mathematics and science instruction in particular.

Instruction affected by reading resource shortages

Principals were asked to comment on the extent to which their school's capacity to provide instruction was affected by a shortage (or inadequacy) of the following general and reading instruction resources:

General resources

- Instructional materials (e.g. textbooks)
- Supplies (e.g. paper, pencils)
- School building and surrounds

- Heating/cooling and lighting systems
- Instructional space (e.g. classrooms)
- Technologically competent staff
- Computers for instruction

Reading resources

- Teachers with a specialisation in reading
- Computer software for reading instruction
- Library books
- Audio-visual resources for reading instruction.

Principals' responses of 'not at all', 'a little', 'some' or 'a lot' were combined to create the scale.

Students in schools where instruction is *not affected* by resource shortages had a score of at least 11.2, which is the point on the scale corresponding to their principals indicating that shortages affected instruction 'not at all' for six of the eleven resources and 'a little' for the other five, on average.

Students in schools where instruction was *affected a lot* by resource shortages had scores no higher than 6.7, which is the scale point corresponding to their principals indicating that the capacity to provide instruction was affected 'a lot' for six of the eleven resources and 'some' for the other five, on average.

All other students were in schools that were categorised as *somewhat affected* by resource shortages.

The proportions of students in each of the three categories for this scale, along with their average reading achievement scores, are presented in Table 6.31.

Table 6.31 The Reading Resource Shortages scale and student achievement in reading, Australia and the international average

	Not affected				Somewhat affected				Affected a lot				Average Scale score	SE
	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE	% of students	SE of %	Average reading achievement	SE		
Australia	42	3.5	537	4.9	57	3.5	521	3.5	1	0.6	~	~	11.2	0.1
International average	24	0.5	523	1.1	71	0.5	511	0.5	5	0.2	478	3.0		

Over 40 per cent of Year 4 students in Australia were attending schools that were *not affected* by reading resource shortages, with only one per cent in schools that were *affected a lot* by shortages.

Unsurprisingly, given the content of the scale, a relationship was found between student performance in the reading assessment and the degree to which principals reported instruction at their school was affected by reading resource shortages. Students at schools that were *not affected* scored higher on average than students in other schools, while students in schools *affected a lot* scored lower on average than students in other schools. This relationship was also found across other participating countries, on average.

Instruction affected by mathematics resource shortages

Principals were also asked to comment on the extent to which shortages in mathematics resources impacted on instruction at their school. Principals were asked how much ('not at all', 'a little', 'some' or 'a lot') shortages in the following mathematics resources affected learning at their school:

- Teachers with a specialisation in mathematics
- Computer software for mathematics instruction

- Library materials relevant to mathematics instruction
- Audio-visual resources for mathematics instruction
- Calculators for mathematics instruction.

Principals' responses to these items were combined with their responses to items about shortages with general school resources (listed above) to create the Mathematics Resource Shortage scale. Students were then assigned to groups based on their principal's scale score.

Students in schools where instruction was *not affected* by mathematics resource shortages had a score of at least 11.1, which is the point on the scale corresponding to their principals indicating that resource shortages affected instruction 'not at all' for six of the twelve resources and 'a little' for the other six, on average.

Students in schools where instruction was *affected a lot* had scores no higher than 6.8, which corresponds to principals reporting that shortages affected instruction 'a lot' for six of the twelves resources and 'some' for the remaining six, on average.

All other students were allocated to the middle category, where instruction in schools was *somewhat affected* by resource shortages.

Just over four in every ten Year 4 students in Australia were attending a school in which instruction was *not affected* by shortages in mathematics resources, with a further five in ten students attending schools in which instruction was *somewhat affected* by such shortages (see Table 6.32). Very few students, around one per cent, were in schools in which instruction was *affected a lot* by shortages in mathematics resources. These proportions compare quite favourably with those of other participating countries, on average.

Table 6.32 The Mathematics Resource Shortages scale and student achievement in mathematics, Australia and the international average

	Not affected				Somewhat affected				Affected a lot				Average Scale score	SE
	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE	% of students	SE of %	Average mathematics achievement	SE		
Australia	44	3.3	529	5.1	54	3.3	507	3.4	1	0.8	~	~	11.1	0.1
International average	25	0.5	497	1.2	70	0.5	488	0.6	5	0.2	462	3.5		

Among Australian Year 4 students, those who attended schools *not affected* by mathematics resource shortages scored higher on average on the TIMSS mathematics assessment than students in schools that were *somewhat affected* by shortages in resources. Due to the very small number of students who were in schools that were *affected a lot*, a reliable mathematics performance estimate for this group was not able to be calculated.

Instruction affected by science resource shortages

Similarly to the Mathematics Resource Shortage scale reported above, principals were asked to indicate to what extent ('not at all', 'a little', 'some' or 'a lot') their school's capacity to provide science instruction was affected by shortages of the following science resources:

- Teachers with a specialisation in science
- Computer software for science instruction
- Library materials relevant to science instruction
- Audio-visual resources for science instruction
- Science equipment and materials.

Their responses to these items were combined with their responses to the set of items about general resource shortages (listed under the section reporting on the Reading Resource Shortage scale) to create the Science Resource Shortage scale. Students were then assigned to groups based on their principal's scale score.

Students in schools where instruction was *not affected* had a score of at least 11.3, which is the point on the scale corresponding to their principals indicating that capacity to provide instruction is affected 'not at all' for six of the twelve science resources and 'a little' for the other six, on average.

Students in schools where instruction was *affected a lot* had scores of no higher than 7.1, which is the point corresponding to their principals indicating that capacity to provide instruction is affected 'a lot' for six of the twelve resources and 'some' for the other six, on average.

All other students were in schools that were *somewhat affected* by science resource shortages.

In Australia, just under one-third of Year 4 students were attending a school that, according to their principal, was *not affected* by shortages in science resources, while just over two-thirds of students were in schools that were *somewhat affected* by such shortages (Table 6.33).

Table 6.33 The Science Resource Shortages scale and student achievement in science, Australia and the international average

	Not affected				Somewhat affected				Affected a lot				Average Scale score	SE
	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE	% of students	SE of %	Average science achievement	SE		
Australia	32	3.7	529	5.1	68	3.7	511	3.7	1	0.5	~	~	10.6	0.1
International average	22	0.4	495	1.3	72	0.5	485	0.6	7	0.3	460	4.0		

Internationally, a relationship between principals' reports of science resource shortages and the performance of students in the TIMSS science assessment was found, with students in schools *not affected* by shortages outperforming students in other schools, and students in schools *affected a lot* scoring lower on average than students in other schools.

In Australia, the extremely small number of students in schools *affected a lot* by science resource shortages precluded a reliable estimate of student performance in science being calculated, but students in schools *not affected* did score higher on average than students in schools that were *somewhat affected* by shortages in science resources.

Principal's activities

Another aspect of the school environment that may have an impact on students' performance is school leadership – how school principals spend their time and on what. Principals of schools that participated in TIMSS and PIRLS were asked to indicate how much time they spent on a variety of activities, and their responses are presented below (as proportions of students whose principals spend 'a lot of time' on each activity) in Table 6.34.

Table 6.34 Principals' activities, Australia and the international average

	Students whose principals spend 'a lot of time' on these activities																	
	Promoting the school's educational vision or goals		Developing the school's curricular and educational goals		Monitoring teachers' implementation of the school's educational goals in their teaching		Monitoring students' learning progress to ensure that the school's educational goals are reached		Keeping an orderly atmosphere in the school		Addressing disruptive student behaviour		Advising teachers who have questions or problems with their teaching		Initiating educational projects or improvement		Participating in professional development activities specifically for school principals	
	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %	% of students	SE of %
Australia	60	4.1	73	3.8	52	4.6	68	3.8	63	3.6	35	3.8	27	3.4	53	4.4	33	3.7
International average (PIRLS)	59	0.6	59	0.5	48	0.5	55	0.5	68	0.5	44	0.5	35	0.5	41	0.6	38	0.5
International average (TIMSS)	59	0.5	60	0.5	53	0.5	57	0.5	68	0.5	44	0.5	39	0.5	43	0.6	39	0.5

Around 60 per cent of students, both within Australia and on average across participating countries, were in schools in which the principal spent 'a lot of time' promoting the schools' educational vision or goals, or developing the school's curricular and educational goals. Almost 70 per cent of Australian Year 4 students were in schools in which principals spent a lot of time monitoring students' learning progress to ensure that educational goals were met, which was a slightly larger proportion than was found across participating countries on average.

The next chapter reports on the climate of schools of TIMSS students, using information provided by students, their teachers and school principals to build a well-rounded picture of the school environment.

Chapter

7

The School Climate – Multiple Perspectives

Key Findings

- Achievement in reading, mathematics and science was higher on average –
  - Among students who: liked school and felt like they belong, were engaged during lessons, felt that they were safe and were almost never or only sometimes bullied.
  - In schools in which principals and teachers report a very high or high emphasis on academic success, that teachers thought were safe and orderly, where student factors such as lack of prerequisite knowledge, nutrition and sleep deprivation and disruptive or uninterested students did not impact on student learning and where teachers reported hardly any problems with working conditions.
- Among Australian students, engagement was highest (that is, the greatest proportion of students were in the most engaged category) in science, followed by mathematics and then reading.
- The percentage of Australian Year 4 students in the most engaged category for reading lessons was significantly lower than the international average.
- Compared to the international average, more Australian Year 4 students reported being bullied *about weekly* and fewer reported being bullied *almost never*.
- The percentage of Australian Year 4 students who had teachers who reported schools as *safe and orderly* was significantly higher than the international average.
- Around 44 per cent of students had teachers who reported *hardly any problems* with their working conditions, which was a figure significantly greater than the international average.

This chapter explores different school climate issues that have the potential to impact on Year 4 students' learning. Multiple perspectives are considered in this analysis – the views of the principal, teacher and students themselves. In particular, school climate is considered in terms of school emphasis on academic success, students' reported school and classroom engagement, school discipline and safety, factors that limit teachers' classroom instruction and teachers' reported working conditions.

Data discussed in this chapter were collected from background questionnaires completed by students, teachers and principals. As in the previous chapter, for teachers' responses, data reflect the percentages of students whose teachers reported on various characteristics. As mentioned in Chapter 6, the teachers were not drawn as a representative sample of teachers, and so the information in this chapter should be thought of as indicative, and is provided for the purposes of setting students' achievement in context.

Percentages are reported separately for the different subject areas, where appropriate, firstly as achievement scores are included to provide a context for scales discussed, and secondly because it was not always the case that teachers taught participating students all three subjects. In some cases,

teachers only taught one of the subject areas to students. International averages are also reported separately for TIMSS and PIRLS as there were different countries that participated in each study.

School emphasis on academic success – principals' and teachers' reports

Principals' reports

Part of the 2011 PIRLS study incorporated measures of academic emphasis, as schools that have higher expectations of students' achievement and potential, better teaching capacity and higher community support are often those that have more positive outcomes. The School Emphasis on Academic Success scale measures five aspects of academic emphasis:

- Teachers' understanding of the school's curricular goals
- Teachers' degree of success in implementing the school's curriculum
- Teachers' expectations for student achievement
- Parental support for student achievement
- Students' desire to do well in school.

Principals were asked to rate their schools on each aspect ('very high', 'high', 'medium', 'low' or 'very low'). Ratings were combined to create a scale and students were categorised into three groups based on their principals' scale score.

On average, students' schools were classified as placing a *very high emphasis* on academic success if principals rated three of the five aspects at their school as 'very high' and the other two aspects as 'high' (associated with a scale score of at least 13.0 in PIRLS and 13.1 in TIMSS).

A *medium emphasis* (linked to a scale score no greater than 8.8 in PIRLS and 8.9 in TIMSS) was associated with students whose principals, on average, gave no more than three ratings as 'medium' and two as 'high'.

All other students attended schools that had a *high emphasis* on academic success. Table 7.1 shows the results for Australia and the international average.

Table 7.1 The School Emphasis on Academic Success – Principals scale and student achievement in reading mathematics and science, Australia and the international average

	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE of score
	% of students	SE of %	Average achievement	SE of score	% of students	SE of %	Average achievement	SE of score	% of students	SE of %	Average achievement	SE of score		
	Reading													
Australia	16	3.0	554	6.6	64	3.8	531	3.1	21	3	498	5.3	10.8	0.1
International average (PIRLS)	9	0.3	527	1.9	59	0.6	517	0.6	32	0.5	497	0.8		
	Mathematics													
Australia	16	3.0	544	7.6	64	3.8	519	3.7	21	3.0	488	5.6	10.9	0.1
International average (TIMSS – Mathematics)	8	0.3	511	2.2	58	0.5	496	0.7	34	0.5	477	0.9		
	Science													
Australia	16	3.0	544	7.3	64	3.8	519	3.4	21	3.0	487	5.1	10.9	0.1
International average (TIMSS – Science)	8	0.3	508	2.3	58	0.5	492	0.7	34	0.5	471	1		

Sixteen per cent of Australian Year 4 students came from schools that placed a *very high emphasis* on academic success, which was higher than the international average of eight per cent. The majority of Australian students (64%) came from schools with principals who reported a *high emphasis* on academic success. Just over one-fifth of students (21%) were in schools with a *medium emphasis*, which was less that the international average of just over one-third.

Northern Ireland was the country with the highest proportion of students in the *very high emphasis* category with 33 per cent of students coming from schools in this category and only seven per cent assigned to the *medium emphasis* category. Somewhat surprisingly, Hong Kong had one of the smallest percentages of students in the *very high emphasis* category (1%) whereas around 38% of its students were assigned to the *medium emphasis* category.

Among Australian students, and across participating countries on average, students in schools that placed a *very high emphasis* on academic success recorded the highest average achievement scores in all three subject areas, while students from schools with a *medium emphasis* recorded the lowest average scores. For Australian students, for reading, mathematics and science, the average achievement of students in the *very high emphasis* category was significantly higher than that of students in the other two categories and the average achievement of students in the *high* category was significantly higher than that of students in the *medium* category.

Teachers' reports

Teachers were also asked how much emphasis was placed on academic success at their schools. Teachers' responses to the five items comprising the School Emphasis on Academic Success scale were combined to create a scale.

The same process as described for the Principals' reports was used to classify students to the *very high emphasis* (scale score of at least 13.0 in PIRLS and 13.1 in TIMSS), *high emphasis* and *medium emphasis* (a scale score no greater than 8.7 in PIRLS and 8.8 in TIMSS) categories based on the scale scores of their teachers, and these results are presented in Table 7.2.

Table 7.2 The School Emphasis on Academic Success – Teachers scale and student achievement in reading, mathematics and science, Australia and the international average

	Very high emphasis				High emphasis				Medium emphasis				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
	Reading													
Australia	17	3.0	554	8.8	63	4.4	533	3.6	20	3.1	507	4.3	10.7	0.2
International average (PIRLS)	9	0.3	529	1.8	60	0.6	517	0.6	31	0.5	497	0.8		
	Mathematics													
Australia	16	3.0	550	12.3	63	4.2	519	4.4	20	3	495	5.8	10.8	0.2
International average (TIMSS – Mathematics)	7	0.3	503	3.3	60	0.5	496	0.7	33	0.5	477	0.9		
	Science													
Australia	16	2.9	548	11.3	64	4.4	520	4.1	20	3.1	494	5.4	10.8	0.2
International average (TIMSS – Science)	8	0.3	499	2.2	60	0.5	492	0.7	33	0.5	472	1.0		

The percentage of Year 4 Australian students assigned to the *very high emphasis* category based on teachers' responses was 16 per cent; the same proportion that was assigned based on principals'

responses. Again the majority of students (64%) attended schools in which teachers reported there was a *high emphasis* on success, and only 20 per cent of students were placed in the *medium emphasis* category. The proportion of students in the *very high emphasis* and *high emphasis* categories for Australia was higher than the international average and the proportion of students in the *medium emphasis* category was lower than the international average.

Northern Ireland had the highest percentage of students in the *very high emphasis* category according to teachers' responses (28% in comparison to all participating PIRLS countries and 31% in comparison to all TIMSS countries), as they had for the principals' version of this scale. No students in the Netherlands were placed in the *very high emphasis* category according to teachers' responses.

As was found for the previous academic success scale, average achievement scores in all subjects were highest among students from schools that placed a *very high emphasis* on academic success and lowest for students from schools with a *medium emphasis,* across participating countries on average and for Australian students. The average achievement of Australian students in the *very high emphasis category* was significantly higher than that of Australian students in the other two categories and the average achievement of Australian students in the *high category* was significantly higher than the *medium* category.

Students' engagement with school

Australian Year 4 students were asked to give their level of agreement ('agree a lot', 'agree a little', 'disagree a little', 'disagree a lot') to two statements assessing their engagement with school:

- I like being in school
- I feel like I belong at this school

Table 7.3 presents the distribution of responses to these statements and combines them with students' achievement scores in reading, mathematics and science for Australian students only.

Table 7.3 Students like being at school and feel like they belong and student achievement in reading, mathematics and science, Australia

	Agree a lot				Agree a little				Disagree a little				Disagree a lot			
	% of students	SE of %	Average score	SE of score	% of students	SE of %	Average score	SE of score	% of students	SE of %	Average score	SE of score	% of students	SE of %	Average score	SE of score
Reading																
Like being at school	42	1.2	529	3.6	39	1.1	533	2.9	10	0.6	531	3.9	9	0.7	495	5.3
Feel like belong at this school	57	1.1	534	2.8	25	0.7	533	3.3	10	0.5	515	4.5	9	0.6	493	5.9
Mathematics																
Like being at school	42	1.2	517	4.4	39	1.1	524	3.0	10	0.6	520	4.2	9	0.7	487	6.2
Feel like belong at this school	57	1.1	521	3.5	25	0.7	522	4.0	10	0.5	514	5.6	9	0.6	480	6.0
Science																
Like being at school	42	1.2	515	4.1	39	1.1	523	2.9	10	0.6	526	3.4	9	0.7	491	6.9
Feel like belong at this school	57	1.1	521	3.2	25	0.7	521	3.7	10	0.5	510	5.9	9	0.6	486	5.8

The majority of Year 4 Australian students (57%) 'agreed a lot' to the belonging statement, while the most common response for the liking school statement was also 'agree a lot' (42%). Around ten per cent of students 'disagreed a lot' or 'disagreed a little' that they liked being in school or felt like they belonged.

Students who 'agreed a lot' or 'agreed a little' that they like being in school scored higher on average in reading, mathematics and science than students who 'disagreed a lot'. Students who 'disagreed a little' that they liked school also scored higher than those who 'disagreed a lot', but their scores were not statistically different to those of students who agreed (either a lot or a little) that they liked school.

Students who 'agreed a lot' or 'agreed a little' that they felt like they belonged at their school also scored higher on average in reading, mathematics and science than students who 'disagreed a lot' to the belonging statement. For reading, there was also a significant difference in the average performance of students who agreed (either a lot or a little) that they felt like they belonged at their school and students who 'disagreed a little' to this statement.

Students' engagement in reading lessons

Students were asked to comment on their experiences in reading lessons, as a means of gauging how engaged they were with lessons. 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 what I read about in school
- My teacher gives me interesting thing to read
- I know what my teacher expects me to do
- I think of things not related to the lesson (reverse coded)
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do.

Responses to these items were combined to create a scale and scale scores were used to classify students into three response groups.

Students who were *engaged* in reading lessons 'agreed a lot' with at least four statements and 'agreed a little' with three, on average (associated with a scale score of at least 10.5).

Students who were classified as *not engaged* 'agreed a little' with no more than three statements and 'disagreed a little' with four statements, on average (associated with a scale score no greater than 7.4).

All remaining students were categorised as *somewhat engaged*. These data on reading engagement are shown in Table 7.4.

Table 7.4 The Engaged in Reading Lessons scale and student achievement in reading, Australia and the international average

	Engaged				Somewhat engaged				Not engaged				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	33	1.1	538	3.7	56	0.9	526	2.5	11	0.7	509	4.4	9.6	0.1
International average	42	0.2	519	0.5	50	0.2	510	0.5	8	0.1	494	1.0		

Approximately one-third of Australian Year 4 students were *engaged* with reading lessons, which was significantly lower than the international average (42%). More than half of Australian students were *somewhat engaged* and just over one-tenth of students were classified as *not engaged*.

Indonesia had the highest percentage of students in the *engaged* category at 71 per cent. Interestingly, two of the highest achieving countries in reading, Hong Kong and Finland, had two of the lowest percentages of students who were *engaged* (24% and 15%, respectively).

For both Australian students and students across participating countries on average, higher levels of engagement during reading classes were associated with higher achievement. Students who were *engaged* with reading scored significantly higher in reading than students who were *somewhat engaged* and both of these groups of students scored significantly higher than students who were *not engaged*.

Students' engagement in mathematics lessons

As they had for reading, students were asked about their engagement with mathematics in the classroom. 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 mathematics lessons:

- I know what my teacher expects me to do
- I think of things not related to the lesson (reverse coded)
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do.

A scale was created by combining responses to these items and students were assigned to one of three groups based on their scale scores.

Students who were *engaged* in mathematics lessons, on average, had a scale score of at least 10.2, and 'agreed a lot' with at least three statements and 'agreed a little' with the remaining two statements.

Students who were *not engaged* (associated with a scale score no greater than 7.4) 'agreed a little' with no more than two statements and 'disagreed a little' with two statements, on average.

All other students were assigned to the *somewhat engaged* category. The proportions of students in each of these categories, along with their average mathematics achievement, are shown in Table 7.5.

Table 7.5 The Engaged in Mathematics Lessons scale and student achievement in mathematics, Australia and the international average

	Engaged				Somewhat engaged				Not engaged					
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	Average scale score	SE
Australia	41	1.2	534	3.1	50	1.1	506	3.8	9	0.5	503	5.3	9.9	0.1
International average	42	0.2	507	0.5	49	0.2	482	0.5	8	0.1	464	1.0		

The distribution of Australian students in the three categories was quite similar to the international average; just over 40 per cent of students were *engaged*, 50 per cent were *somewhat engaged* and nine per cent were *not engaged* in their mathematics lessons.

Tunisia and Iran had two of the highest percentages of students classified as *engaged* at 65 and 59 per cent, respectively. In a pattern similar to that found with reading, one of the highest achieving mathematics countries, Korea, had one of the lowest proportion of students who were *engaged* (13%).

In Australia, students who were *engaged* had significantly higher mathematics achievement than students who were *somewhat engaged* or *not engaged*. There was no significant difference between achievement levels of students in the latter two categories.

Students' engagement in science lessons

Students' levels of engagement in the science classroom were gauged from their responses to the following set of five statements about science lessons:

- I know what my teacher expects me to do
- I think of things not related to the lesson (reverse coded)
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do.

Students indicated their level of agreement ('agree a lot', 'agree a little', 'disagree a little' or 'disagree a lot') to these items and their responses were combined to create scale scores.

Students who were classified as *engaged* in science lessons, on average, 'agreed a lot' with at least three statements and 'agreed a little' with two statements.

Students who were *not engaged* 'agreed a little' with a maximum of two statements and 'disagreed a little' with three statements, on average.

All other students were assigned to the *somewhat engaged* category.

Table 7.6 shows the proportion of Australian Year 4 students in these three groups, along with the average across countries participating in TIMSS for comparison.

Table 7.6 The Engaged in Science Lessons scale and student achievement in science, Australia and the international average

	Engaged				Somewhat engaged				Not engaged				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
Australia	46	1.0	532	2.9	44	0.9	506	3.4	9	0.6	498	6.9	10	0.1
International average	45	0.2	504	0.6	47	0.2	476	0.6	8	0.1	457	1.2		

As was the case for mathematics, the distribution of Australian students in the three categories was similar to the international average; 46 per cent of students were *engaged*, in their science lessons, 44 per cent were *somewhat engaged* and nine per cent were *not engaged*. Of the three subject areas, science had the largest proportion of students in the *engaged* category, followed by mathematics and then reading.

Tunisia and Iran had the two highest percentages of students classified as *engaged* for science, as they had for mathematics (65% and 61%, respectively). As was found for mathematics and reading, one of the highest achieving countries for science, Korea, had one of the lowest proportions of students who were *engaged* (12%).

Among Australian students, and across participating countries on average, students who were *engaged* in the science classroom had significantly higher levels of average science achievement than students who were *somewhat engaged* or *not engaged*. The average science achievement of students who were *somewhat engaged* and those who were *not engaged* in their science lessons did not differ significantly.

Safety, discipline and other issues

Students' reports of school bullying behaviours

An essential part of a positive school climate is student safety and security.

When asked to respond to the statement 'I feel safe at school' 59 per cent of Australian Year 4 students 'agreed a lot', 29 per cent 'agreed a little', seven per cent 'disagreed a little' and four per cent 'disagreed a lot'.

Students' views of their personal safety at school were also 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') they had experienced the following:

- I was made fun of or called names
- I was left out of games or activities by other students
- Someone spread lies about me
- Something was stolen from me
- I was hit or hurt by other student(s) (e.g. shoving, hitting, kicking)
- I was made to do things I didn't want to do by other students.

Responses to these items were combined to form a scale. Students who reported 'never' experiencing three of the behaviours and the other three only 'a few times a year', on average, were classified as *almost never* experiencing bullying (associated with a scale score of at least 10.1).

Students were classified as bullied *about weekly* if they reported, on average, experiencing three items 'once or twice a month' and three items 'a few times a year' (associated with a scale score no greater than 8.3).

All other students were classified as being bullied *about monthly*. Table 7.7 presents results of these bullying data for Year 4 Australian students and the average across participating countries.

Table 7.7 The Students Bullied at School scale and student achievement in reading, mathematics and science, Australia and the international average

	Almost never				About monthly				About weekly				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
	Reading													
Australia	37	1.1	539	2.8	38	1.0	529	2.7	25	0.8	509	3.8	9.6	0.0
International average (PIRLS)	47	0.2	523	0.5	33	0.1	513	0.5	20	0.1	489	0.7		
	Mathematics													
Australia	38	1.1	525	2.9	38	1.0	521	3.7	25	0.7	498	4.2	9.5	0.0
International average (TIMSS – Mathematics)	48	0.2	501	0.5	32	0.1	493	0.6	20	0.1	469	0.7		
	Science													
Australia	38	1.1	525	2.9	38	1.0	519	3.3	25	0.7	501	4.1	9.5	0.0
International average (TIMSS – Science)	48	0.2	497	0.6	32	0.1	489	0.6	20	0.1	464	0.8		

Almost equal proportions of Australian Year 4 students (just over one-third) reported being bullied at school *almost never* or *about monthly*, while one-quarter of students reported that this happened *about weekly*. Compared to the international average, more Australian Year 4 students reported being bullied *about weekly* and fewer reported that they were *almost never* bullied. Armenia had the highest percentage (80%) of students who reported they were *almost never* bullied, and Thailand had the lowest (17%).

For Australian students, those who reported being bullied *almost never* had significantly higher reading achievement than students who were bullied *about monthly*, and both of these groups of students had significantly higher reading achievement than students who were bullied *about weekly*. For mathematics and science, there was no significant difference between the achievement scores of Australian students who were bullied *almost never* or *about monthly* but these students had significantly higher achievement than students who were bullied *about weekly*.

Teachers' views of school safety

Teachers' perceptions of school safety were also considered and investigated as part of the TIMSS and PIRLS study. Teachers were asked to indicate the extent of their agreement ('agree a lot', 'agree a little', 'disagree a little', 'disagree a lot') to the following five 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 an orderly manner
- The students are respectful of the teachers.

Responses to these items were combined to form a scale and scale scores were used to create three categories of responses. Students assigned to the *safe and orderly* category had a scale score of at least 10.1 in PIRLS (10.2 in TIMSS), which corresponded to their teachers 'agreeing a lot' with five of the items and 'agreeing a little' with two items, on average.

The *not safe and orderly* category (associated with a scale score no higher than 6.2 in PIRLS and 6.3 in TIMSS) was formed for students whose teachers, on average, 'disagreed a little' with three statements and 'agreed a little' with two statements.

All other students were part of the *somewhat safe and orderly* category.

Table 7.8 presents the percentage of students in each category for Australia and internationally, along with students' average achievement in reading, mathematics and science.

Table 7.8 The Safe and Orderly School scale and student achievement in reading, mathematics and science, Australia and the international average

	Safe and orderly				Somewhat safe and orderly				Not safe and orderly				Average scale score	SE
	%of students	SE of %	Average achievement	SE	%of students	SE of %	Average achievement	SE	%of students	SE of %	Average achievement	SE		
	Reading													
Australia	76	3.2	540	3.1	21	3.1	509	6.9	4	1.4	489	15.1	11	0.2
International average (PIRLS)	55	0.5	518	0.6	41	0.5	505	0.8	4	0.2	486	3.6		
	Mathematics													
Australia	76	3.1	529	3.7	20	3.0	491	7.9	4	1.4	460	12.4	11.1	0.2
International average (TIMSS – Mathematics)	53	0.5	498	0.7	43	0.5	483	0.8	4	0.2	470	2.9		
	Science													
Australia	75	3.5	528	3.5	21	3.2	497	7.8	4	1.4	462	15.4	11	0.2
International average (TIMSS – Science)	53	0.5	493	0.7	43	0.5	480	0.9	4	0.2	449	4		

Around 75 per cent of Australian Year 4 students had teachers who reported that they worked in *safe and orderly* schools, while around 20 per cent of students had teachers who reported that schools were *somewhat safe and orderly.* Just four per cent said schools were *not safe and orderly*. The percentage of Australian Year 4 students who had teachers that reported schools as *safe and orderly* was significantly higher than the international average (for both TIMSS and PIRLS studies) and for all three subject areas. Moreover, Australia had the fifth highest percentage among participating TIMSS countries and the seventh highest percentage among PIRLS participating countries on this scale.

Among PIRLS countries, Indonesia had the highest percentage of students whose teachers reported that they worked in *safe and orderly* schools, at 91 per cent, while Northern Ireland had the highest percentage among TIMSS participating countries, at 85 per cent. The lowest percentage of students in *safe and orderly* schools, based on teacher reports, was recorded in Italy for PIRLS (18%) and Japan for TIMSS (5%).

Among Australian students, and across participating countries on average, those who were in *safe and orderly* schools, according to their teachers' reports, scored higher on average than students in other schools.

Principals' reports of discipline and attendance problems

Principals' views of safety and disciplinary issues at their schools were collected using a different scale than was used for students and teachers. Principals were asked to indicate the degree to which the following behaviours were problematic in their schools:

Among students

- Arriving late at school
- Absenteeism (i.e. unjustified absences)
- Classroom disturbance
- Cheating
- Profanity
- 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.)

Among staff

- Arriving late or leaving early
- Absenteeism

Principals were asked to rate each of these as 'not a problem', a 'minor problem', a 'moderate problem' or a 'serious problem'. These responses were combined to create a scale and students were assigned to one of three groups based on their principal's scale score.

Students assigned to the *hardly any problems* category had a score of at least 9.9 in PIRLS (9.7 in TIMSS), which corresponded to their principals reporting that five of the behaviours were 'not a problem' and five behaviours were 'minor problems', on average. Students placed in the *moderate problems* category (associated with a scale score no greater than 7.7 in PIRLS and 7.6 in TIMSS) had principals that reported five of the behaviours were a 'moderate problem' and five of the behaviours were a 'minor problem', on average.

All other students were assigned to the *minor problems* category. Table 7.9 presents the percentage of students in each category for Australia along with the average across participating countries.

Table 7.9 The School Discipline and Safety scale and student achievement in reading, mathematics and science, Australia and the international average

	Hardly any problems				Minor problems				Moderate problems				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
	Reading													
Australia	64	3.9	534	3.5	34	3.8	521	4.5	2	1.0	~	~	10.5	0.1
International average (PIRLS)	58	0.5	519	0.7	31	0.5	504	1	11	0.3	476	2.0		
	Mathematics													
Australia	64	3.9	523	4.1	34	3.8	511	5.3	2	1.0	~	~	10.4	0.1
International average (TIMSS – Mathematics)	61	0.5	496	0.7	29	0.5	482	1.1	11	0.3	451	2.2		
	Science													
Australia	64	3.9	523	4.1	34	3.8	510	5.0	2	1.0	~	~	10.4	0.1
International average (TIMSS – Science)	61	0.5	492	0.7	29	0.5	477	1.2	11	0.3	448	2.2		

The majority of Australian students (64%) had principals who reported *hardly any* discipline and attendance problems at their schools, which was similar to the international average of 58 per cent (PIRLS) and 61 per cent (TIMSS). Thirty-four per cent of students were at schools that had only *minor problems* and two per cent were at schools with *moderate problems* as reported by principals. This latter percentage was significantly lower than the international average of 11 per cent.

Hong Kong had the highest percentage (87%) of students from schools with *hardly any* discipline and attendance problems, as reported by principals, among PIRLS countries and Kazakhstan (91%) had the highest percentage of TIMSS participating countries. The lowest percentages of students in schools with *hardly any problems*, based on principals' reports, were found in Indonesia for PIRLS countries (17%) and Yemen for TIMSS countries (5%).

Australian students at schools where the principal reported *hardly any problems* had significantly higher achievement in reading and science than students from schools with *minor problems*. There was no significant difference in mathematics achievement for students at schools with *hardly any problems* or *minor problems*. It was not possible to report achievement levels for Australian students from schools that had *moderate problems* as only a small percentage of students fell into this category and therefore insufficient data were available, but across participating countries on average, these recorded the lowest average scores in reading, mathematics and science.

Student factors affecting learning-instruction limited by students not ready to learn

In order to develop a better understanding of classroom climate and student characteristics that can impact teachers' instructional practices, teachers of the TIMSS and PIRLS classes were asked about the extent to which instruction at their school was limited by students who were not ready to learn ('limited a lot', 'some' or 'not at all').

Three types of 'unready' students were referred to:

- Students lacking prerequisite knowledge or skills
- Students suffering from lack of basic nutrition
- Students suffering from not enough sleep.

The proportions of students whose teachers indicated that instruction was *not at all*, *some* and *limited a lot* by a lack of knowledge and prerequisite skills are presented in Table 7.10 along with the average performance of students in schools who were impacted on by these factors.

Table 7.10 Factors impacting learning (lack of knowledge and prerequisite skills) and student achievement in reading, mathematics and science, Australia and the international average

	Not at all				Some				A lot			
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE
	Reading											
Australia	30	3.2	555	4.6	60	4.0	524	3.9	10	2.4	501	7.1
International average (PIRLS)	28	0.5	526	0.9	61	0.5	512	0.5	11	0.3	485	1.6
	Mathematics											
Australia	30	3.3	542	7.5	60	4.2	511	4.2	10	2.5	479	6.8
International average (TIMSS – Mathematics)	27	0.5	506	1.0	61	0.5	489	0.6	12	0.3	467	1.9
	Science											
Australia	31	3.5	542	6.7	59	4.4	513	4.1	10	2.4	482	7.8
International average (TIMSS – Science)	28	0.5	502	1.1	60	0.5	485	0.7	11	0.3	460	2.1

Around 30 per cent of Year 4 students in Australia had teachers who reported that instruction was *not at all* limited by students lacking prerequisite skills or knowledge while around 60 per cent said it was limited at *some* level and 10 per cent said it was limited *a lot*. The proportion of students in each of these categories was relatively similar to the international average.

Kazakhstan (64%) and the Netherlands (49%) had the highest percentages of students whose teachers reported that instruction was *not at all* limited by students lacking prerequisite skills and knowledge (for TIMSS and PIRLS, respectively).

For all three subject areas, students whose teachers reported that instruction was *not at all* limited by students lacking prerequisite skills or knowledge had significantly higher levels of achievement

than students from schools where there was *some* limitation to instruction. Not surprisingly, both of these groups of students had significantly higher achievement than students in schools where instruction was limited *a lot*.

Student factors affecting learning-instruction limited by nutrition and sleep factors

Table 7.11 presents the proportions of students whose teachers reported that students lacking adequate nutrition or sleep limited instruction in their classrooms,. For these questions, the categories of *some* and *a lot* were combined and compared to the proportion of students whose teachers reported that instruction was *not at all* limited by inadequate nutrition or sleep.

Table 7.11 Factors impacting learning (poor nutrition and sleep) and student achievement in reading, mathematics and science, Australia and the international average

	Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Lack of Basic Nutrition								Students in Classrooms Where Teachers Report Instruction Is Limited by Students Suffering from Not Enough Sleep							
	Not at all				Some or a lot				Not at all				Some or a lot			
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE
	Reading															
Australia	73	3.0	544	2.7	27	3.0	497	5.6	33	3.5	546	4.5	67	3.5	524	4.1
International average (PIRLS)	73	0.4	519	0.6	27	0.4	495	1.0	51	0.5	518	0.6	49	0.5	507	0.7
	Mathematics															
Australia	73	3.0	531	3.7	27	3.0	486	6.7	33	3.5	539	6.2	67	3.5	509	5.1
International average (TIMSS – Mathematics)	71	0.4	498	0.7	29	0.4	472	1.1	53	0.5	497	0.7	47	0.5	486	0.8
	Science															
Australia	73	3.0	531	3.4	27	3.0	488	6.6	36	3.7	536	4.8	64	3.7	509	5.2
International average (TIMSS – Science)	71	0.4	493	0.8	29	0.4	467	1.1	54	0.5	492	0.7	46	0.5	481	0.9

Around three-quarters of Australian Year 4 students had teachers who reported that a lack of nutrition was *not at all* a limiting factor to instruction, which was similar to the international average. Around one-third of teachers reported that lack of sleep was *not at all* a limiting factor for Australian Year 4 students, which was significantly lower than the international average across all subject areas.

For TIMSS and PIRLS countries, the Czech Republic (99%) had one of the highest percentages of students in the *not at all* category for poor nutrition as a limiting factor while Morocco (21%) had one the smallest percentages. When considering sleep as a factor limiting teaching, Kazakhstan (88%) had the highest percentage of students from TIMSS countries and Azerbaijan (84%) had the highest percentage of students from PIRLS countries in the *not at all* category. Interestingly, the United States (27%) and Belgium (23%), two well-developed countries, had the lowest percentage of students in the *not at all* category of TIMSS and PIRLS countries, respectively.

Student factors affecting learning-instruction limited by disruptive or uninterested students

Teachers were also asked the extent ('limited a lot', 'some' or 'not at all') to which instruction at their school was limited by students who were disruptive or uninterested.

The proportions of students whose teachers indicated that instruction was not at all limited, compared to limited some or a lot (combined as for the previous question) by these types of student behaviour are presented in Table 7.12 along with the average performance of students in these categories.

Table 7.12 Factors impacting learning (disruptive and uninterested students) and student achievement in reading, mathematics and science, Australia and the international average

	Students in Classrooms Where Teachers Report Instruction Is Limited by Disruptive Students								Students in Classrooms Where Teachers Report Instruction Is Limited by Uninterested Students							
	Not at all				Some or a lot				Not at all				Some of a lot			
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE
	Reading															
Australia	86	2.7	535	3.2	14	2.7	509	5.2	95	1.7	533	2.9	5	1.7	503	11.0
International average (PIRLS)	88	0.3	514	0.4	12	0.3	501	1.4	90	0.3	515	0.4	10	0.3	494	1.6
	Mathematics															
Australia	86	2.7	523	4.0	14	2.7	494	6.2	94	1.7	521	3.7	6	1.7	487	11.3
International average (TIMSS – Mathematics)	87	0.3	493	0.5	13	0.3	479	1.6	89	0.3	494	0.5	11	0.3	468	1.9
	Science															
Australia	86	2.7	523	3.8	14	2.7	497	6.2	94	1.7	521	3.6	6	1.7	494	11.7
International average (TIMSS – Science)	87	0.3	488	0.6	13	0.3	472	1.6	89	0.3	489	0.6	11	0.3	463	1.9

With a percentage similar to the international average, 86 per cent of Australian Year 4 students had teachers that reported that disruptive students were *not at all* a limiting factor to their classroom teaching. Around 94 per cent of Australian Year 4 students had teachers that reported uninterested students were also *not at all* a limiting factor to instruction, which was slightly higher than the international average.

Of the participating TIMSS and PIRLS countries, Azerbaijan (99%) had one of the highest percentages of students with teachers who reported that disruptive students were *not at all* an issue, while Slovenia (66%) had the smallest percentage. When considering uninterested students as a factor limiting teaching, Japan, the Netherlands and Northern Ireland all had the highest percentages of students (98%) in the *not at all* limited category for TIMSS participants, while Indonesia had the highest percentage of students (99%) among PIRLS countries. Morocco had the smallest percentage of both TIMSS and PIRLS countries (62% and 67%, for TIMSS and PIRLS, respectively).

Australian students whose teachers reported that uninterested or disruptive students did not impact on instruction at all had significantly higher levels of achievement in all three subject areas than students who had teachers that reported *some/a lot* of lessons were limited by such students. A similar pattern was found across participating countries on average.

Teachers' report of working conditions

Teachers' views of the physical environment and working conditions at their school were collected using the following five statements:

- The school building needs significant repair
- Classrooms are overcrowded
- Teachers have too many teaching hours
- Teachers do not have adequate workspace (e.g. for preparation, collaboration or meeting with students)
- Teachers do not have adequate instructional materials and supplies.

Teachers were asked to indicate whether each of these issues was 'not a problem', 'a minor problem', 'a moderate problem' or 'a serious problem' at their school. These responses were combined to create a scale, and students assigned to one of three categories on this scale based on their teachers' responses.

Students in the *hardly any problems* category had a scale score of at least 11.2 in PIRLS (11.3 in TIMSS) and had teachers who reported 'no problems' with three areas and 'minor problems' associated with two, on average.

Students assigned to the *moderate problems* category had a scale score no higher than 8.6 in PIRLS (8.7 in TIMSS) and had teachers who reported 'moderate problems' with three of the five working conditions and 'minor problems' with the remaining two.

All other students were assigned to the *minor problems* category. Table 7.13 shows the proportions of students in each of these three categories and the associated level of average achievement in reading, mathematics and science.

Table 7.13 The Teacher Working Conditions scale and student achievement in reading, mathematics and science, Australia and the international average

	Hardly any problems				Minor problems				Moderate problems				Average scale score	SE
	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE	% of students	SE of %	Average achievement	SE		
	Reading													
Australia	43	4.5	536	4.8	38	4.4	533	5.4	19	2.7	518	6.1	10.8	0.2
International average (PIRLS)	27	0.5	518	0.9	48	0.6	514	0.7	25	0.5	509	0.9		
	Mathematics													
Australia	44	4.2	531	6.2	37	4.1	513	5.2	19	2.7	505	8.4	10.9	0.2
International average (TIMSS – Mathematics)	26	0.5	498	1.1	47	0.5	491	0.7	27	0.5	487	1.0		
	Science													
Australia	45	4.1	528	5.6	37	4.3	514	5.9	18	2.6	507	8.1	10.9	0.2
International average (TIMSS – Science)	26	0.5	494	1.2	47	0.5	487	0.8	27	0.5	481	1.1		

Around 44 per cent of Australian students had teachers who reported *hardly any problems* with their working conditions, which was significantly greater than the international average. In fact, Australia was in the top five countries for PIRLS and top six countries for TIMSS on this scale. Around 37 per cent of students had teachers that reported *minor problems* and around 18 per cent reported *moderate problems*. Australian Year 4 students' percentages for these latter two categories were below the international average.

Poland and the United States had the highest percentage of students with teachers reporting *hardly any problems* with working conditions among participating TIMSS and PIRLS countries, at 49%

(this dropped to 47% for the United States when only PIRLS countries were considered). Tunisia (4%) had the lowest percentage of students in this category among TIMSS countries and Morocco (5%) had the lowest among PIRLS countries

Australian students whose teachers reported *hardly any problems* had significantly higher levels of achievement in reading and science than students in the *moderate problems* category. There was no difference in the reading or science scores of students in the *hardly any problems* category and the *minor problems* category, or between scores of students in the *minor problems* and *moderate problems* categories, however. In mathematics, students whose teachers reported *hardly any problems* scored higher on average than those students whose teachers reported *minor problems* or *moderate problems*, but there was no difference in the average mathematics scores of these two latter groups of students.

The next, and final, chapter of this report presents a summary of the findings and considerations for policy-makers.

Chapter

8 Summary and Policy Considerations

Developing the knowledge and skills of young people in the key areas of reading, mathematics and science is important to a society in terms of future prosperity and well-being. Education systems play a vital role not only in developing students' knowledge and skills, but also in strengthening students' disposition towards learning at school and beyond. For those reasons an increasing number of education systems around the world monitor student performance at key points of schooling to provide information about how well young people are being prepared for life.

National tests in literacy and numeracy carried out in Australia for Years 3, 5, 7 and 9 provide some of this monitoring information. Comparative international studies such as the Trends in International Mathematics and Science Study (TIMSS), the Progress in International Reading Literacy Study (PIRLS) and the Programme for International Student Assessment (PISA) can provide an international context within which to interpret national results.

TIMSS and PIRLS have a more explicit curriculum focus than PISA and provide data against a framework in which most areas of the curriculum examined are covered in most countries. The goal of TIMSS and PIRLS is to provide comparative information about educational achievement across countries in order to improve teaching and learning in reading, mathematics and science. To achieve this goal, TIMSS measures achievement in mathematics and science at Year 4 and Year 8 and, as it has collected data every four years since 1995, is able to monitor trends in achievement and provision of resources, as well as monitoring curricular implementation. PIRLS measures achievement in reading, and has done so every five years since 2001. While Australia has participated in TIMSS in each cycle since 1995, this is the first time we have participated in PIRLS.

This report details results from the participation by Australian Year 4 students in the combined TIMSS and PIRLS 2011 study (for which Australia collected data in late 2010); reporting achievement internationally and nationally for the states and territories, for males and females, and for designated equity groups, as agreed by Education Ministers to enable reporting against the National Goals for Schooling. The samples of schools and students were large and nationally representative.

Summary

TIMSS and PIRLS in Australia

In Australia, 280 primary schools and more than 6000 Year 4 students participated in TIMSS and PIRLS 2011. The same students sat both TIMSS and PIRLS assessments on different days, with the order of sitting the two assessments randomised between schools. The Australian students undertook the assessment in late 2010, while their northern hemisphere counterparts completed it in early 2011 ensuring that students in all countries were assessed at around the same stage of their school year. Students in the smaller states and Indigenous students were oversampled so that reliable estimates could be drawn for each of the individual states and for Indigenous students nationally.

International performance in reading, mathematics and science

Reading

Australia's average score of 527 score points was significantly higher than that of 17 other countries, but was significantly lower than the scores of 21 countries, including the high achieving Asian countries but also including Northern Ireland, the United States, England and Canada. Australia's score was similar to that of New Zealand.

Within Australia, students in the Australian Capital Territory scored at a significantly higher level than students in any other state, while those in New South Wales and Victoria outperformed students in Queensland, South Australia, Western Australia and the Northern Territory.

Mathematics

In TIMSS 2011, Australian Year 4 students' average performance in mathematics was significantly higher than that achieved in TIMSS 1995 but remains unchanged since TIMSS 2007. Australia's score was lower than that of a large group of countries, including the high performing Asian countries – Singapore, Korea, Hong Kong, Chinese Taipei and Japan – and also countries such as Northern Ireland, England, the United States and Ireland. Slovenia, Czech Republic and Austria, whose relative positions were significantly lower than Australia in 2007, have recently caught up and are now at the same level, while Denmark, which had the same relative position as Australia in 2007, has now outperformed Australia. In terms of trends since 1995, the Czech Republic and Portugal both scored significantly lower than Australia in 1995 but the Czech Republic has since gained the same relative position as Australia in 2011, and Portugal scored significantly higher than Australia in TIMSS 2011.

Science

Australian students' scores in TIMSS 2011 had declined significantly from TIMSS 2007. Australia was outperformed by students in 18 other countries, including the United States, England and the Slovak Republic, as well as the participating Asian countries Korea, Singapore, Japan, Chinese Taipei and Hong Kong. In TIMSS 2007, Singapore, Japan, Chinese Taipei, the Russian Federation, the United States, Hong Kong and England similarly outperformed Australia. However, the Czech Republic and Denmark performed at a significantly lower level, and Hungary, Sweden, Austria, the Slovak Republic, the Netherlands, Germany and Italy all performed at a level similar to Australia in TIMSS 2007 – but all outperformed Australia in TIMSS 2011.

International benchmarks

Achievement is not only measured in terms of mean scores, but also using benchmarks: put simply, what students can and cannot do regarding the curriculum. An examination of the international data shows that countries with similar mean scores might have different profiles of performance and both the profiles and the overall mean score are important for considering policy directions. International benchmarks were developed to describe performance at four levels. These were the Advanced, High, Intermediate and Low benchmarks. In addition to having students grouped by their mean scores, it is also therefore possible to obtain a picture of the skills and knowledge that students at each level typically possess. At the advanced level, students typically are able to understand complex or abstract ideas and to interpret and apply these ideas. At the other end of the continuum are students at the Low international benchmark, who have basic knowledge and skills and are limited in their ability to apply this knowledge or skills. The report also highlights the proportions of students who do not achieve this Low benchmark as these students may be at risk educationally. While having a large proportion of students achieving at the highest level is clearly something to which to aspire, it is also important that a country has as few students as possible below the Low benchmark.

While no minimum standard of proficiency has been set for PIRLS at this stage, the minimum standard set for TIMSS in mathematics and science is the performance at the Intermediate Benchmark and is therefore deemed to be a useful standard for this report for all three domains.

In reading at Year 4, 10 per cent of Australian students achieved the Advanced international benchmark. While not as high as some of the high scoring countries such as Singapore (24%), Northern Ireland or the Russian Federation (19%), or as high as New Zealand (14%), this is better than that achieved by some of the other higher scoring countries such as the Netherlands (7%) or Czech Republic (8%). However, almost one-quarter (24%) of Australian students failed to achieve the Intermediate benchmark, with 17 per cent of those achieving the Low benchmark and seven per cent failing to achieve this level. Comparing Australia to the United States, as an example, 17 per cent of students in the United States achieved the Advanced benchmark, with 14 per cent failing to achieve the Intermediate benchmark.

In mathematics at Year 4, ten per cent of Australian students achieved the Advanced international benchmark, which is about the same as TIMSS 2007. At the other end of the achievement scale, almost one-third (30%) of Year 4 students did not achieve the Intermediate benchmark. Comparisons can be made again to the United States, in which 13 per cent of students achieved the Advanced benchmark, and 19 per cent failed to achieve the Intermediate benchmark.

Similarly in science at Year 4, seven per cent of Australian students achieved the Advanced international benchmark, which was lower than in previous cycles. Twenty-nine per cent of students did not achieve the Intermediate benchmark. Comparisons can again be made with the United States, in which 15 per cent of students achieved the Advanced benchmark, while 19 per cent did not achieve the Intermediate benchmark.

Gender differences

In Year 4 in TIMSS 2011, as in previous cycles, there were no significant gender differences in either mathematics or science in Australia. This is the case in the majority of participating countries, however there are still a substantial number of countries in which the gender difference in favour of males, albeit small, is still significant, and a handful of countries in which the gender difference is slightly larger and in favour of females. The only significant gender difference at the jurisdictional level was found in South Australia, where males significantly outperformed females in mathematics.

In PIRLS, however, as is also found in PISA, the gender differences in reading internationally are generally more substantial and always in favour of females. Within Australia, the gender differences were only found to be significant in Western Australia, Queensland and Victoria.

Performance within Australia

The major purpose of this report is to study achievement in reading, mathematics and science within an international framework. This enables us to compare Australian students' achievement against that of students in other countries using a standard instrument and standard procedures. In addition to this the report examines results for each of the States and Territories of Australia.

Reading

The performance of Year 4 students in the Australian Capital Territory was significantly higher in reading than that of students in all other states. The performance of students in New South Wales and Victoria were not significantly different to each other, and both scored significantly higher than students in the remaining states, with the exception of Tasmania.

At Year 4, the international median proportion of students reaching the Advanced benchmark in reading was eight per cent. The Australian Capital Territory did substantially better than this, with 17 per cent of its students achieving at the highest benchmark, followed by Victoria and New South Wales both with 12 per cent and Tasmania with 11 per cent of its students achieving at this level.

At the same time, the international median for the proportion of students not reaching the Intermediate benchmark was 20 per cent, with the Australian Capital Territory the only jurisdiction to achieve better results than this (i.e. fewer students were below the Intermediate

benchmark) with 13 per cent of students not achieving this level. As a comparison, in Hong Kong 18 per cent of students achieved the Advanced international benchmark and just seven per cent of students failed to achieve the Intermediate benchmark.

Mathematics

The performance of students in the Australian Capital Territory was significantly higher than that of students in all states except Victoria. The performance of students in Victoria and New South Wales was not significantly different to each other, but were significantly higher than performance of students in all remaining states with the exception of Tasmania.

Within Australia, the Australian Capital Territory was the only jurisdiction to show a significant increase in average scores from TIMSS 2007; however the scores for New South Wales, Victoria, South Australia and Tasmania all showed a significant increase from TIMSS 1995. Queensland and Northern Territory are the only two states that have registered no statistically significant gains in Year 4 mathematics achievement across all the cycles of TIMSS assessment. In the other states there were minor changes but none reaching statistical significance.

At Year 4, the international median proportion of students reaching the Advanced benchmark was four per cent. Several states had substantially higher proportions of students at this level – the Australian Capital Territory (14%), Victoria (13%), New South Wales (12%) and Tasmania (10%). At the same time, the international median for the proportion of students not reaching the Intermediate benchmark was 31 per cent, and the Australian Capital Territory (19%), Victoria (25%) and New South Wales (26%) all achieved better results than this (i.e. fewer students were below the Intermediate benchmark). As a comparison, in Singapore 43 per cent of students achieved the Advanced international benchmark and six per cent of students failed to achieve the Intermediate benchmark.

Science

The average science score of students in the Australian Capital Territory was significantly higher than that of students in all other states. The performance of students in New South Wales and Victoria were not significantly different to each other, with students in both of these jurisdictions scoring significantly higher than students in all remaining states, with the exception of Tasmania.

Among the Australian states and territories, there was a significant increase in scores in the Australian Capital Territory, and a significant decline in scores in New South Wales from the TIMSS 2007 assessment. While the differences in scores between TIMSS 2007 and TIMSS 2011 were not significant, in all states other than Queensland the trend was for scores to have dropped, all contributing towards the cumulative lower score for the country as a whole.

The international median proportion of students reaching the Advanced benchmark in science at Year 4 was five per cent. Several states had substantially higher proportions of students at this level – the Australian Capital Territory (13%), Victoria (10%), New South Wales (9%) and Tasmania (9%). At the same time, the international median for the proportion of students not reaching the Intermediate benchmark was 28 per cent, and the Australian Capital Territory (16%), Victoria (23%) and New South Wales (26%) all achieved better results than this (i.e. fewer students were below the Intermediate benchmark). As a comparison, in Korea 29 per cent of students achieved the Advanced international benchmark and five per cent of students failed to achieve the Intermediate benchmark.

Books in the home

The number of books in the home has traditionally acted as a proxy in large scale international studies for a family's educational and social background. Generally, there is a strong correlation between books in the home and parental education and income, and a moderate to strong positive correlation between books in the home and achievement. Nevertheless this relationship does not always work between countries. For example on average, Australian students reported a

greater number of books in the home than students in most other countries yet achievement levels for Australia overall were not substantially better than those of students in these other countries. However, within Australia, the relationship is strong. In each of the domains covered by PIRLS and TIMSS, the average score for students who reported having many (i.e. more than 200) books in the home was significantly and substantially higher than that of students who reported an average number (i.e. between 26 and 200) of books in the home, and this score was in turn, in each domain, higher than the score for students with few books in the home. This relationship was the same in all countries.

Indigenous students

At Year 4 the average score for Indigenous students in reading, mathematics and science was around 60 score points lower than that of their non-Indigenous counterparts. This gap has declined from TIMSS 2007 (back to TIMSS 2003 and TIMSS 1995 levels) due to a significant increase in the scores of Indigenous students in mathematics between TIMSS 2007 and TIMSS 2011, and a significant decrease in the scores of non-Indigenous students in science over the same period. In mathematics, the average scores for both Indigenous and non-Indigenous students have shown a trend upwards since TIMSS 1995, whereas in science there has been little change for either group.

In terms of benchmarks, which represent what students can and cannot do, it is notable that around half of the Indigenous students tested, in all three domains, did not reach the Intermediate benchmark.

Student attitudes

Developing positive attitudes towards reading, mathematics and science are important goals of the curriculum, particularly in primary school. Within Australia, students who expressed more positive attitudes and reported a higher level of self-confidence in reading, mathematics and science scored higher in the cognitive assessments than those who expressed less positive attitudes.

A lack of motivation to read was associated with lower achievement and the difference in achievement between those who were motivated to read and those who were not was greater among males and Indigenous students.

Female students in Australia were more likely to express a liking of and greater confidence in reading than male students, while male students were more likely than female students to express a liking of and greater confidence in learning mathematics.

Attending a pre-primary education program was associated with higher reading, mathematics and science achievement. In general, students whose parents often engaged their child in early literacy and numeracy activities before beginning primary school had higher reading and mathematics achievement (respectively) than students whose parents only sometimes engaged them in such activities. Correspondingly, students whose parents reported that their child performed very well on early literacy and numeracy tasks when they entered primary school had higher reading and mathematics achievement (respectively) than students who were reported to perform moderately well or not well.

School environments fostering learning

There is a body of literature that argues that successful schools have ambitious but reasonable goals and work towards implementing them (Teddlie & Reynolds, 2000). A supportive school climate helps to build better morale among teachers and students, leading to higher student achievement. The results from TIMSS and PIRLS suggest that reading, mathematics and science achievement was highest in schools in which principals and teachers had a positive view of

the school climate, including high levels of teacher job satisfaction, expectations for student achievement and parental support.

For students to have the opportunity to learn, they need to attend school regularly. As well, student learning can be more difficult in schools where students are frequently absent or late for class. Internationally and in Australia, achievement was highest among students attending schools with few attendance or disciplinary problems.

Resources to support mathematics and science learning

Access to facilities, equipment and materials can enhance curriculum implementation and instruction. Achievement was highest in schools where principals reported that resource shortages were not a problem. Teachers can be considered the most important resource of all and the supply of qualified teachers is problematic in some areas, such as remote schools and schools in poorer socioeconomic areas. Relatively few students were taught by younger teachers; the majority of students were taught by teachers aged between 30 and 50 years of age.

Policy considerations

The results of TIMSS 2011 show that Australia's scores in mathematics and science have largely stagnated over the past 16 years. The only area in which Australian achievement has shown improvement over this time has been in mathematics at Year 4 (and this increase occurred between TIMSS 2007 and TIMSS 2003); while our first participation in PIRLS has highlighted that many Year 4 students have substantial literacy problems.

Over this same time, a number of other countries have either dramatically improved their results (Singapore and Hong Kong, for example), or slowly but surely improved (for example the United States in mathematics). Many more countries now outperform Australia in mathematics and science than they did in TIMSS 1995 or in TIMSS 2007, and we have seen that a substantial proportion of developed countries also outperform Australia in PIRLS.

It is clear that in each of the three areas – reading, mathematics and science – Australia has a substantial 'tail' of underperformance. For such a highly developed country, this level of underperformance is not acceptable and its minimisation should become a priority. Examining policy in countries such as the Netherlands, in which all students attained at least the Low benchmark in reading, could provide some pointers. If the seven per cent of students in Australia currently not achieving this very basic level of literacy were to do so, it would lift Australia's overall average score substantially.

In addition, more attention needs to be paid to extending students at the highest levels of achievement. In comparison to higher achieving countries, the proportion of Australian students at the High and Advanced benchmarks is modest.

Science at the primary level continues to be a concern. In comparison to the international average, few primary teachers have a science background, compared to mathematics and reading there is substantially less professional development undertaken in science, and teachers' reported level of confidence in teaching science is substantially lower than their confidence in teaching reading or mathematics. Only around half of the students in TIMSS were being taught science by teachers who felt *well prepared* to teach all science topics, and this dipped to less than half for the particular areas of physical and Earth science.

It is evident that student motivation and self-confidence are also important factors within Australia. Similarly, teachers' job satisfaction is important, as is the provision of a supportive, ambitious school climate. It is important that Australia continues to develop systems that build accountability and support capacity building for teachers and school management in order to address attitudinal barriers towards teaching and learning, particularly in specific subject areas such as reading, mathematics and science.

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Appendix

1

Sampling in TIMSS and PIRLS

The TIMSS and PIRLS 2011 assessments were administered to carefully-drawn random samples of students from the target population in each country. Because the accuracy of the assessment results depends on the quality of the national samples, the TIMSS and PIRLS study center worked with participating countries on all phases of sampling to ensure efficient sampling design and implementation.

National coordinators were trained in how to select the school and student samples, and in how to use the WinW3S 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 & PIRLS International Study Center (in consultation with Statistics Canada and the sampling referee) to evaluate the quality of the samples.

In a few situations where it was not possible to test the entire international target population (i.e. all students enrolled in Year 4), countries were permitted to define a target population that excluded part of the international target population. Tables A1.1 and A1.2 show any differences in coverage between the international and the national target populations for the PIRLS and TIMSS participating countries. Almost all participants achieved 100% coverage, the exceptions being Georgia (tested only students taught in Georgian) and Lithuania (tested only students taught in Lithuanian) in TIMSS and PIRLS, while Kuwait, who participated in TIMSS only, limited their population to students in public schools.

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). Almost all countries kept their excluded students below the five per cent limit. Exceptions in PIRLS included Azerbaijan, Belgium (French-speaking), Canada, Croatia, Denmark, Lithuania, Qatar, Singapore and the United States, which excluded more than five but less than 10 per cent of their Year 4 population, and Israel, which excluded more that 20 per cent of its Year 4 student population. In TIMSS, Azerbaijan, Croatia, Denmark, Hong Kong, Kazakhstan, Lithuania, Qatar, Serbia, Singapore and the United States also excluded more than five but less than 10 per cent of their Year 4 students.

The basic design of the sample used in TIMSS and PIRLS 2011 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. Some countries elected to conduct TIMSS and PIRLS with the same students, while others selected separate samples for each study.

Table A1.1 Coverage of Year 4 population – PIRLS

Country		International Target Population		Exclusions from National Target Population		
		Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
	Australia	100%		2.1%	2.3%	4.4%
	Austria	100%		1.3%	3.8%	5.1%
2 a	Azerbaijan	100%		2.3%	4.9%	7.2%
2	Belgium	100%		3.5%	2.1%	5.6%
	Bulgaria	100%		1.2%	1.3%	2.5%
2	Canada	100%		4.1%	5.8%	9.9%
	Chinese Taipei	100%		0.1%	1.4%	1.4%
	Colombia	100%		1.2%	0.3%	1.5%
2	Croatia	100%		2.9%	5.0%	7.9%
	Czech Republic	100%		4.1%	0.9%	5.1%
2	Denmark	100%		1.6%	5.8%	7.3%
	England	100%		1.7%	0.8%	2.4%
	Finland	100%		1.6%	1.5%	3.1%
	France	100%		4.9%	0.3%	5.2%
1 a	Georgia	92%	Students taught in Georgian	1.4%	3.5%	4.9%
	Germany	100%		0.9%	1.0%	1.9%
3	Hong Kong	100%		9.1%	2.7%	11.8%
	Hungary	100%		2.2%	2.0%	4.2%
	Indonesia	100%		2.4%	0.0%	2.5%
	Iran	100%		4.4%	0.1%	4.5%
	Ireland	100%		1.6%	0.9%	2.5%
3	Israel	100%		18.5%	6.0%	24.6%
	Italy	100%		0.0%	3.7%	3.7%
1 2	Lithuania	93%	Students taught in Lithuanian	1.9%	3.7%	5.6%
	Malta	100%		0.0%	3.6%	3.6%
	Morocco	100%		2.0%	0.0%	2.0%
	Netherlands	100%		3.7%	0.0%	3.7%
	New Zealand	100%		1.3%	2.0%	3.3%
	Northern Ireland	100%		2.6%	0.9%	3.5%
	Norway	100%		0.9%	3.3%	4.2%
	Oman	100%		0.8%	0.7%	1.5%
	Poland	100%		2.3%	1.5%	3.8%
	Portugal	100%		1.4%	1.1%	2.5%
2	Qatar	100%		4.3%	1.9%	6.2%
	Romania	100%		1.1%	2.9%	4.0%
	Russian Federation	100%		2.9%	2.4%	5.3%
	Saudi Arabia	100%		1.4%	0.2%	1.6%
2	Singapore	100%		5.9%	0.4%	6.3%
	Slovak Republic	100%		3.8%	0.8%	4.6%
	Slovenia	100%		2.3%	0.3%	2.6%
	Spain	100%		1.6%	3.7%	5.4%
	Sweden	100%		1.9%	2.2%	4.1%
	Trinidad and Tobago	100%		0.9%	0.0%	0.9%
	United Arab Emirates	100%		1.4%	1.8%	3.3%
2	United States	100%		0.0%	7.2%	7.2%

1 National Target Population does not include all of the International Target Population.

2 National Defined Population covers 90% to 95% of National Target Population.

3 National Defined Population covers less than 90% of National Target Population.

a Exclusion rates for Azerbaijan and Georgia are slightly underestimated as some conflict zones were not covered and no official statistics were available.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Table A1.2 Coverage of Year 4 population – TIMSS

Country		International Target Population		Exclusions from National Target Population		
		Coverage	Notes on Coverage	School-level Exclusions	Within-sample Exclusions	Overall Exclusions
	Armenia	100%		2.0%	0.0%	2.0%
	Australia	100%		2.1%	2.3%	4.4%
	Austria	100%		1.3%	3.8%	5.1%
2 a	Azerbaijan	100%		2.3%	4.9%	7.2%
	Bahrain	100%		0.4%	0.7%	1.1%
	Belgium	100%		0.5%	4.5%	5.0%
	Chile	100%		1.8%	1.9%	3.7%
	Chinese Taipei	100%		0.1%	1.4%	1.4%
2	Croatia	100%		2.9%	5.0%	7.9%
	Czech Republic	100%		4.1%	0.9%	5.1%
2	Denmark	100%		1.6%	4.7%	6.3%
	England	100%		1.7%	0.4%	2.0%
	Finland	100%		1.6%	1.5%	3.1%
1 a	Georgia	92%	Students taught in Georgian	1.4%	3.5%	4.9%
	Germany	100%		0.9%	1.0%	1.9%
2	Hong Kong	100%		5.8%	2.7%	8.6%
	Hungary	100%		2.2%	2.0%	4.2%
	Iran	100%		4.4%	0.1%	4.5%
	Ireland	100%		1.6%	0.9%	2.5%
	Italy	100%		0.0%	3.7%	3.7%
	Japan	100%		2.2%	1.0%	3.2%
2	Kazakhstan	100%		3.7%	2.5%	6.3%
	Korea	100%		1.5%	1.0%	2.5%
1	Kuwait	78%	Students in public schools	0.3%	0.0%	0.3%
1 2	Lithuania	93%	Students taught in Lithuanian	1.9%	3.7%	5.6%
	Malta	100%		0.0%	3.6%	3.6%
	Morocco	100%		2.0%	0.0%	2.0%
	Netherlands	100%		3.7%	0.4%	4.0%
	New Zealand	100%		2.8%	2.2%	4.9%
	Northern Ireland	100%		2.6%	0.9%	3.5%
	Norway	100%		0.9%	3.3%	4.3%
	Oman	100%		0.8%	0.7%	1.5%
	Poland	100%		2.3%	1.5%	3.8%
	Portugal	100%		1.4%	1.1%	2.5%
2	Qatar	100%		4.3%	1.9%	6.2%
	Romania	100%		1.1%	2.9%	4.0%
	Russian Federation	100%		2.9%	2.4%	5.3%
	Saudi Arabia	100%		1.4%	0.2%	1.6%
2	Serbia	100%		5.3%	4.1%	9.4%
2	Singapore	100%		5.9%	0.4%	6.3%
	Slovak Republic	100%		3.8%	0.8%	4.6%
	Slovenia	100%		2.3%	0.3%	2.6%
	Spain	100%		1.6%	3.6%	5.3%
	Sweden	100%		1.9%	2.2%	4.1%
	Thailand	100%		1.5%	0.0%	1.5%
	Tunisia	100%		2.3%	0.1%	2.5%
	Turkey	100%		1.0%	1.5%	2.5%
	United Arab Emirates	100%		1.4%	1.8%	3.3%
2	United States	100%		0.0%	7.0%	7.0%
	Yemen	100%		3.0%	0.7%	3.7%

1 National Target Population does not include all of the International Target Population.

2 National Defined Population covers 90% to 95% of National Target Population.

3 National Defined population covers less than 90% of National Target population (but at least 77%).

a Exclusion rates for Azerbaijan and Georgia are slightly underestimated as some conflict zones were not covered and no official statistics were available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Tables A1.3 and A1.4 show the participation rates for schools, students and overall – both with and without the use of replacement schools. Most countries achieved the minimum acceptable participation rates – 85 per cent of both the schools and students, or a combined rate (the product of school and student participation) of 75 per cent – although, among PIRLS countries, Belgium (French-speaking only), England, the Netherlands and Northern Ireland did so only after including replacement schools, while Norway nearly met the threshold after inclusion of replacement schools. Among TIMSS countries, the Netherlands and Northern Ireland met the minimum participation rates only after inclusion of replacement schools while Norway was close to the threshold even after inclusion of replacement schools.

Table A1.3 Participation rates (weighted) for Year 4 students – PIRLS

	Country	School Participation		Class Participation	Student Participation	Overall Participation	
		Before Replacement	After Replacement			Before Replacement	After Replacement
	Australia	96%	98%	100%	95%	91%	93%
	Austria	100%	100%	100%	98%	98%	98%
	Azerbaijan	84%	100%	100%	100%	84%	100%
†	Belgium (French)	77%	85%	99%	97%	74%	82%
	Bulgaria	97%	100%	100%	95%	92%	95%
	Canada	98%	98%	100%	96%	94%	94%
	Chinese Taipei	100%	100%	100%	99%	99%	99%
	Colombia	89%	99%	100%	97%	86%	95%
	Croatia	99%	100%	100%	95%	94%	95%
	Czech Republic	90%	99%	100%	94%	85%	94%
	Denmark	87%	98%	100%	97%	84%	95%
†	England	73%	87%	100%	94%	69%	82%
	Finland	97%	99%	100%	96%	93%	95%
	France	98%	100%	100%	98%	96%	97%
	Georgia	97%	98%	100%	98%	95%	96%
	Germany	96%	99%	100%	96%	92%	95%
	Hong Kong	86%	88%	100%	94%	81%	83%
	Hungary	98%	99%	100%	97%	94%	96%
	Indonesia	100%	100%	100%	97%	97%	97%
	Iran	100%	100%	100%	99%	99%	99%
	Ireland	98%	100%	100%	95%	93%	95%
	Israel	98%	99%	100%	94%	92%	93%
	Italy	81%	98%	100%	96%	78%	95%
	Lithuania	94%	100%	100%	94%	89%	94%
	Malta	100%	100%	100%	95%	95%	95%
	Morocco	99%	99%	100%	96%	95%	95%
†	Netherlands	68%	92%	100%	97%	66%	89%
	New Zealand	93%	99%	100%	94%	87%	93%
†	Northern Ireland	62%	85%	100%	93%	58%	79%
‡	Norway	57%	83%	100%	86%	49%	71%
	Oman	98%	98%	100%	98%	96%	96%
	Poland	100%	100%	100%	96%	96%	96%
	Portugal	87%	99%	100%	95%	83%	93%
	Qatar	100%	100%	100%	99%	99%	99%
	Romania	99%	100%	100%	97%	96%	97%
	Russian Federation	100%	100%	100%	98%	98%	98%
	Saudi Arabia	95%	100%	100%	98%	94%	98%
	Singapore	100%	100%	100%	96%	96%	96%
	Slovak Republic	95%	99%	100%	97%	92%	96%
	Slovenia	96%	97%	100%	97%	94%	95%
	Spain	96%	99%	100%	97%	93%	96%
	Sweden	97%	99%	100%	92%	88%	91%
	Trinidad and Tobago	99%	99%	100%	96%	95%	95%
	United Arab Emirates	100%	100%	100%	97%	97%	97%
	United States	80%	85%	100%	96%	77%	81%

PIRLS guidelines for sampling participation: The minimum acceptable participation rates were 85 per cent of both schools and students, or a combined rate (the product of school and student participation) of 75 per cent. Participants not meeting these guidelines were annotated as follows:

† Met guidelines for sample participation rates only after replacement schools were included.

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

¶ Did not satisfy guidelines for sample participation rates.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Table A1.4 Participation rates (weighted) for Year 4 students – TIMSS

	Country	School Participation		Class Participation	Student Participation	Overall Participation	
		Before Replacement	After Replacement			Before Replacement	After Replacement
	Armenia	100%	100%	100%	98%	98%	98%
	Australia	96%	98%	100%	95%	91%	93%
	Austria	100%	100%	100%	98%	98%	98%
†	Azerbaijan	84%	100%	100%	100%	84%	100%
	Bahrain	92%	92%	100%	98%	90%	90%
	Belgium (Flemish)	76%	95%	99%	98%	75%	92%
	Chile	86%	99%	100%	96%	82%	95%
	Chinese Taipei	100%	100%	100%	99%	99%	99%
	Croatia	99%	100%	100%	95%	94%	95%
	Czech Republic	90%	99%	100%	95%	85%	94%
	Denmark	79%	92%	100%	95%	75%	87%
	England	81%	83%	100%	94%	76%	78%
	Finland	97%	99%	100%	96%	93%	96%
	Georgia	97%	98%	100%	99%	95%	96%
	Germany	96%	99%	100%	96%	92%	95%
	Hong Kong	87%	88%	100%	93%	81%	82%
	Hungary	98%	99%	100%	97%	94%	96%
	Iran	100%	100%	100%	99%	99%	99%
	Ireland	97%	99%	100%	95%	93%	95%
	Italy	81%	98%	100%	97%	78%	95%
	Japan	96%	99%	100%	97%	93%	97%
	Kazakhstan	99%	100%	100%	99%	98%	99%
	Korea	100%	100%	100%	98%	98%	98%
	Kuwait	99%	99%	99%	94%	91%	91%
	Lithuania	94%	100%	100%	94%	89%	94%
	Malta	100%	100%	100%	95%	95%	95%
	Morocco	100%	100%	100%	97%	96%	96%
†	Netherlands	49%	82%	99%	97%	47%	79%
	New Zealand	83%	96%	100%	94%	77%	90%
†	Northern Ireland	62%	85%	100%	93%	58%	79%
‡	Norway	57%	82%	100%	85%	48%	70%
	Oman	98%	98%	100%	98%	96%	96%
	Poland	100%	100%	100%	96%	96%	96%
	Portugal	87%	98%	99%	94%	81%	92%
	Qatar	100%	100%	100%	99%	99%	99%
	Romania	99%	100%	100%	98%	97%	97%
	Russian Federation	100%	100%	100%	98%	98%	98%
	Saudi Arabia	95%	100%	100%	99%	94%	99%
	Serbia	97%	100%	100%	97%	94%	97%
	Singapore	100%	100%	100%	96%	96%	96%
	Slovak Republic	95%	99%	100%	96%	91%	96%
	Slovenia	96%	97%	100%	97%	93%	94%
	Spain	96%	99%	100%	97%	94%	97%
	Sweden	97%	99%	100%	92%	89%	91%
	Thailand	85%	100%	100%	99%	84%	99%
	Tunisia	100%	100%	100%	99%	99%	99%
	Turkey	97%	100%	100%	98%	95%	98%
	United Arab Emirates	100%	100%	100%	97%	97%	97%
	United States	79%	84%	100%	95%	76%	80%
	Yemen	99%	99%	100%	97%	95%	95%

TIMSS guidelines for sampling participation: The minimum acceptable participation rates were 85 per cent of both schools and students, or a combined rate (the product of school and student participation) of 75 per cent. Participants not meeting these guidelines were annotated as follows:

† Met guidelines for sample participation rates only after replacement schools were included.

‡ Nearly satisfied guidelines for sample participation rates after replacement schools were included.

¶ Did not satisfy guidelines for sample participation rates.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Appendix

2 The PIRLS reading assessment

PIRLS reading purposes and processes

PIRLS defines the two major purposes of reading for Year 4 students, both in and out of school, as:

- Reading for *literary experience*; and
- Reading to *acquire and use information*.

The four types of comprehension processes assessed in PIRLS are:

- To focus on and retrieve explicitly stated information
- To make straightforward inferences
- To interpret and integrate ideas and information; and
- To examine and evaluate content, language and textual elements.

Each of these four processes is assessed within each of the purposes for reading. Please see Table A2.1 for the distribution of items by reading purpose and process category.

Table A2.1 Distribution of the PIRLS reading assessment across the reading purposes and processes

Purposes for Reading	
Literary Experience	50%
Acquire and Use Information	50%
Processes of Comprehension	
Focus on and Retrieve explicitly stated information	20%
Make Straightforward Inferences	30%
Interpret and Integrate Ideas and Information	30%
Examine and Evaluate Content, Language and Textual Elements	20%

The structure of the assessment

The PIRLS 2011 assessment was based on 10 different texts, five for the literary purpose and five for the informational purpose. These ten blocks (consisting of the text and its related items) were distributed across 13 booklets, with each student completing one assessment booklet and questionnaire during the assessment period. In order to replicate a more 'natural' reading experience, two of the blocks (one literary and one informational) were presented in a magazine type lay-out, rather than the traditional assessment booklet style of the other 12 booklets. The magazine style presentation was known as the PIRLS Reader.

Six of the ten blocks were retained from previous PIRLS assessments – two had appeared both in PIRLS 2001 and PIRLS 2006 and four were retained from the PIRLS 2006 assessment. The inclusion of these 'trend' blocks allows countries who have participated in each of the PIRLS assessments to measure trends in the reading achievement of their students. In addition to the trend blocks, four new blocks were developed for debut in the PIRLS 2011 assessment (two literary and two informational).

In total, there were 135 items in the assessment, about half assessing 'literary experience' and half assessing 'acquire and use information'.

Question types and scoring

Two types of questions were used in the PIRLS assessment: multiple-choice items, in which students are required to select the single correct response from four options (generally worth one point), and constructed-response items. About half the PIRLS 2011 items required students to construct their own answers to the questions (with no help from those administering the assessment). The constructed-response items took three different forms:

For **1-point items**, responses were scored as **acceptable** if they included all elements required by the questions and were determined to be accurate based on ideas and information in the text.

For **2-point items**, responses that were given **full credit** demonstrated complete comprehension by providing appropriate inferences and interpretations consistent with the text and adequate textually-based support if required. Responses were given **partial credit** (1 point), if they included only some of the information or demonstrated only a literal understanding when an inference or interpretation was required.

For **3-point items**, responses were given **full credit** if they demonstrated extensive comprehension by presenting relatively complex, abstract ideas or by providing substantial textual support for inferences and interpretations. Responses were considered **satisfactory** and given 2 points if they contained all the required elements but did not provide complex or abstract ideas, were more literal than interpretive, or were weak in textually-based support. **Minimal** responses (1 point) contained some but not all of the required elements.

For students to demonstrate achievement in the reading comprehension process being assessed by multipoint items, usually the response needed to receive full credit. That is, a more literal response to an item requiring interpretation, integration or evaluation of ideas in the text did provide text-based information, demonstrating that the student could locate and retrieve information. However, this type of response did not demonstrate that the student was able to interpret, integrate or evaluate the information in the text.

So, even though students providing such literal responses received partial credit, the partial credit responses did not necessarily reflect competence in the comprehension process being assessed.

The sets of items identified by the scale anchoring analysis represented the accomplishments of students reaching each successively higher benchmark, and were used by the PIRLS 2011 Reading Development Group (RDG) to develop the benchmark descriptions.

PIRLS international benchmarks

Development of the benchmark descriptions

For each benchmark, the work of the RDG involved developing a short description for each anchor item that characterised the reading skills and strategies demonstrated by students answering it successfully (and for multipoint constructed-response questions, according to whether students answered partially or fully).

Then, the RDG summarised students' reading comprehension skills and strategies across the set of items for each benchmark to provide more general statements of achievement.

The TIMSS & PIRLS International Study Center conducted a scale anchoring analysis to develop descriptions of achievement at the PIRLS 2011 international benchmarks. The scale anchoring data provided a basis for describing students' performance at different points on the reading achievement scale in terms of the types of texts they were asked to read, the types of items they were able to answer successfully and the quality of their answers (for multipoint constructed-response questions). In addition to the data analysis component to identify items that discriminated between successive points on the scale, the process also involved a judgemental component in which the PIRLS 2011 committee of reading experts examined the content of the texts and items and generalised to describe students' comprehension skills and strategies.

For the scale anchoring data analysis, the students' achievement results from all the participating countries and provinces were pooled, so that the benchmark descriptions refer to all students achieving at that level. Thus, in determining performance in relation to the benchmarks, it does not matter what country or province a student is from, only how he or she performed on the test. Considering students' reading achievement scale scores, criteria were applied to identify the sets of items that students reaching each international benchmark were likely to answer correctly and that those at the next lower benchmark were unlikely to answer correctly.

For example, a multiple-choice item anchored at the Advanced International Benchmark if at least 65 per cent of students scoring at 625 answered the item correctly and fewer than 50 per cent of students scoring at the High International Benchmark (550) answered correctly. Similarly, a multiple-choice item anchored at the High International Benchmark if at least 65 per cent of students scoring at 550 answered the item correctly and fewer than 50 per cent of students scoring at the Intermediate International Benchmark answered it correctly; and so on, for each successively lower benchmark. Since constructed-response questions nearly eliminate guessing, the criterion for the constructed-response items was simply 50 per cent at the particular benchmark, and, for multipoint items, the analysis differentiated between partial-credit and full-credit responses.

Interpretation of the PIRLS benchmarks

In thinking about the reading demands underlying any assessment question, there is, of course, a substantial interaction between the sophistication of the comprehension required by the question, the length and complexity of the text and the likelihood of the students' familiarity with the reading content and structure. Although the PIRLS 2011 texts were constrained by the assessment situation, they still varied in features such as length, syntactic complexity, vocabulary, abstractness of ideas and organisational structure. In particular, because of the differences between the literary and informational texts, the benchmark descriptions are presented separately for the two reading purposes. It should also be kept in mind that the descriptions of reading skills and strategies at the PIRLS 2011 benchmarks were developed on the basis of these texts, and are intended to explain differences in achievement on the PIRLS 2011 assessment. The descriptions do not purport to encompass all reading situations encountered by Year 4 students.

To support the variety of questions necessary to cover the range of comprehension processes (e.g. locating and retrieving, integrating, evaluating, etc.), the passages ranged in length from around 800 to 1000 words. PIRLS 2011 included a variety of text types within the two purposes. The informational texts included a brochure, a biography, as well as descriptive articles about a scientist, hot-air ballooning and an African tribe.

Regarding the reading comprehension processes assessed by PIRLS, it might seem that locating and extracting explicitly stated information would be less difficult than, for example, making interpretations and integrating ideas across a whole text. Indeed, in previous assessments, students with higher performance on the PIRLS reading achievement scale were more likely than those at lower levels to successfully complete questions requiring interpretation and integration of information.

All texts are not equal, however, and because the PIRLS 2011 texts needed to conform to the assessment situation, they represent a limited view of the universe of texts available to fourth-grade students. It is not the case that interpretive reading tasks are always more difficult than tasks requiring retrieval of explicit information.

For some items, the comprehension processes necessary to answer successfully may vary according to students' experiences. Understanding vocabulary use may be explicit for one student and require interpretation for another.

Year 4 reading – Descriptors of performance at the 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; and
- the 'Low international benchmark', which was set at 400.

Students who did not reach the Low international benchmark are referred to as Below Low. Benchmarks are only one way of examining student performance. The benchmarks discussed in this report are based solely on student performance in PIRLS 2011, on items that were developed specifically for the purpose of that assessment. Some students scoring below a benchmark may very well know or understand some of the concepts that characterise a higher level. It is important to consider performance on the individual items and clusters of items in developing a profile of student achievement in each country.

The remainder of this appendix describes Year 4 students' reading achievement at each of the four benchmarks. For each benchmark, illustrative items and examples of the correct answers are provided. Alongside each example is a table providing the percentage of students in participating countries answering the item correctly, to gain an idea of how Australian students performed.

The description of achievement at each higher benchmark is cumulative, building on the description of achievement demonstrated by students at the next lower benchmark. Students reaching a particular benchmark demonstrated the comprehension skills and strategies characterising that benchmark as well as the competencies of students at any lower benchmarks.

Table A2.2 Descriptions of the PIRLS international benchmarks

Low International Benchmark	Intermediate International Benchmark	High International Benchmark	Advanced International Benchmark
400	475	550	625
Literary When reading literary texts, students can locate and retrieve an explicitly stated detail. **Informational** When reading informational texts, students can locate and reproduce explicitly stated information that is at the beginning of the text.	**Literary** When reading literary texts, students can retrieve and reproduce explicitly stated actions, events and feelings; make straightforward inferences about the attributes, feelings and motivations of main characters; interpret obvious reasons and causes and give simple explanations; and begin to recognise language features and styles. **Informational** When reading informational texts, students can locate and reproduce one or two pieces of information from within the text; and use subheadings, textboxes and illustrations to locate parts of the text.	**Literary** When reading literary texts, students can locate and distinguish significant actions and details embedded across the text; make inferences to explain relationships between intentions, actions, events and feelings, and give text-based support; interpret and integrate story events and character actions and traits from different parts of the text; evaluate the significance of events and actions across the entire story; and recognise the use of some language features (e.g. metaphor, tone, imagery). **Informational** When reading informational texts, students can locate and distinguish relevant information within a dense text or a complex table; make inferences about logical connections to provide explanations and reasons; integrate textual and visual information to interpret the relationship between ideas; and evaluate content and textual elements to make a generalisation.	**Literary** When reading literary texts, students can integrate ideas and evidence across a text to appreciate overall themes; and interpret story events and character actions to provide reasons, motivations, feelings and character traits with full text-based support. **Informational** When reading informational texts, students can distinguish and interpret complex information from different parts of text, and provide full text-based support; integrate information across a text to provide explanations, interpret significance and sequence activities; and evaluate visual and textual features to explain their function.

Year 4 reading – Performance at the Advanced international benchmark

Year 4 students who performed at the Advanced benchmark could integrate information across the texts, and provide full text-based support for their responses. They typically demonstrated success on the knowledge and skills represented by this benchmark, as well as those demonstrated at the High, Intermediate and Low benchmarks.

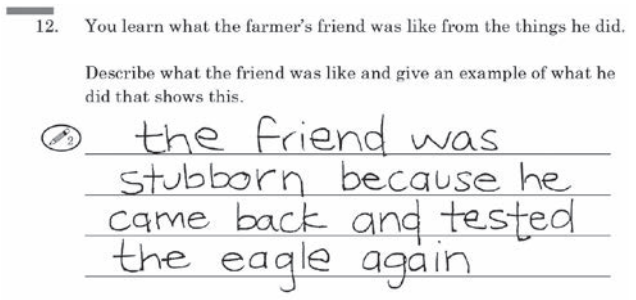
Figure A2.1 shows a *literary* item that required students to *interpret and integrate ideas and information* that was likely to be answered correctly by students who are performing at the Advanced benchmark. In this item, students had to provide a description of the farmer's friend (what he was like) as well as an example of his behaviour in the story that supported this description in order to receive two points.

Country	Percent Full Credit		
Hong Kong	59	(2.2)	↑
Chinese Taipei	55	(2.2)	↑
Israel	50	(2.2)	↑
Russian Federation	50	(2.7)	↑
Singapore	48	(1.9)	↑
Ireland	46	(2.1)	↑
Croatia	45	(1.8)	↑
Italy	45	(2.4)	↑
England	44	(1.9)	↑
Austria	44	(2.1)	↑
Northern Ireland	43	(2.3)	↑
Czech Republic	42	(2.2)	↑
United States	42	(1.2)	↑
Slovak Republic	41	(1.9)	↑
Sweden	40	(2.1)	↑
Bulgaria	39	(2.2)	↑
Portugal	38	(2.1)	↑
Canada	38	(1.4)	↑
Lithuania	38	(1.9)	↑
Finland	38	(2.0)	↑
Denmark	37	(1.6)	↑
Hungary	35	(1.9)	↑
International Avg.	**29**	**(0.3)**	
Poland	28	(1.8)	
Australia	25	(1.8)	↓
Romania	25	(2.0)	↓
Georgia	24	(1.7)	↓
New Zealand	23	(1.6)	↓
Spain	21	(1.5)	↓
Netherlands	20	(1.5)	↓
Colombia	19	(1.7)	↓
Belgium (French)	19	(1.6)	↓
Malta	18	(1.1)	↓
Iran	18	(1.2)	↓
Trinidad and Tobago	18	(1.4)	↓
France	17	(1.0)	↓
Norway	15	(1.5)	↓
Germany	14	(1.2)	↓
United Arab Emirates	14	(0.8)	↓
Slovenia	13	(1.5)	↓
Qatar	12	(1.5)	↓
Oman	7	(0.9)	↓
Azerbaijan	7	(1.5)	↓
Saudi Arabia	4	(0.8)	↓
Indonesia	3	(0.6)	↓
Morocco	1	(0.3)	↓

Purpose: Literary Experience

Process: Interpret and Integrate Ideas and Information

Description: Interpret a character's actions to provide a description of a character trait with a supporting example



The answer shown illustrates the type of student response that was given 2 of 2 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.1 Advanced international benchmark - reading example 1

Less than one-third (29%) of students across PIRLS countries (on average) received credit for their response to this item. One-quarter of Australian students received credit for their answer, which was significantly lower than the international average. The top performing countries on this difficult item, Hong Kong and Chinese Taipei, have over half of their students receive credit.

Figure A2.2 shows an *information* item that was likely to be answered correctly by students who are performing at the Advanced benchmark. Students had to *interpret and integrate ideas and information* in order to successfully complete the table.

Country	Percent Full Credit		
Hong Kong	62	(2.3)	↑
Singapore	57	(1.7)	↑
Chinese Taipei	53	(1.8)	↑
Finland	48	(1.9)	↑
Russian Federation	47	(2.1)	↑
England	46	(2.2)	↑
Sweden	44	(2.4)	↑
Northern Ireland	44	(2.6)	↑
Denmark	44	(1.8)	↑
United States	44	(1.3)	↑
Ireland	44	(2.2)	↑
Croatia	42	(1.7)	↑
Portugal	42	(2.2)	↑
Canada	42	(1.4)	↑
Netherlands	42	(2.1)	↑
Hungary	41	(1.8)	↑
New Zealand	40	(1.6)	↑
Italy	40	(1.9)	↑
Australia	40	(2.0)	↑
Czech Republic	39	(2.1)	↑
Germany	38	(1.7)	↑
Bulgaria	37	(2.2)	↑
Israel	36	(2.1)	
Slovenia	33	(1.8)	
Lithuania	32	(1.8)	
International Avg.	**32**	**(0.3)**	
Austria	31	(2.0)	
France	31	(1.8)	
Slovak Republic	30	(1.7)	
Belgium (French)	29	(2.8)	
Romania	27	(2.1)	↓
Poland	26	(1.8)	↓
Spain	26	(1.6)	↓
Norway	23	(2.0)	↓
Malta	22	(1.4)	↓
Georgia	17	(1.6)	↓
Qatar	15	(1.4)	↓
United Arab Emirates	14	(0.7)	↓
Trinidad and Tobago	13	(1.5)	↓
Saudi Arabia	10	(1.6)	↓
Oman	8	(0.9)	↓
Indonesia	7	(1.1)	↓
Iran	7	(0.8)	↓
Azerbaijan	6	(1.4)	↓
Colombia	6	(1.0)	↓
Morocco	2	(0.5)	↓

Purpose: Acquire and Use Information
Process: Interpret and Integrate Ideas and Information
Description: Interpret and integrate textual and visual information to make 3 contrasts

13. Later discoveries proved that Gideon Mantell was wrong about what the *Iguanodon* looked like. Fill in the blanks to complete the table.

What Gideon Mantell thought the *Iguanodon* looked like	What scientists today think the *Iguanodon* looked like
The *Iguanodon* walked on four legs.	The Iguanadon walks on 2 legs
The Iguanodon had a spike on his nose	The *Iguanodon* had a spike on its thumb.
The *Iguanodon* was 100 feet long.	The Iguanadon was 30 feet long

The answer shown illustrates the type of student response that was given 3 of 3 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.2 Advanced international benchmark - reading example 2

On average, just under one-third of students across the participating countries (32%) were able to correctly complete this item. Forty per cent of Australian Year 4 students received credit for their response, which was significantly above the international average. Hong Kong was once again a top performer on this item, with 62 per cent of its students receiving credit for their response.

Year 4 reading – Performance at the High international benchmark

Students reaching the High international benchmark were competent readers. For example, based on the literary texts, they could retrieve significant details embedded across the text and provide text-based support for inferences. At this level, students recognised main ideas, some textual features and elements and could integrate information provided in the text or accompanying displays or illustrations to interpret relationships between ideas.

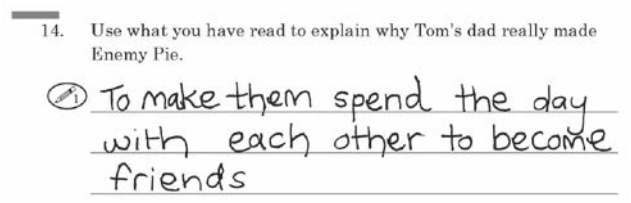
Figure A2.3 shows an item that students at the High benchmark would be expected to complete successfully. It is a *literary* item that required students to *interpret and integrate ideas and information* – namely to identify the motivation of the main character's father in making Enemy Pie.

Country	Percent Full Credit		
Russian Federation	75	(1.8)	↑
Hong Kon	73	(1.6)	↑
Finland	71	(1.9)	↑
Chinese Taipei	69	(1.7)	↑
Germany	64	(1.8)	↑
United States	63	(1.2)	↑
Sweden	63	(1.9)	↑
Italy	62	(2.0)	↑
Northern Ireland	62	(2.4)	↑
Hungary	62	(1.8)	↑
Poland	62	(1.9)	↑
Croatia	61	(1.7)	↑
Canada	61	(1.4)	↑
Ireland	61	(2.1)	↑
Denmark	60	(1.8)	↑
Netherlands	59	(1.6)	↑
England	59	(1.8)	↑
Portugal	58	(2.1)	↑
Israel	58	(1.9)	↑
Bulgaria	57	(2.3)	↑
Slovak Republic	57	(2.0)	↑
Singapore	57	(1.6)	↑
Slovenia	56	(2.0)	↑
New Zealand	56	(1.8)	↑
Czech Republic	56	(2.5)	↑
Spain	55	(2.0)	↑
Australia	53	(2.1)	
Romania	52	(2.5)	
Georgia	50	(2.0)	
International Avg.	**50**	**(0.3)**	
Austria	49	(2.0)	
Lithuania	47	(2.2)	
France	46	(2.4)	
Belgium (French)	46	(2.1)	
Iran	45	(1.6)	↓
Norway	43	(2.0)	↓
Azerbaijan	36	(2.4)	↓
Trinidad and Tobago	31	(2.1)	↓
Malta	29	(1.6)	↓
Qatar	25	(1.7)	↓
Colombia	25	(2.2)	↓
United Arab Emirates	22	(1.0)	↓
Saudi Arabia	15	(2.2)	↓
Indonesia	12	(1.3)	↓
Oman	10	(0.8)	↓
Morocco	4	(0.6)	↓

Purpose: Literary Experience

Process: Interpret and Integrate Ideas and Information

Description: Integrate evidence to show understanding of a character's intention



The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.3 High international benchmark -reading example 1

On average, around half of the students in PIRLS received credit for their response to this item – identifying the true purpose of Tom's dad's pie. The proportion of Australian Year 4 students who provided a correct response to this item was not significantly different to the international average, at 52 per cent. In contrast, some of the top performing countries on this item had over 70 per cent of their students receive credit for their responses (Russian Federation 75%; Hong Kong 73%; and Finland 71%).

Figure A2.4 shows an item belonging to the *literary* purpose and the *examine and evaluate* process that was likely to be answered correctly by students who are performing at the High benchmark.

Country	Percent Correct	
Russian Federation	79 (2.3)	↑
Portugal	77 (2.0)	↑
Finland	74 (1.8)	↑
United States	73 (1.1)	↑
Ireland	72 (2.1)	↑
Northern Ireland	72 (1.8)	↑
Sweden	71 (2.1)	↑
Hong Kong	68 (2.0)	↑
Italy	68 (1.8)	↑
Lithuania	67 (2.1)	↑
Hungary	66 (2.0)	↑
England	66 (2.2)	↑
Slovak Republic	66 (1.8)	↑
Israel	65 (2.0)	↑
Bulgaria	65 (2.4)	↑
Romania	65 (2.2)	↑
Czech Republic	65 (2.1)	↑
Denmark	65 (1.7)	↑
Singapore	64 (1.7)	↑
Poland	63 (1.8)	↑
Netherlands	63 (1.8)	↑
Canada	63 (1.2)	↑
Azerbaijan	62 (2.2)	↑
Australia	62 (1.7)	↑
Slovenia	62 (2.1)	↑
New Zealand	60 (1.8)	
Croatia	58 (1.8)	
Georgia	58 (2.3)	
Spain	57 (1.7)	
International Avg.	**57 (0.3)**	
Germany	55 (1.8)	
France	54 (1.7)	
Austria	53 (1.9)	↓
Malta	53 (2.2)	
Belgium (French)	51 (2.7)	↓
Trinidad and Tobago	51 (2.1)	↓
United Arab Emirates	44 (1.4)	↓
Chinese Taipei	44 (1.9)	↓
Colombia	37 (2.4)	↓
Indonesia	34 (2.6)	↓
Qatar	34 (2.0)	↓
Norway	33 (3.0)	↓
Iran	29 (1.5)	↓
Saudi Arabia	25 (1.7)	↓
Morocco	23 (1.5)	↓
Oman	23 (1.1)	↓

Purpose: Literary Experience

Process: Examine and Evaluate Content, Language, and Textual Elements

Description: Evaluate the significance of an event

11. Why was the rising sun important to the story?

- ● It awakened the eagle's instinct to fly.
- Ⓑ It reigned in the heavens.
- Ⓒ It warmed the eagle's feathers.
- Ⓓ It provided light on the mountain paths.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

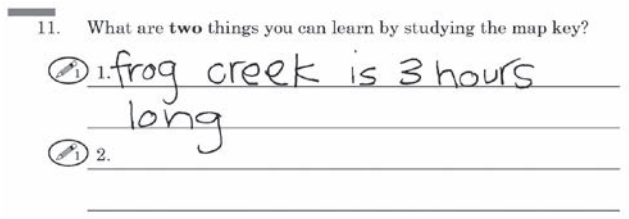
SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.4 High international benchmark - reading example 2

Across the countries participating in PIRLS, over half of the students on average were able to identify why the rising sun was important in 'Fly Eagle Fly' – option A, that it awakened the eagle's instinct to fly. Sixty-two per cent of Australian Year 4 students selected the correct option, which was significantly higher than the international average. Over 75 per cent of students in the Russian Federation (79%) and Portugal (77%) identified the correct response to this multiple-choice item.

Figure A2.5 shows an item belonging to the *information* purpose and the *examine and evaluate* process that was likely to be answered correctly by students who are performing at the High benchmark. This was a two-point item – students were required to provide two pieces of information that they might learn from the map key in the Day Hiking brochure. The example here only provided one piece of information (that the Frog Creek hike took around three hours to complete) and thus scored one point.

Country	Percent at Least 1 Point	Purpose: Acquire and Use Information Process: Examine and Evaluate Content, Language, and Textual Elements Description: Examine a specified table of information and show understanding of 1 (of 2) use of the information
Denmark	86 (1.1) ↑	
United States	83 (0.9) ↑	
England	83 (1.6) ↑	
Northern Ireland	82 (1.6) ↑	
Netherlands	81 (1.7) ↑	
Portugal	79 (1.8) ↑	
Hong Kong	78 (2.0) ↑	
Canada	75 (1.4) ↑	
Chinese Taipei	74 (1.5) ↑	
Ireland	73 (2.0) ↑	
New Zealand	73 (1.4) ↑	
Norway	72 (2.2) ↑	
Russian Federation	71 (1.9) ↑	
Czech Republic	71 (2.0) ↑	
Singapore	70 (1.7) ↑	
Israel	70 (1.9) ↑	
Germany	69 (1.7) ↑	
Sweden	68 (2.1) ↑	
Finland	66 (1.9) ↑	
Slovak Republic	66 (1.7) ↑	
Lithuania	64 (2.2) ↑	
Poland	64 (2.1) ↑	
Italy	63 (2.0) ↑	
Australia	62 (2.0)	
Slovenia	62 (2.2)	
Hungary	62 (1.6)	
France	61 (1.9)	
International Avg.	**59 (0.3)**	
Spain	59 (1.6)	
Malta	58 (2.1)	
Austria	54 (1.8) ↓	
Bulgaria	52 (2.5) ↓	
Belgium (French)	51 (2.4) ↓	
Trinidad and Tobago	49 (2.4) ↓	
Croatia	49 (1.6) ↓	
Romania	47 (2.6) ↓	
Georgia	43 (2.2) ↓	
United Arab Emirates	43 (1.3) ↓	
Saudi Arabia	43 (2.6) ↓	
Qatar	41 (1.8) ↓	
Indonesia	33 (2.1) ↓	
Oman	32 (1.6) ↓	
Iran	29 (1.5) ↓	
Saudi Arabia	25 (1.7) ↓	
Morocco	23 (1.5) ↓	
Oman	23 (1.1) ↓	



The answer shown illustrates the type of student response that was given 1 of 2 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent

A dash (-) indicates comparable data not available.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.5 High international benchmark - reading example 3

Close to 60 per cent of students across participating countries on average (59%) received credit for their response to this item. Australian students performed similarly to the international average, with 62 per cent receiving credit. In Denmark, the top performing country on this item, 86 per cent of students received credit for their answers.

Figure A2.6 shows another item belonging to the *information* purpose that students at the High benchmark would be expected to complete successfully. This item required students to *make straightforward inferences* as to the reasons a scientist took a fossilised tooth to a museum.

Country	Percent Correct		
Hong Kong	80	(1.7)	↑
Chinese Taipei	79	(1.6)	↑
Singapore	75	(1.5)	↑
Italy	74	(1.4)	↑
Finland	73	(1.8)	↑
Russian Federation	72	(1.4)	↑
Sweden	69	(1.9)	↑
Portugal	67	(2.0)	↑
Czech Republic	66	(2.2)	↑
Ireland	66	(2.3)	↑
Slovenia	65	(2.1)	↑
England	64	(2.1)	↑
Northern Ireland	64	(2.3)	↑
Lithuania	64	(1.9)	↑
Israel	63	(1.9)	↑
Slovak Republic	63	(1.8)	↑
France	63	(1.6)	↑
Croatia	63	(1.7)	↑
Hungary	62	(1.5)	↑
Spain	61	(2.0)	
Germany	61	(1.9)	
United States	61	(1.2)	↑
Austria	61	(2.0)	
Belgium (French)	60	(2.1)	
Canada	60	(1.4)	
Bulgaria	58	(1.9)	
Denmark	58	(2.0)	
International Avg.	**58**	**(0.3)**	
Romania	56	(2.3)	
Australia	55	(1.9)	
Netherlands	55	(2.0)	
Azerbaijan	54	(2.7)	
Norway	52	(2.5)	↓
New Zealand	52	(1.6)	↓
Malta	52	(1.8)	↓
Poland	51	(1.8)	↓
Georgia	51	(2.1)	↓
Trinidad and Tobago	47	(1.8)	↓
Iran	46	(1.8)	↓
United Arab Emirates	46	(1.2)	↓
Qatar	43	(2.4)	↓
Saudi Arabia	42	(2.4)	↓
Colombia	36	(2.4)	↓
Indonesia	35	(2.1)	↓
Oman	31	(1.6)	↓
Morocco	26	(1.5)	↓

Purpose: Acquire and Use Information

Process: Make Straightforward Inferences

Description: Infer a scientist's purpose from a series of statements

9. Why did Gideon Mantell take the tooth to a museum?

(A) to ask if the fossil belonged to the museum

(B) to prove that he was a fossil expert

● to hear what scientists thought of his idea

(D) to compare the tooth with others in the museum

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.6 High international benchmark- reading example 4

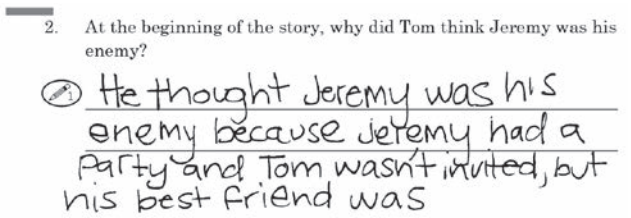
On average, 58 per cent of students across the PIRLS countries correctly identified the purpose of the museum trip as being option C – to share his theories with other scientists and hear what they thought of it. The proportion of Australian students who selected the correct response (55%) was not significantly different to the international average, while top performing countries on this item had around 80 per cent of their students identify the correct response (Hong Kong 80%, Chinese Taipei 79%).

Year 4 reading – Performance at the Intermediate international benchmark

Students at the Intermediate benchmark were able to retrieve and reproduce elements of the stories that were explicitly mentioned in the text (such as actions, events and feelings), and also to make some inferences and connections across the text.

Figure A2.7 shows a *literary* item at the Intermediate international benchmark that required students to *make straightforward inferences.*

Country	Percent Full Credit			Purpose: Literary Experience Process: Make Straightforward Inferences Description: Make a straightforward inference about a character's reaction to a situation
Singapore	87	(1.1)	↑	
Ireland	86	(1.4)	↑	
Denmark	84	(1.2)	↑	
Sweden	84	(1.4)	↑	
Canada	83	(1.0)	↑	
United States	83	(0.9)	↑	
Chinese Taipei	82	(1.5)	↑	
Northern Ireland	81	(1.8)	↑	
Hong Kon	81	(1.4)	↑	
Portugal	80	(1.9)	↑	
New Zealand	79	(1.4)	↑	
Georgia	79	(1.6)	↑	
Czech Republic	79	(2.2)	↑	
Croatia	78	(1.5)	↑	
Netherlands	78	(1.5)	↑	
Australia	77	(1.9)	↑	
Russian Federation	77	(1.7)	↑	
Poland	76	(1.6)	↑	
Israel	76	(1.5)	↑	
Germany	75	(1.6)	↑	
Finland	75	(1.9)	↑	
Italy	74	(1.7)	↑	
Slovak Republic	74	(1.6)	↑	
Slovenia	74	(1.9)		
England	73	(1.8)		
France	72	(1.6)		
Azerbaijan	71	(2.0)		
Hungary	71	(1.9)		
International Avg.	**70**	**(0.3)**		
Austria	69	(1.7)		
Belgium (French)	68	(1.9)		
Spain	68	(1.6)		
Lithuania	65	(2.0)	↓	
Bulgaria	64	(2.3)	↓	
Romania	63	(2.2)	↓	
Norway	63	(2.4)	↓	
Trinidad and Tobago	62	(2.4)	↓	
Malta	59	(1.8)	↓	
Colombia	59	(2.4)	↓	
Saudi Arabia	56	(2.2)	↓	
Qatar	52	(1.9)	↓	
Iran	52	(1.9)	↓	
United Arab Emirates	51	(1.3)	↓	
Indonesia	45	(2.0)	↓	
Oman	43	(1.5)	↓	
Morocco	42	(1.5)	↓	



The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.7 Intermediate international benchmark - reading example 1

On average, seven out of every ten students across participating countries were able to provide a response that received credit (identifying a reason for Tom thinking that Jeremy was his enemy). Over three-quarters (77%) of Australian students received credit for their response, which was significantly higher than the international average, but still below the levels of some of the top performing countries on this item, such as Singapore and Ireland, which both had over 85 per cent of their students responding correctly.

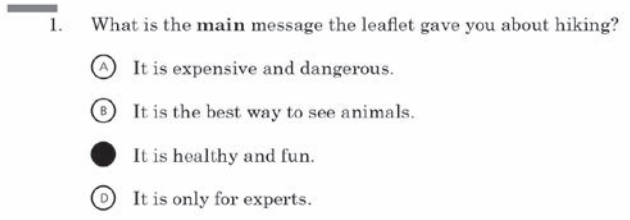
Figure A2.8 shows an *information* item at the Intermediate international benchmark that required students to *make straightforward inferences* from information provided in the brochure about Day Hiking.

Country	Percent Correct		
Chinese Taipei	92	(1.1)	↑
Russian Federation	91	(0.9)	↑
Netherlands	91	(1.0)	↑
Hong Kong	91	(1.0)	↑
Croatia	90	(1.2)	↑
Denmark	90	(1.2)	↑
Finland	89	(1.2)	↑
United States	87	(0.7)	↑
Germany	87	(1.4)	↑
Singapore	86	(1.1)	↑
Portugal	85	(1.6)	↑
England	84	(1.7)	↑
Northern Ireland	84	(1.7)	↑
Australia	84	(1.6)	↑
Lithuania	83	(1.4)	↑
Ireland	83	(1.5)	↑
Sweden	83	(1.9)	↑
Iran	83	(1.4)	↑
Canada	82	(0.8)	↑
Bulgaria	81	(1.6)	↑
Austria	80	(1.4)	↑
New Zealand	80	(1.6)	↑
Israel	80	(1.5)	↑
International Avg.	**76**	**(0.3)**	
Slovak Republic	76	(1.9)	
Poland	76	(1.5)	
Spain	75	(1.8)	
Italy	75	(1.8)	
Belgium (French)	75	(2.1)	
France	73	(1.9)	
Georgia	73	(2.3)	
Azerbaijan	72	(2.5)	
Malta	71	(1.8)	↓
Czech Republic	71	(2.2)	↓
Norway	71	(2.3)	↓
Romania	69	(2.0)	↓
Slovenia	69	(2.2)	↓
Hungary	68	(1.9)	↓
Trinidad and Tobago	64	(2.1)	↓
Indonesia	60	(2.1)	↓
United Arab Emirates	58	(1.3)	↓
Qatar	58	(3.2)	↓
Colombia	57	(2.0)	↓
Oman	49	(1.5)	↓
Saudi Arabia	48	(2.4)	↓
Morocco	47	(1.9)	↓

Purpose: Acquire and Use Information

Process: Make Straightforward Inferences

Description: Recognize the main message of a brochure


1. What is the **main** message the leaflet gave you about hiking?

Ⓐ It is expensive and dangerous.

Ⓑ It is the best way to see animals.

● It is healthy and fun.

Ⓓ It is only for experts.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.8 Intermediate international benchmark -reading example 2

Over three-quarters of students, on average across participating countries, were able to correctly identify option C as being the main message of the brochure. Australian Year 4 students performed well on this item, with 84 per cent identifying the correct response, which was higher than the international average. Some of the highest performing countries on this item had over 90 per cent of their students selecting the correct response.

Year 4 reading – Performance at the Low international benchmark

Students who performed at the Low international benchmark displayed basic reading skills. They were able to recognise, locate and reproduce explicitly stated details from the informational texts, particularly if the details were close to the beginning of the text. Students reaching the Low International Benchmark also demonstrated success with some items requiring straightforward inferences.

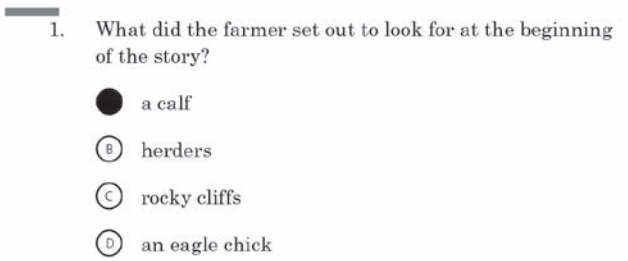
Figure A2.9 shows a *literary* item at the Low international benchmark that required students to *focus on and retrieve explicitly stated information and ideas*, in this case, what it was that the farmer set out to find in the beginning of 'Fly Eagle Fly'.

Country	Percent Correct		
Russian Federation	99	(0.4)	↑
Croatia	98	(0.7)	↑
Hong Kong	97	(0.8)	↑
Italy	96	(0.7)	↑
Finland	96	(0.7)	↑
Austria	96	(0.7)	↑
Northern Ireland	96	(1.0)	↑
Chinese Taipei	95	(0.8)	↑
Czech Republic	95	(1.2)	↑
Israel	95	(0.8)	↑
Germany	95	(0.9)	↑
Denmark	94	(0.7)	↑
Netherlands	94	(0.8)	↑
Slovenia	94	(1.0)	↑
Bulgaria	94	(0.9)	↑
Sweden	94	(1.3)	↑
Canada	94	(0.6)	↑
Lithuania	93	(1.1)	↑
Portugal	93	(1.1)	↑
Ireland	93	(0.9)	↑
France	93	(0.8)	↑
Georgia	93	(1.1)	↑
Singapore	92	(0.9)	↑
Azerbaijan	92	(1.1)	↑
Hungary	91	(1.0)	↑
Australia	91	(1.0)	↑
England	91	(1.1)	↑
New Zealand	91	(1.0)	
Slovak Republic	90	(1.2)	
Norway	90	(1.5)	
Poland	90	(1.1)	
United States	90	(0.8)	
International Avg.	**89**	**(0.2)**	
Romania	88	(1.5)	
Belgium (French)	87	(1.5)	
Spain	86	(1.1)	↓
Iran	85	(1.4)	↓
Malta	84	(1.3)	↓
Indonesia	82	(1.6)	↓
Colombia	81	(2.0)	↓
Trinidad and Tobago	81	(1.7)	↓
United Arab Emirates	74	(0.9)	↓
Saudi Arabia	73	(1.7)	↓
Oman	72	(1.3)	↓
Qatar	71	(1.7)	↓
Morocco	52	(1.8)	↓

Purpose: Literary Experience

Process: Focus on and Retrieve Explicitly Stated Information and Ideas

Description: Locate and retrieve explicitly stated detail from the beginning of the text



1. What did the farmer set out to look for at the beginning of the story?

● a calf

Ⓑ herders

Ⓒ rocky cliffs

Ⓓ an eagle chick

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Progress in International Reading Literacy Study – PIRLS 2011

Figure A2.9 Low international benchmark - reading example 1

Across the countries participating in PIRLS, 89 per cent of students on average were able to correctly identify option A – a calf – as being what the farmer had set out to find. At 91 per cent, the proportion of Australian Year 4 students who selected the correct response was significantly higher than the international average, while a number of countries had almost all of their students answer correctly.

Appendix

3 The TIMSS mathematics and science assessments

Two organising dimensions, a content dimension and a cognitive dimension, framed the mathematics and science assessment for TIMSS 2011, analogous to those used in the earlier TIMSS assessments. There are three content domains in mathematics and in science at Year 4. In addition there are three cognitive domains in each curriculum area: *knowing*, *applying* and *reasoning*. The two dimensions and their domains are the foundation of the mathematics and science assessments. The content domains define the specific subject matter covered by the assessment, and the cognitive domains define the sets of behaviours expected of students as they engage with the content. These are elaborated in the next section.

Content domains

The content domains for mathematics in Year 4 are shown in Table A3.1. For a more detailed description of each of the content domains in both mathematics and science refer to the TIMSS 2011 Assessment Frameworks (Mullis et al., 2009).

For each of the content domains shown in Table A3.1, the mathematics framework identifies several topic areas to be included in the assessment. For example at Year 4, *number* is further categorised by whole numbers, fractions and decimals, number sentences and patterns and relationships.

Table A3.1 TIMSS mathematics content domains and proportion of assessment for each domain at Year 4

Mathematics domain	Topic areas	Target % of TIMSS assessment
Number	Whole numbers	
	Fractions and decimals	
	Number sentences with whole numbers	
	Patterns and relationships	50
Geometric shapes and measurement	Points, lines and angles	
	Two- and three-dimensional shapes	35
Data display	Reading and interpreting	
	Organising and representing	15

Similarly, the content domains for science for Year 4 are shown in Table A3.2. For each of the content domains shown in this table, the science framework identifies several topic areas to be included in the assessment. For example at Year 4, *life science* is further categorised by the topic areas: characteristics and life processes of living things; life cycles, reproduction and heredity; interaction with the environment; ecosystems; and human health.

Table A3.2 TIMSS science content domains and proportion of assessment for each domain at Year 4

Science domain	Topic areas	Target % of TIMSS assessment
Life science	Characteristics and life processes of living things	
	Life cycles, reproductions and heredity	
	Interaction with the environment	
	Ecosystems	
	Human health	45
Physical science	Classification and properties of matter	
	Sources and effects of energy	
	Forces and motion	35
Earth science	Earth's structure and physical characteristics, and resources	
	Earth's processes, cycles and history	
	Earth in the solar system	20

Each topic area is presented in the framework as a list of objectives covered in a majority of participating countries. The organisation of topics across the content domains reflects some minor revision in the reporting categories used in each of the previous assessments; however, each of the trend items from the previous assessments may be mapped directly onto the content domains defined for 2011.

Cognitive domains

To respond correctly to TIMSS test items, students need to be familiar with the mathematics and science content of the items. Just as importantly, the items were designed to elicit the use of particular cognitive skills. The assessment framework presents detailed descriptions of the skills and abilities that make up the cognitive domains that are assessed in conjunction with the content. These skills and abilities should play a central role in developing items and achieving a balance in learning outcomes assessed by the items at Year 4.

The student behaviours used to define both the mathematics and the science framework at Year 4 have been classified into three cognitive domains.

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; and
- *Reasoning* – which goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts and multi-step problems.

These three cognitive domains are used for both year levels, but the balance of testing time differs, reflecting the difference in age and experience of students in the two year levels. 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 in both mathematics and science. The percentage of time assigned to the evaluation of each of the cognitive domains in the 2011 assessment for Year 4 students is shown in Table A3.3.

Table A3.3 TIMSS mathematics and science cognitive domains and proportion of assessment for each domain at Year 4

Cognitive Domain	Mathematics	Science
Knowing	40%	40%
Applying	40%	40%
Reasoning	20%	20%

Further examples of the behaviours associated with each of the cognitive domains may be found in Mullis et al. (2009).

The structure of the TIMSS assessment

TIMSS 2011 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 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 10 to 14 items in each block at Year 4.

TIMSS 2011 had 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 2007 assessment, approximately half (8 of 14) of the mathematics blocks and approximately half (8 of 14) of the science blocks were secured for use in measuring trends in 2011. The remaining blocks were released into the public domain for use in publications, research and teaching, to be replaced by newly developed items in the TIMSS 2011 assessment. Accordingly, the 28 blocks in the TIMSS 2011 assessment comprise 16 blocks of trend items (eight mathematics and eight science) and 12 blocks of new items developed for 2011.

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 points represented by all the questions 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.

In assessing Year 4 students, 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 the question.

The options that are incorrect are written to be plausible, but not deceptive. 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 skills that require students to explain phenomena or interpret data based on their background knowledge and experience.

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 the question assesses. 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.

As each student's achievement book contained only a sample of items from the assessment, student responses are combined for an overall picture of the assessment results for each country.

Item response theory (IRT) methods are used to place the individual student responses to the items onto a common scale that links to TIMSS results for 1995, 1999, 2003 and 2007. This allows countries to accurately compare their Year 4 achievement in 2011 with that of 1995, 1999 and 2003 (for the years in which the country participated).

TIMSS benchmarks

While the achievement scales in mathematics and science summarise student performance on the cognitive processes and content knowledge measured by the TIMSS tests, the international benchmarks help put these scores in context. The benchmarks were developed using scale anchoring techniques and student achievement data from all countries that participated in TIMSS 2011. A similar exercise was carried out for the TIMSS 1999 study, and Martin et al. (2000) noted that six factors seemed to differentiate between student performance at each level:

- the depth and breadth of content area knowledge
- the level of understanding and use of technical vocabulary
- the context of the problem (progressing from practical to more abstract)
- the level of scientific investigation skills
- the complexity of diagrams, graphs, tables and textual information used
- the completeness of written responses.

Scale anchoring is a way of describing students' performance on the TIMSS 2011 achievement scales at both year levels in terms of the types of items that students at the particular year level answered correctly. It has both empirical and qualitative components. The empirical component used IRT to identify items that discriminated between successive points on the scale. For the empirical component, the results of all students taking part in TIMSS 2011 were pooled so that the levels describe what the best students can do, irrespective of which country they come from.

For the qualitative component, subject matter specialists examined the content of the items and generalised to the students' knowledge and understanding. The descriptions of the levels are cumulative, so that a student who reached the High international benchmark can typically demonstrate the knowledge and skills of both the Intermediate and the Low benchmarks. These are shown in Figures A3.1 through A3.19.

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; and
- the 'Low international benchmark', which was set at 400.

Students who did not reach the Low international benchmark are referred to as Below Low. Benchmarks are only one way of examining student performance. The benchmarks discussed in this report are based solely on student performance in TIMSS 2011 on items that were developed specifically for the purpose of obtaining information on the science domains in the TIMSS framework. There are undoubtedly other curricular elements on which students at the various benchmarks would have been successful if they had been included in the assessment. The remainder of this appendix provides more detail and examples of the benchmarks.

For each benchmark, in both subjects, illustrative items and examples of the correct answers are provided. Alongside each example is a table providing the percentage of students in participating countries answering the item correctly to gain an idea of how Australian students performed.

Year 4 mathematics – Descriptors of performance at the international benchmarks

Table A3.4 provides descriptors for each level of the benchmarks for Year 4 mathematics. More detailed descriptions of the benchmarks can be found in the TIMSS international mathematics and science reports. As can be seen in Table A3.4, students at the advanced international benchmark applied mathematical understanding and knowledge in a variety of relatively complex problem situations and were able to explain their reasoning, whereas those at the low international benchmark demonstrated some basic mathematical knowledge and were able to compute with whole numbers, recognise some geometric shapes and read simple graphs and tables.

At Year 4, half of the assessment items were devoted to assessing the *number* content domain, including understanding place value, ways of representing numbers and the relationships between numbers. According to the *TIMSS 2011 Mathematics Framework*, students should have developed number sense and computational fluency, be able to use numbers and operations to solve problems and be familiar with a range of number patterns.

Within the *geometric shapes and measures* domain (35% of the assessment), students should be able to identify and analyse the properties and characteristics of lines, angles and a variety of geometric figures, including two- and three-dimensional shapes, and to provide explanations based on geometric relationships. This domain also included understanding informal coordinate systems and using spatial visualisation skills.

The *data display* content domain (15%) included understanding how to organise data that have been collected and how to display it in graphs as well as reading and interpreting various

data displays. Students at Year 4 should be able to compare characteristics of data and to draw conclusions based on data displays. Within each of the content domains, students were expected to demonstrate knowledge as well as application and reasoning skills.

Table A3.4 Descriptions of the TIMSS international benchmarks for mathematics

Low International Benchmark	Intermediate International Benchmark	High International Benchmark	Advanced International Benchmark
400	475	550	625
Students have some basic mathematical knowledge. Students can add and subtract whole numbers. They have some recognition of parallel and perpendicular lines, familiar geometric shapes and coordinate maps. They can read and complete simple bar graphs and tables.	Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers and some understanding of fractions. Students can visualise three-dimensional shapes from two-dimensional representations. They can interpret bar graphs, pictographs and tables to solve simple problems.	Students can apply their knowledge and understanding to solve problems. Students can solve word problems involving operations with whole numbers. They can use division in a variety of problem situations. They can use their understanding of place value to solve problems. Students can extend patterns to find a later specified term. Students demonstrate understanding of line symmetry and geometric properties. Students can interpret and use data in tables and graphs to solve problems. They can use information in pictographs and tally charts to complete bar graphs.	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 including proportions. Students at this level show an increasing understanding of fractions and decimals. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can draw conclusions from data in tables and justify their conclusions.

Year 4 mathematics – Performance at the Advanced international benchmark

Year 4 students achieving at the Advanced international benchmark demonstrated fluency with many framework topics. They also demonstrated their ability to apply their understanding and knowledge in a wide variety of relatively complex situations. They typically demonstrated success on the knowledge and skills represented by this benchmark, as well as those demonstrated at the High, Intermediate and Low benchmarks.

Figure A3.1 shows a numerical reasoning item (belonging to the content domain *number* and the cognitive domain *reasoning*) likely to be answered correctly by students who are performing at the Advanced benchmark.

Country	Percent Full Credit		
Hong Kong	59	(2.2)	↑
Japan	56	(2.2)	↑
Korea	52	(2.0)	↑
Singapore	52	(1.9)	↑
Chinese Taipei	48	(2.1)	↑
England	47	(2.3)	↑
Northern Ireland	45	(2.7)	↑
Serbia	45	(2.4)	↑
Czech Republic	41	(2.7)	↑
Denmark	40	(2.1)	↑
Portugal	40	(2.4)	↑
Ireland	39	(2.3)	↑
Lithuania	37	(2.6)	↑
Sweden	36	(2.6)	↑
Netherlands	36	(2.3)	↑
Finland	35	(2.2)	↑
United States	34	(1.5)	↑
Slovak Republic	34	(2.2)	↑
Australia	31	(1.9)	↑
Germany	29	(1.9)	
Russian Federation	28	(2.0)	
International Avg.	**27**	**(0.3)**	
Azerbaijan	26	(2.7)	
New Zealand	26	(1.8)	
Romania	26	(2.5)	
Turkey	26	(1.6)	
Hungary	26	(1.7)	
Belgium (Flemish)	25	(1.8)	
Kazakhstan	25	(2.3)	
Croatia	25	(2.1)	
Armenia	25	(2.5)	
Italy	23	(2.2)	
Poland	22	(1.7)	↓
Spain	21	(1.8)	↓
Malta	21	(1.6)	↓
Slovenia	21	(1.9)	↓
Thailand	20	(2.1)	↓
Norway	19	(2.0)	↓
Austria	17	(1.6)	↓
Chile	16	(1.5)	↓
Georgia	14	(2.2)	↓
Saudi Arabia	13	(2.1)	↓
Morocco	13	(1.5)	↓
United Arab Emirates	12	(0.8)	↓
Bahrain	11	(1.6)	↓
Iran	9	(1.0)	↓
Qatar	8	(1.7)	↓
Oman	5	(0.8)	↓
Tunisia	4	(0.7)	↓
Yemen	3	(0.7)	↓
Kuwait	2	(0.6)	↓

Content Domain: Number
Cognitive Domain: Reasoning
Description: Solves a multi-step numerical reasoning problem

In a soccer tournament, teams get:

3 points for a win
1 point for a tie
0 points for a loss

Zedland has 11 points.

What is the **smallest** number of games Zedland could have played?

Answer: 5

The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average
↓ Percent significantly lower than international average
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.1 Advanced international benchmark - mathematics example 1

On average across participating countries, 27 per cent of students answered this item correctly. Australia performed significantly above this international average, with 31 per cent of students responding correctly. In the highest performing countries – Hong Kong, Japan, Korea and Singapore – over half of their Year 4 students provided the correct answer to this question.

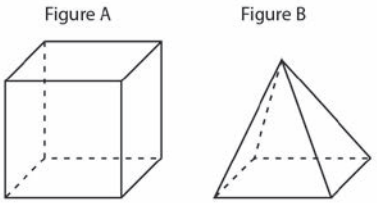
Figure A3.2 shows an item belonging to the content domain *geometric shapes and measures* and the cognitive domain *knowing* that students who performed at the Advanced benchmark were likely to complete correctly.

Country	Percent Full Credit		
Portugal	70	(2.1)	↑
Austria	67	(2.4)	↑
Northern Ireland	58	(2.6)	↑
England	58	(2.4)	↑
Hong Kong	57	(2.3)	↑
Chinese Taipei	53	(2.4)	↑
Japan	53	(2.0)	↑
United States	50	(1.4)	↑
Denmark	47	(2.0)	↑
Australia	45	(2.2)	↑
Ireland	45	(2.6)	↑
Germany	44	(2.5)	↑
Korea	44	(2.1)	↑
Italy	44	(2.1)	↑
Hungary	42	(2.0)	↑
Belgium (Flemish)	42	(2.3)	↑
Poland	42	(2.1)	↑
Chile	41	(2.1)	↑
Singapore	41	(2.2)	↑
Malta	40	(2.2)	↑
Slovenia	39	(2.3)	↑
Croatia	35	(1.9)	
Lithuania	34	(2.5)	
Finland	33	(2.7)	
International Avg.	**32**	**(0.3)**	
New Zealand	32	(1.9)	
Romania	32	(2.8)	
Serbia	28	(2.1)	↓
Qatar	27	(2.0)	↓
Kazakhstan	27	(2.6)	↓
Spain	26	(2.4)	↓
United Arab Emirates	26	(1.2)	↓
Norway	26	(2.7)	↓
Oman	26	(1.5)	↓
Russian Federation	22	(1.8)	↓
Sweden	20	(1.9)	↓
Netherlands	20	(2.0)	↓
Kuwait	20	(1.9)	↓
Slovak Republic	19	(1.7)	↓
Czech Republic	18	(1.9)	↓
Armenia	16	(1.9)	↓
Iran	15	(1.2)	↓
Georgia	15	(1.7)	↓
Bahrain	13	(1.8)	↓
Tunisia	11	(1.5)	↓
Saudi Arabia	11	(1.5)	↓
Azerbaijan	6	(1.2)	↓
Thailand	6	(1.3)	↓
Turkey	4	(1.1)	↓
Yemen	1	(0.5)	↓

Content Domain: Geometric Shapes and Measures

Cognitive Domain: Knowing

Description: Given the pictures of two common solids classifies four statements as true or false



Here are some statements about Figure A and Figure B. Put an X to show whether each statement is true or false.

Statement	True	False
A and B both have a square face.	X	
A and B both have the same number of faces.		X
All the angles in A are right angles.	X	
B has more edges than A.		X
Some of the edges in B are curved.		X

The answer shown illustrates the type of student response that was given 2 of 2 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent

A dash (-) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.2 Advanced international benchmark - mathematics example 2

To receive full credit on this item, students had to complete each row in the table, indicating whether the statement was true or false. On average across the participating countries, 32 per cent of students were able to do this. Forty-five per cent of Australian Year 4 students successfully completed this item, which was significantly higher than the international average, but still well below the highest performing countries on this item, Portugal and Austria (70% and 67%, respectively).

Year 4 mathematics – Performance at the High international benchmark

Students at this level could solve word problems involving operations with whole numbers, read unlabelled graduations on a scale and solve word problems involving measures and proportional reasoning, demonstrate understanding of line symmetry and interpret and use data in tables and graphs to solve problems.

Figure A3.3 shows an item belonging to the content domain *number* and the cognitive domain *applying* likely to be answered correctly by students who are performing at the High benchmark.

Country	Percent Correct		
Chinese Taipei	85	(1.5)	↑
Korea	82	(1.8)	↑
Singapore	82	(1.4)	↑
Hong Kong	76	(2.0)	↑
Netherlands	73	(2.2)	↑
Northern Ireland	73	(2.3)	↑
Japan	69	(1.8)	↑
Czech Republic	69	(2.5)	↑
Lithuania	67	(2.0)	↑
Poland	67	(2.0)	↑
Germany	65	(2.1)	↑
Russian Federation	65	(1.8)	↑
Finland	65	(2.4)	↑
Belgium (Flemish)	63	(2.3)	↑
England	63	(2.6)	↑
Sweden	62	(2.2)	↑
Serbia	60	(2.8)	↑
Denmark	60	(2.7)	↑
Slovak Republic	58	(3.0)	↑
Hungary	57	(2.3)	↑
United States	57	(1.5)	↑
Norway	55	(3.2)	
Ireland	54	(3.2)	
Slovenia	54	(2.1)	
Azerbaijan	52	(3.2)	
Austria	52	(2.4)	
International Avg.	**52**	**(0.3)**	
Australia	51	(2.4)	
Croatia	49	(2.1)	
New Zealand	49	(2.1)	
Romania	48	(2.3)	
Portugal	47	(2.9)	
Kazakhstan	47	(2.9)	
Turkey	46	(2.0)	↓
Italy	45	(2.3)	↓
Armenia	43	(2.3)	↓
Malta	41	(2.2)	↓
Thailand	41	(2.7)	↓
Chile	40	(1.9)	↓
Georgia	37	(2.3)	↓
Spain	34	(2.1)	↓
Tunisia	33	(1.9)	↓
Iran	33	(2.3)	↓
United Arab Emirates	32	(1.2)	↓
Qatar	30	(1.8)	↓
Yemen	29	(1.9)	↓
Saudi Arabia	26	(2.1)	↓
Bahrain	25	(2.0)	↓
Morocco	24	(2.4)	↓
Kuwait	23	(1.7)	↓
Oman	21	(1.3)	↓

Content Domain: Number

Cognitive Domain: Applying

Description: Solves a word problem involving addition of time and conversion between hours and minutes

A train left Redville at 8:45 a.m. It arrived in Bedford 2 hours and 18 minutes later. What time did it arrive in Bedford?

Ⓐ 11:15 a.m.

Ⓑ 11:13 a.m.

● 11:03 a.m.

Ⓓ 10:53 a.m.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.3 High international benchmark - mathematics example 1

On average, just over half of the Year 4 students across participating countries answered this item correctly. Australia's proportion, at 51 per cent, was not significantly different to the international average, while Chinese Taipei, Korea and Singapore, the highest performing countries on this item, had over 80 per cent of their students identify the correct response.

Figure A3.4 shows an item belonging to the content domain *geometric shapes and measures* and the cognitive domain *applying* that students who are performing at the High benchmark should be able to complete correctly.

Country	Percent Full Credit	
Hong Kong	84 (2.0)	↑
Korea	67 (1.8)	↑
England	61 (2.6)	↑
Singapore	61 (2.0)	↑
Russian Federation	61 (2.7)	↑
Denmark	57 (2.2)	↑
Kazakhstan	55 (2.6)	↑
Slovenia	55 (2.3)	↑
Northern Ireland	53 (2.3)	↑
Portugal	53 (3.4)	↑
Belgium (Flemish)	52 (2.5)	↑
Lithuania	52 (2.4)	↑
United States	51 (1.6)	↑
Italy	50 (2.5)	↑
Australia	50 (2.0)	↑
Slovak Republic	47 (2.1)	↑
Ireland	47 (2.6)	
Georgia	46 (2.7)	
Sweden	45 (2.8)	
Finland	45 (2.5)	
Azerbaijan	45 (3.2)	
Chinese Taipei	44 (2.0)	
Germany	44 (2.2)	
Malta	44 (2.2)	
Czech Republic	43 (2.6)	
Romania	42 (2.6)	
Hungary	42 (2.5)	
International Avg.	**42 (0.3)**	
New Zealand	42 (2.1)	
Armenia	41 (2.8)	
Spain	41 (2.7)	
Iran	40 (2.3)	
Japan	39 (1.9)	
Poland	39 (1.9)	
Norway	38 (2.6)	
Chile	38 (2.0)	↓
Thailand	37 (2.6)	↓
Bahrain	31 (3.3)	↓
Serbia	31 (2.5)	↓
Oman	31 (1.7)	↓
Croatia	29 (1.9)	↓
United Arab Emirates	29 (1.2)	↓
Netherlands	29 (2.3)	↓
Saudi Arabia	29 (2.7)	↓
Austria	26 (2.1)	↓
Qatar	26 (2.3)	↓
Turkey	26 (1.7)	↓
Morocco	23 (2.0)	↓
Tunisia	19 (1.8)	↓
Kuwait	17 (1.7)	↓
Yemen	5 (1.1)	↓

Content Domain: Geometric Shapes and Measures

Cognitive Domain: Applying

Description: Completes a shape so that it has line symmetry and a given number of sides

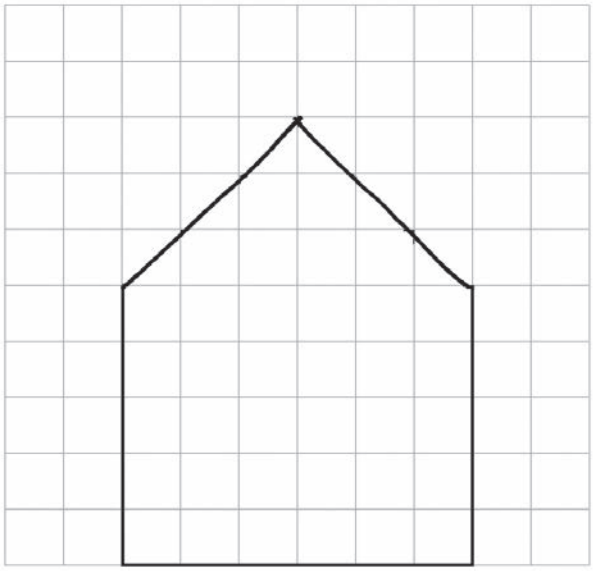
Jay has to draw a shape.

It must have 5 sides.

It must have one line of symmetry.

Jay has started to draw the shape.

Complete Jay's shape.



The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.4 High international benchmark - mathematics example 2

Just over forty per cent of students across the participating countries were able to complete this figure correctly (as shown in the example above). Fifty per cent of Australian Year 4 students provided a correct response, which was significantly higher than the international average, while over 80 per cent of students In Hong Kong completed this item correctly.

Figure A3.5 shows an item belonging to the content domain *data display* and the cognitive domain *reasoning* that students who were performing at the High benchmark should be able to complete.

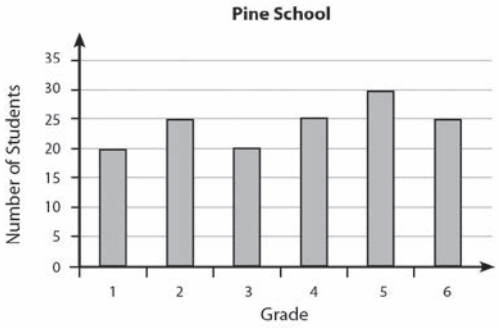
Country	Percent Correct		
Chinese Taipei	79	(1.9)	↑
Hong Kong	78	(2.0)	↑
Korea	75	(1.3)	↑
Netherlands	74	(2.1)	↑
Singapore	73	(1.8)	↑
Japan	71	(2.0)	↑
Portugal	70	(2.8)	↑
Norway	67	(2.3)	↑
Germany	67	(2.0)	↑
Denmark	66	(2.0)	↑
England	65	(2.5)	↑
Sweden	64	(2.4)	↑
Lithuania	64	(2.1)	↑
Ireland	64	(2.5)	↑
Slovenia	64	(1.9)	↑
Finland	63	(2.1)	↑
United States	63	(1.5)	↑
Belgium (Flemish)	62	(2.2)	↑
New Zealand	60	(2.1)	↑
Northern Ireland	59	(2.9)	
Serbia	59	(2.4)	↑
Australia	58	(2.1)	
Austria	57	(2.5)	
Georgia	55	(2.3)	
International Avg.	**54**	**(0.3)**	
Russian Federation	53	(2.4)	
Malta	52	(2.4)	
Croatia	51	(2.1)	
Poland	51	(2.5)	
Slovak Republic	50	(2.1)	
Spain	50	(2.5)	
Turkey	50	(2.0)	↓
Chile	50	(2.0)	↓
Italy	49	(2.4)	↓
Romania	48	(2.7)	↓
Kazakhstan	47	(2.1)	↓
Hungary	47	(2.1)	↓
Thailand	46	(2.6)	↓
Czech Republic	45	(2.7)	↓
Iran	44	(1.8)	↓
United Arab Emirates	41	(1.3)	↓
Qatar	41	(2.5)	↓
Bahrain	39	(2.4)	↓
Saudi Arabia	38	(2.3)	↓
Oman	33	(1.7)	↓
Armenia	29	(2.2)	↓
Morocco	29	(1.8)	↓
Yemen	29	(2.2)	↓
Kuwait	26	(2.0)	↓
Tunisia	26	(1.9)	↓
Azerbaijan	-	-	

Content Domain: Data Display

Cognitive Domain: Reasoning

Description: Solves a multi-step reasoning problem using data from a bar graph

The graph shows the number of students at each grade in the Pine School.



In the Pine School there is room in each grade for 30 students.
How many more students could be in the school?

Ⓐ 20
Ⓑ 25
Ⓒ 30
● 35

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent

A dash (-) indicates comparable data not available.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.5 High international benchmark - mathematics example 3

Just over half of the Year 4 students in participating countries correctly identified option D as the response to this multiple-choice item. At 58 per cent, the proportion of Australian students who answered this item correctly was not significantly different to the international average. Over three-quarters of students in such high performing countries as Chinese Taipei, Hong Kong and Korea answered this item correctly.

Year 4 mathematics – Performance at the Intermediate international benchmark

Students who reached the Intermediate international benchmark were able to demonstrate an understanding of whole numbers, for example, solving problems involving multiplication of one-digit numbers. They could visualise three-dimensional shapes from two-dimensional representations, including recognising some properties of familiar solids, like cubes. Students were also able to interpret information presented in bar graphs, pictographs and tables and use this information to solve simple problems.

Figure A3.6 shows an item belonging to the content domain *number* and the cognitive domain *applying* that students who were performing at the Intermediate benchmark should be able to complete.

Country	Percent Correct		
Korea	97	(0.7)	↑
Japan	95	(0.9)	↑
Singapore	92	(1.1)	↑
Chinese Taipei	92	(1.1)	↑
Finland	86	(1.7)	↑
Belgium (Flemish)	86	(1.4)	↑
Portugal	84	(2.2)	↑
Germany	76	(1.7)	↑
Ireland	75	(2.0)	↑
Northern Ireland	74	(2.6)	↑
Lithuania	74	(2.2)	↑
England	74	(2.4)	↑
United States	74	(1.8)	↑
Hong Kong	74	(1.9)	↑
Netherlands	73	(1.9)	↑
Denmark	73	(2.0)	↑
Austria	72	(2.2)	↑
Italy	69	(2.1)	↑
Malta	67	(1.9)	↑
Russian Federation	67	(1.9)	↑
Sweden	65	(2.3)	↑
Chile	64	(1.7)	↑
Kazakhstan	63	(2.7)	
Azerbaijan	62	(2.7)	
Australia	62	(2.2)	
Hungary	61	(2.4)	
International Avg.	**60**	**(0.3)**	
Slovak Republic	60	(2.5)	
Poland	59	(2.3)	
Czech Republic	59	(2.6)	
Norway	59	(3.2)	
Spain	58	(2.6)	
Romania	57	(2.7)	
Turkey	56	(1.9)	↓
Slovenia	54	(2.3)	↓
Serbia	54	(2.0)	↓
Croatia	54	(2.2)	↓
New Zealand	48	(2.3)	↓
Georgia	48	(2.4)	↓
Bahrain	44	(2.4)	↓
Thailand	44	(1.8)	↓
Qatar	42	(2.6)	↓
Armenia	41	(2.2)	↓
United Arab Emirates	41	(1.2)	↓
Saudi Arabia	30	(2.5)	↓
Morocco	30	(2.2)	↓
Oman	29	(2.1)	↓
Iran	29	(1.9)	↓
Tunisia	28	(2.2)	↓
Yemen	19	(1.8)	↓
Kuwait	19	(1.8)	↓

Content Domain: Number
Cognitive Domain: Applying
Description: Solves a word problem involving addition of decimals (one place)

Duncan first traveled 4.8 km in a car and then he traveled 1.5 km in a bus.
How far did Duncan travel?

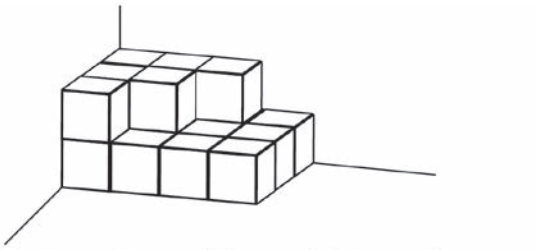
● 6.3 km
Ⓑ 5.8 km
Ⓒ 5.13 km
Ⓓ 4.95 km

↑ Percent significantly higher than international average
↓ Percent significantly lower than international average
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.6 Intermediate international benchmark - mathematics example 1

On average, over sixty per cent of Year 4 students across participating countries correctly identified response option A as the answer to this item, which was similar to the 62 per cent of Australian students who did so. The highest performing countries on this item – Korea, Japan, Singapore and Chinese Taipei – all had over 90 per cent of their students answer correctly.

Figure A3.7 shows an item belonging to the content domain *geometric shapes and measures* and the cognitive domain *applying* that students at the Intermediate benchmark were likely to complete correctly.

Country	Percent Correct			Content Domain: Geometric Shapes and Measures Cognitive Domain: Applying Description: Determines the number of cubes in a stack with some hidden
Chinese Taipei	95	(0.8)	↑	 Ann stacks these boxes in the corner of the room. All the boxes are the same size. How many boxes does she use? Ⓐ 25 Ⓑ 19 ● 18 Ⓓ 13
Belgium (Flemish)	90	(1.2)	↑	
Netherlands	90	(1.5)	↑	
Korea	85	(1.3)	↑	
Germany	85	(1.6)	↑	
Japan	84	(1.5)	↑	
Portugal	84	(1.8)	↑	
Finland	81	(2.0)	↑	
Hong Kong	80	(1.7)	↑	
Lithuania	78	(1.9)	↑	
Singapore	78	(1.4)	↑	
Denmark	77	(1.9)	↑	
Czech Republic	74	(2.2)	↑	
Sweden	74	(1.9)	↑	
Norway	74	(2.5)	↑	
Australia	74	(2.2)	↑	
Austria	74	(2.5)	↑	
Northern Ireland	72	(2.1)	↑	
Slovenia	70	(1.9)	↑	
Hungary	70	(1.9)	↑	
Serbia	70	(2.5)	↑	
United States	69	(1.3)	↑	
Russian Federation	68	(2.1)	↑	
England	67	(2.5)		
Ireland	66	(2.3)		
Slovak Republic	66	(2.2)		
New Zealand	63	(2.0)		
Poland	63	(2.4)		
International Avg.	**63**	**(0.3)**		
Croatia	62	(2.3)		
Chile	59	(1.9)		
Romania	57	(2.6)	↓	
Kazakhstan	57	(2.4)	↓	
Malta	57	(2.4)	↓	
Spain	55	(2.5)	↓	
Thailand	53	(2.5)	↓	
Italy	52	(2.3)	↓	
Georgia	51	(2.2)	↓	
Bahrain	50	(2.3)	↓	
Armenia	47	(2.4)	↓	
Azerbaijan	46	(2.8)	↓	
Turkey	45	(1.8)	↓	
Iran	44	(2.0)	↓	
Saudi Arabia	43	(2.9)	↓	
United Arab Emirates	41	(1.3)	↓	
Qatar	38	(2.4)	↓	
Oman	33	(1.7)	↓	
Tunisia	32	(2.2)	↓	
Morocco	31	(2.2)	↓	
Kuwait	31	(2.0)	↓	
Yemen	31	(2.2)	↓	

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.7 Intermediate international benchmark - mathematics example 2

Just under three-quarters of Australian Year 4 students answered this multiple-choice item correctly, identifying response option C as the correct answer, which was higher than the international average of 63 per cent of students. The top performing country on this item was Chinese Taipei, with 95 per cent of students identifying the correct response.

Figure A3.8 shows an item belonging to the content domain *data display* and the cognitive domain *reasoning* likely to be completed by students who were performing at the Intermediate benchmark.

Country	Percent Correct		
Korea	95	(0.9)	↑
Japan	92	(1.1)	↑
Singapore	89	(1.0)	↑
Hong Kong	88	(1.5)	↑
Chinese Taipei	87	(1.4)	↑
Russian Federation	86	(1.7)	↑
Finland	84	(2.1)	↑
United States	83	(1.1)	↑
Germany	83	(1.8)	↑
Portugal	82	(1.9)	↑
Slovenia	82	(2.0)	↑
Denmark	81	(1.6)	↑
Australia	81	(1.9)	↑
Italy	81	(1.9)	↑
Netherlands	80	(2.0)	↑
Austria	79	(1.9)	↑
Northern Ireland	78	(2.2)	↑
Slovak Republic	78	(1.9)	↑
Lithuania	77	(2.4)	↑
Belgium (Flemish)	76	(2.4)	↑
England	76	(2.0)	↑
Hungary	76	(2.1)	↑
Kazakhstan	76	(2.3)	↑
Chile	75	(1.8)	↑
Turkey	75	(1.4)	↑
Spain	75	(2.0)	↑
Ireland	75	(2.1)	
New Zealand	73	(1.9)	
Poland	72	(2.1)	
Czech Republic	72	(2.1)	
Norway	72	(2.8)	
Sweden	71	(2.2)	
International Avg.	**71**	**(0.3)**	
Romania	71	(2.6)	
Bahrain	69	(2.1)	
Malta	69	(2.0)	
Serbia	69	(2.7)	
Croatia	66	(2.5)	
Thailand	65	(2.6)	↓
United Arab Emirates	63	(1.3)	↓
Qatar	61	(2.7)	↓
Saudi Arabia	61	(2.7)	↓
Georgia	61	(2.5)	↓
Iran	55	(2.6)	↓
Oman	52	(1.7)	↓
Azerbaijan	52	(2.8)	↓
Kuwait	46	(2.2)	↓
Armenia	39	(2.4)	↓
Morocco	33	(1.9)	↓
Tunisia	32	(2.2)	↓
Yemen	22	(1.8)	↓

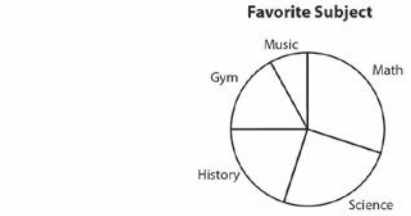
Content Domain: Data Display

Cognitive Domain: Reasoning

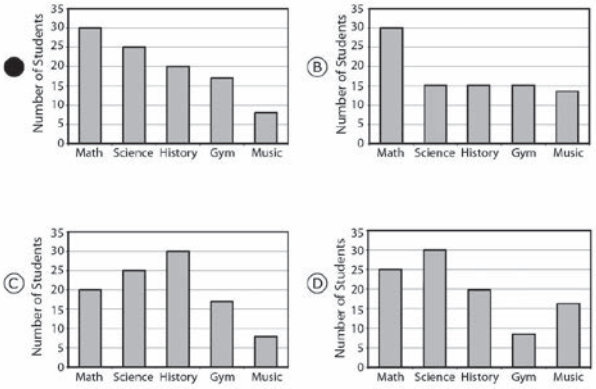
Description: Identifies the bar graph that matches the information shown in a pie chart

Mr. Johnson asked the students in his school about their favorite subject.

This pie chart shows how many students liked each of 5 subjects.



Which graph shows the same information as the pie chart?



↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.8 Intermediate international benchmark - mathematics example 3

Over 70 per cent of Year 4 students across participating countries identified the graph in response option A as the bar graph equivalent of the information displayed in the stimulus pie chart. Australian students performed quite strongly on this item, with just over 80 per cent of them identifying the correct response, which was higher than the international average, but not as high as the proportion from the top performing country, Korea, with 95 per cent of students answering correctly.

Year 4 mathematics – Performance at the Low international benchmark

Students who performed at the Low international benchmark could add and subtract whole numbers, including four-digit and three-digit numbers. They showed some recognition of parallel and perpendicular line and familiar geographic shapes.

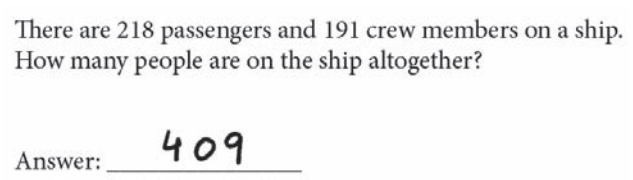
Figure A3.9 shows an item belonging to the content domain *number* and the cognitive domain *applying* likely to be completed by students who were performing at the Low benchmark. This item was also provided as an example in Chapter 3.

Country	Percent Full Credit		
Singapore	93	(0.8)	↑
Korea	93	(1.2)	↑
Japan	91	(1.1)	↑
Chinese Taipei	89	(1.6)	↑
Portugal	89	(1.6)	↑
Croatia	89	(1.2)	↑
Serbia	87	(1.7)	↑
Hong Kong	86	(1.8)	↑
Russian Federation	86	(1.3)	↑
United States	84	(0.9)	↑
Hungary	84	(1.6)	↑
Slovak Republic	83	(1.7)	↑
Italy	83	(1.7)	↑
Spain	83	(1.7)	↑
Lithuania	82	(1.9)	↑
Ireland	82	(1.8)	↑
Slovenia	81	(2.2)	↑
Belgium (Flemish)	81	(1.8)	↑
Turkey	81	(2.0)	↑
Netherlands	81	(1.9)	↑
Malta	81	(1.7)	↑
Kazakhstan	80	(2.3)	↑
Northern Ireland	80	(2.3)	↑
Czech Republic	79	(2.4)	↑
Austria	79	(1.8)	↑
Germany	79	(1.5)	↑
England	78	(2.3)	↑
Romania	77	(2.2)	↑
Chile	77	(1.8)	↑
Denmark	77	(1.7)	↑
Thailand	76	(2.5)	
Sweden	75	(2.2)	
Georgia	75	(2.3)	
Poland	75	(2.1)	
International Avg.	**73**	**(0.3)**	
Iran	70	(2.1)	
Armenia	70	(1.8)	
Australia	69	(2.2)	
Azerbaijan	68	(2.6)	
Finland	68	(2.6)	↓
Norway	67	(2.7)	↓
Bahrain	64	(2.4)	↓
United Arab Emirates	54	(1.3)	↓
New Zealand	52	(1.7)	↓
Tunisia	48	(2.4)	↓
Qatar	48	(1.9)	↓
Oman	41	(1.6)	↓
Saudi Arabia	39	(2.4)	↓
Morocco	35	(2.1)	↓
Kuwait	24	(1.9)	↓
Yemen	15	(1.9)	↓

Content Domain: Number

Cognitive Domain: Applying

Description: Solves a word problem involving addition of three-digit whole numbers



The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.9 Low international benchmark - mathematics example 1

Just under three-quarters of Year 4 students across countries who participated in TIMSS 2011 provided a correct response to this item. Sixty-nine per cent of Australian students (a proportion not significantly different to the international average) provided the correct response, compared to over 90 per cent of students in some of the top performing countries (Singapore, Korea and Japan).

Figure A3.10 shows an item belonging to the content domain *data display* and the cognitive domain *applying* likely to be completed by students who were performing at the Low benchmark.

Country	Percent Full Credit		
Korea	97	(0.7)	↑
Singapore	95	(0.8)	↑
Hong Kong	95	(1.1)	↑
Japan	93	(1.1)	↑
Northern Ireland	92	(1.6)	↑
Netherlands	91	(1.5)	↑
England	89	(1.3)	↑
Finland	88	(1.7)	↑
Germany	88	(1.2)	↑
Lithuania	87	(1.9)	↑
Ireland	87	(1.5)	↑
Chinese Taipei	87	(1.8)	↑
Belgium (Flemish)	86	(1.3)	↑
Australia	84	(1.6)	↑
Portugal	84	(2.0)	↑
Denmark	84	(1.7)	↑
Sweden	83	(2.0)	↑
Malta	83	(1.8)	↑
Hungary	83	(1.5)	↑
Russian Federation	81	(1.6)	↑
New Zealand	81	(2.2)	↑
Austria	80	(1.9)	↑
Slovenia	80	(1.9)	↑
Thailand	78	(2.5)	
United States	78	(1.2)	↑
Spain	78	(1.9)	↑
Slovak Republic	77	(1.7)	↑
Czech Republic	77	(2.4)	
Italy	77	(2.1)	
Bahrain	75	(2.1)	
Croatia	74	(2.3)	
Norway	74	(2.5)	
International Avg.	**73**	**(0.3)**	
Turkey	73	(2.1)	
Kazakhstan	73	(2.7)	
Poland	73	(2.0)	
Qatar	70	(2.0)	
Chile	69	(2.1)	↓
United Arab Emirates	68	(1.3)	↓
Serbia	67	(2.3)	↓
Romania	62	(2.7)	↓
Saudi Arabia	60	(2.4)	↓
Oman	57	(1.6)	↓
Georgia	56	(2.7)	↓
Kuwait	55	(1.8)	↓
Iran	54	(2.0)	↓
Azerbaijan	47	(2.7)	↓
Armenia	41	(2.4)	↓
Tunisia	24	(2.0)	↓
Morocco	23	(1.8)	↓
Yemen	13	(1.6)	↓

Content Domain: Data Display

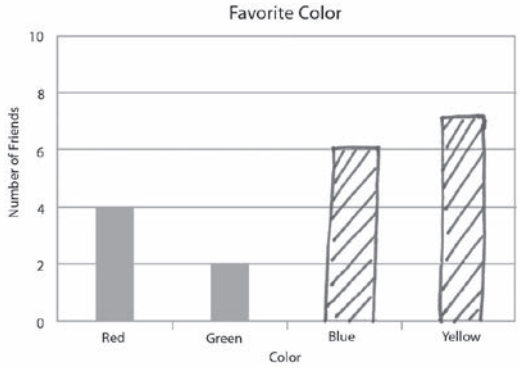
Cognitive Domain: Applying

Description: Completes a bar graph from data in a table

Darin asked his friends to name their favorite color. He collected the information in the table shown below.

Favorite Color	Number of Friends
Red	4
Green	2
Blue	6
Yellow	7

Then Darin started to draw a graph to show the information. Complete Darin's graph.



The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.10 Low international benchmark - mathematics example 2

As for the previous item, just under three-quarters of students across participating countries (on average), successfully completed this item, by correctly adding the required bars to the graph based on the information provided in the tally table in the stimulus. Australian students performed quite well on this item, with 84 per cent correctly completing the bar graph. In Korea, Singapore and Hong Kong, 95 per cent of students were able to complete this item.

Year 4 science – Descriptors of performance at the international benchmarks

Table A3.5 provides the brief descriptors for science for Year 4. At this year level, almost half (45%) of the assessment items were devoted to assessing the *life science* content domain. A further 35 per cent was devoted to assessing *physical science* and the remaining 20 per cent to *Earth science.* As can be seen in Table A3.5, students at the Advanced international benchmark applied knowledge and understanding of scientific processes and relationships in beginning scientific inquiry, whereas those at the Low international benchmark displayed some elementary knowledge of life science and physical science.

According to the *TIMSS 2011 Science Framework*, in the *life science* domain, Year 4 students should be able to demonstrate knowledge of the characteristics and life processes of living things, know and be able to compare the life cycles of common organisms such as the butterfly and frog, describe relationships between plants and animals in common ecosystems and have a rudimentary knowledge of human health, nutrition and disease.

Within the *physical science* domain Year 4 students should be able to compare or classify objects and materials on the basis of physical properties, identify common energy sources and have some understanding of heat flow, relate familiar physical phenomena to the behaviour of light and sound, have some notion of a complete electrical circuit and some practical knowledge of magnets and their uses and have some grasp of the idea of forces as they relate to movement.

In the *Earth science* content domain Year 4 students were expected to demonstrate some general knowledge about the structure and physical characteristics of Earth; Earth's processes, cycles and history; and some understandings about Earth's place in the solar system. Within each of the content domains, students were expected to demonstrate knowledge as well as application and reasoning skills.

Table A3.5 Descriptions of the TIMSS international benchmarks for science

Low International Benchmark	Intermediate International Benchmark	High International Benchmark	Advanced International Benchmark
400	475	550	625
Students have some elementary knowledge of life, physical and Earth science. Students demonstrate knowledge of some simple facts related to human health, ecosystems and the behavioural and physical characteristics of animals. They also demonstrate some basic knowledge of energy and the physical properties of matter. Students interpret simple diagrams, complete simple tables, and provide short written responses to questions requiring factual information.	Students have basic knowledge and understanding of practical situations in the sciences. Students recognise some basic information related to characteristics of living things, their reproduction and life cycles and their interactions with the environment, and show some understanding of human biology and health. They also show some knowledge of properties of matter and light, electricity and energy and forces and motion. Students know some basic facts about the solar system and show an initial understanding of Earth's physical characteristics and resources. They demonstrate ability to interpret information in pictorial diagrams and apply factual knowledge to practical situations.	Students apply their knowledge and understanding of the sciences to explain phenomena in everyday and abstract contexts. Students demonstrate some understanding of plant and animal structure, life processes, life cycles and reproduction. They also demonstrate some understanding of ecosystems and organisms' interactions with their environment, including understanding of human responses to outside conditions and activities. Students demonstrate understanding of some properties of matter, electricity and energy, and magnetic and gravitational forces and motion. They show some knowledge of the solar system, and of Earth's physical characteristics, processes and resources. Students demonstrate elementary knowledge and skills related to scientific inquiry. They compare, contrast and make simple inferences, and provide brief descriptive responses combining knowledge of science concepts with information from both everyday and abstract contexts.	Students apply knowledge and understanding of scientific processes and relationships and show some knowledge of the process of scientific inquiry. Students communicate their understanding of characteristics and life processes of organisms, reproduction and development, ecosystems and organisms' interactions with the environment and factors relating to human health. They demonstrate understanding of properties of light and relationships between physical properties of materials, apply and communicate their understanding of electricity and energy in practical contexts and demonstrate an understanding of magnetic and gravitational forces and motion. Students communicate their understanding of the solar system and of Earth's structure, physical characteristics, resources, processes, cycles and history. They have a beginning ability to interpret results in the context of a simple experiment, reason and draw conclusions from descriptions and diagrams and evaluate and support an argument.

Year 4 science – Performance at the Advanced international benchmark

Students achieving at or above this benchmark at Year 4 demonstrated fluency with most framework topics. They typically demonstrated success on the knowledge and skills represented by this benchmark, as well as those demonstrated at the High, Intermediate and Low benchmarks. In *life science*, they showed knowledge of characteristics and life processes of a variety of organisms, while in *physical science*, they showed understanding of the relationships among physical properties of materials and of the basic properties of light.

Figure A3.11 shows an item belonging to the content domain *life science* and the cognitive domain *knowing* that students achieving at this benchmark would be expected to have answered correctly. This item was also included as an example in Chapter 4.

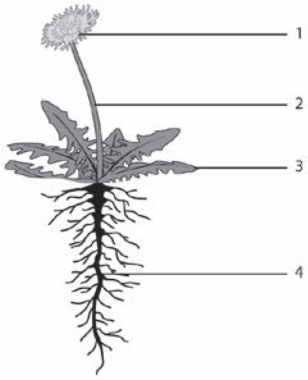
Country	Percent Full Credit		
Singapore	80	(1.6)	↑
Korea	42	(2.2)	↑
Thailand	40	(2.7)	↑
Czech Republic	39	(2.8)	↑
Bahrain	37	(2.7)	↑
Italy	36	(2.4)	↑
Romania	35	(2.6)	↑
Hungary	34	(2.5)	↑
Croatia	33	(2.2)	↑
Finland	32	(2.3)	↑
Portugal	31	(3.0)	↑
Iran	28	(2.1)	↑
Kazakhstan	27	(2.5)	↑
Chinese Taipei	26	(1.8)	↑
Austria	25	(2.2)	↑
Slovak Republic	25	(2.2)	↑
United States	24	(1.0)	↑
Serbia	23	(2.0)	
United Arab Emirates	22	(1.3)	
Lithuania	21	(1.8)	
England	21	(2.8)	
International Avg.	**21**	**(0.3)**	
Russian Federation	20	(1.8)	
Japan	20	(1.6)	
Oman	19	(1.7)	
Sweden	18	(1.9)	
Kuwait	18	(1.6)	
Saudi Arabia	16	(2.3)	
Hong Kong	16	(1.5)	↓
Spain	16	(1.8)	↓
Slovenia	15	(1.6)	↓
Denmark	15	(1.6)	↓
Azerbaijan	15	(2.0)	↓
Qatar	13	(1.7)	↓
Chile	13	(1.3)	↓
Poland	13	(1.8)	↓
Morocco	12	(1.2)	↓
Turkey	11	(1.1)	↓
Ireland	10	(1.9)	↓
Georgia	10	(1.9)	↓
Germany	10	(1.2)	↓
Australia	10	(1.3)	↓
Armenia	10	(1.7)	↓
Northern Ireland	9	(1.4)	↓
Netherlands	8	(1.3)	↓
Belgium (Flemish)	6	(1.0)	↓
Malta	6	(1.0)	↓
New Zealand	6	(1.0)	↓
Norway	4	(1.1)	↓
Tunisia	2	(0.8)	↓
Yemen	1	(0.5)	↓

Content Domain: Life Science

Cognitive Domain: Knowing

Description: From a diagram of a flowering plant, identifies numbered parts and states a function of most of these parts

The diagram shows a flowering plant. Four of its parts are numbered.



In the table below, write the name of each part, and state its function.

Part Number	Name of Part	Function of Part
1	flower	produces seeds
2	stem	transports water and food
3	leaf	makes food for the plant
4	root	absorbs water, minerals, and nutrients into the plant

The answer shown illustrates the type of student response that was given 2 of 2 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.11 Advanced international benchmark - science example 1

Around one in every five students across participating countries was able to complete the table in this item correctly, identifying all the parts of the plant and providing their functions. Australian students did not perform well on this item, with only one in ten (10%) receiving credit for their response, which was significantly lower than the international average. In contrast, Singapore, by far the top performer on this item, had 80 per cent of its students receive credit on this item.

Figure A3.12 shows an item belonging to the content domain *physical science* and the cognitive domain *reasoning* that students achieving at the Advanced benchmark would be expected to have answered correctly.

Country	Percent Full Credit		
Singapore	66	(2.0)	↑
Japan	50	(1.8)	↑
Chinese Taipei	47	(2.3)	↑
Finland	41	(2.6)	↑
Sweden	37	(2.6)	↑
United States	37	(1.4)	↑
England	35	(2.4)	↑
Portugal	35	(2.1)	↑
Belgium (Flemish)	35	(2.2)	↑
Slovenia	32	(2.2)	↑
Norway	32	(3.4)	
Hong Kong	31	(2.3)	↑
Northern Ireland	30	(2.3)	
Netherlands	30	(2.1)	
Serbia	29	(1.9)	
Turkey	29	(1.7)	
Denmark	28	(2.0)	
Czech Republic	28	(2.4)	
Germany	28	(1.7)	
Ireland	28	(2.4)	
Spain	27	(1.9)	
Australia	27	(1.8)	
Korea	27	(1.6)	
Russian Federation	27	(1.9)	
Kazakhstan	27	(2.4)	
Poland	26	(1.9)	
International Avg.	**26**	**(0.3)**	
Georgia	26	(2.3)	
Iran	26	(1.7)	
Bahrain	26	(1.6)	
New Zealand	25	(1.9)	
Malta	25	(1.9)	
Lithuania	24	(1.8)	
Romania	23	(2.4)	
Thailand	23	(1.7)	↓
Italy	23	(1.9)	
Hungary	23	(1.8)	↓
Saudi Arabia	22	(2.1)	↓
Austria	21	(1.7)	↓
Slovak Republic	20	(1.6)	↓
Chile	20	(1.7)	↓
Tunisia	19	(2.1)	↓
United Arab Emirates	19	(1.0)	↓
Qatar	17	(1.9)	↓
Croatia	17	(1.6)	↓
Kuwait	15	(1.5)	↓
Armenia	14	(1.6)	↓
Azerbaijan	12	(1.8)	↓
Oman	6	(0.8)	↓
Morocco	5	(0.7)	↓
Yemen	1	(0.4)	↓

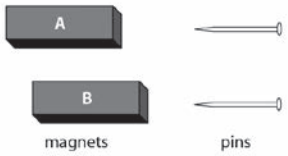
Content Domain: Physical Science

Cognitive Domain: Reasoning

Description: Infers that magnets have different strengths from an observation of magnets attracting pins from two different distances

Betty has two magnets (A and B) and two metal pins that are the same.

She slides Magnet A along a table until a pin is attracted to the magnet.
She slides Magnet B along a table until a pin is attracted to the magnet.



She finds that Magnet A attracts the pin from 15cm and Magnet B attracts the pin from 10cm.

Steven says that both magnets are equally strong.

Do you agree?

(Check one box.)

☐ Yes

☒ No

Explain your answer.

magnet A is stronger because it attracted the pin from farther away than magnetB did.

The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.12 Advanced international benchmark - science example 2

Just over one-quarter of Year 4 students across participating countries on average received credit for their response to this constructed response item. At 27 per cent, the proportion of Australian students with a correct response was similar to the international average. Singapore was the highest performing country on this item, with two-thirds of its students receiving credit for their answer.

Figure A3.13 shows an item belonging to the content domain *Earth science* and the cognitive domain *knowing* likely to be completed correctly by students at this benchmark.

Country	Percent Correct		
Korea	63	(2.3)	↑
Finland	61	(2.2)	↑
Russian Federation	60	(2.0)	↑
Japan	55	(2.1)	↑
United States	54	(1.6)	↑
Kazakhstan	53	(2.7)	↑
Azerbaijan	52	(2.9)	↑
Slovak Republic	51	(2.2)	↑
Hungary	51	(2.2)	↑
Croatia	48	(2.3)	↑
Turkey	48	(1.7)	↑
Chinese Taipei	48	(2.3)	↑
Slovenia	47	(2.6)	↑
Poland	45	(2.1)	↑
Lithuania	44	(2.2)	↑
Australia	44	(2.0)	↑
Hong Kong	44	(2.1)	↑
Italy	43	(2.2)	↑
Czech Republic	41	(2.4)	
Sweden	41	(2.4)	
Portugal	40	(3.7)	
Singapore	40	(1.7)	
England	39	(2.5)	
International Avg.	**39**	**(0.3)**	
Romania	39	(2.7)	
Northern Ireland	38	(2.5)	
Ireland	37	(3.5)	
Belgium (Flemish)	37	(2.1)	
New Zealand	36	(1.8)	
United Arab Emirates	36	(1.2)	
Austria	36	(2.3)	
Denmark	35	(2.1)	
Georgia	35	(2.6)	
Serbia	34	(2.1)	↓
Saudi Arabia	34	(2.4)	↓
Netherlands	33	(2.2)	↓
Oman	32	(1.4)	↓
Iran	31	(1.8)	↓
Thailand	30	(2.4)	↓
Spain	30	(2.0)	↓
Bahrain	29	(1.9)	↓
Armenia	29	(2.3)	↓
Chile	28	(1.5)	↓
Norway	28	(2.4)	↓
Malta	27	(2.0)	↓
Germany	26	(1.8)	↓
Qatar	26	(2.7)	↓
Kuwait	22	(1.7)	↓
Morocco	21	(1.7)	↓
Yemen	19	(1.6)	↓
Tunisia	19	(1.6)	↓

Content Domain: Earth Science
Cognitive Domain: Knowing
Description: Recognizes a soil change due to natural causes

Which of these soil changes is due only to natural causes?

Ⓐ Loss of minerals due to farming.
Ⓑ Deserts forming due to tree cutting.
Ⓒ Flooding due to dam construction.
● Minerals washing out due to heavy rain.

↑ Percent significantly higher than international average
↓ Percent significantly lower than international average
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.13 Advanced international benchmark - science example 3

Across participating countries, an average of 39 per cent of students identified response option D as the correct answer to this item. At 44 per cent, the proportion of Australian Year 4 students who responded correctly was significantly higher than the international average, but significantly lower than the proportions of correct responses from the highest performing countries, Korea, Finland and the Russian Federation, all with 60 per cent or more students answering correctly.

Year 4 science – Performance at the High international benchmark

Students achieving the High international benchmark in science at Year 4 demonstrated some competency with many of the topics in the framework. At this level, students demonstrate some knowledge of life processes, and some knowledge of properties of matter and physical phenomena. In *life science,* they demonstrate understanding of plant and animal structure and life processes. In *physical science*, they demonstrate basic understanding of some properties of matter, for example that objects with greater volume do not necessarily weigh more. In *Earth science*, students at this level demonstrate a basic understanding of Earth's physical characteristics and response and some knowledge of the solar system.

The following examples illustrate the types of items that are typically answered correctly by students reaching the High benchmark.

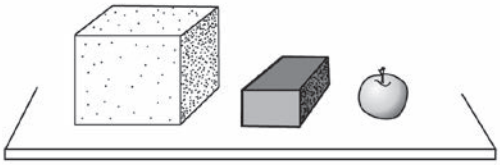
Country	Percent Full Credit		
Chinese Taipei	74	(2.2)	↑
Austria	74	(1.9)	↑
Serbia	72	(2.3)	↑
Russian Federation	71	(1.9)	↑
Finland	71	(2.3)	↑
Korea	68	(1.9)	↑
Hungary	68	(1.9)	↑
Norway	62	(2.4)	↑
Portugal	61	(2.4)	↑
Poland	58	(1.8)	↑
Sweden	56	(2.8)	↑
Italy	56	(2.0)	↑
Czech Republic	55	(2.9)	↑
Lithuania	54	(2.1)	↑
Slovak Republic	53	(2.2)	↑
Singapore	52	(2.0)	↑
Germany	51	(2.2)	↑
Hong Kong	49	(2.2)	↑
Croatia	47	(1.8)	↑
United States	46	(1.5)	↑
Denmark	46	(2.4)	
Japan	45	(2.3)	
Belgium (Flemish)	45	(2.0)	
Kazakhstan	45	(2.5)	
Slovenia	43	(2.1)	
Australia	43	(2.2)	
Spain	42	(2.1)	
International Avg.	**42**	**(0.3)**	
Chile	41	(2.1)	
Netherlands	40	(2.7)	
Northern Ireland	40	(2.1)	
Ireland	39	(3.4)	
England	39	(2.7)	
New Zealand	39	(2.2)	
Romania	38	(2.5)	
Turkey	36	(1.5)	↓
Saudi Arabia	35	(2.4)	↓
Thailand	30	(2.5)	↓
Iran	24	(1.6)	↓
Kuwait	23	(1.7)	↓
Oman	21	(1.4)	↓
United Arab Emirates	19	(1.0)	↓
Azerbaijan	19	(2.1)	↓
Georgia	19	(2.0)	↓
Bahrain	19	(1.9)	↓
Malta	19	(1.8)	↓
Armenia	18	(1.8)	↓
Tunisia	15	(1.5)	↓
Qatar	12	(1.8)	↓
Yemen	3	(0.6)	↓
Morocco	0	(0.2)	↓

Content Domain: Physical Science

Cognitive Domain: Reasoning

Description: Justifies that objects with more volume do not necessarily weigh more using a diagram of three objects of different materials ordered by volume

Jack's teacher places three objects on a table, as shown below. She puts them in order according to their volume.



Jack thinks that objects with more volume weigh more.

Do you agree with him?

(Check one box.)

☐ Yes

☒ No

Explain your answer.

It depends on what the object is made of. The brick is smaller than the styrofoam block but it is more dense so it probably weighs more.

The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.14 High international benchmark - science example 1

Just over 40 per cent of Year 4 students on average across the participating countries (42%) received credit for their response to this item, identifying that volume/size and weight were not necessarily correlated. At 43 per cent, the proportion of Australian students who provided a correct answer was not significantly different to the international average. Chinese Taipei and Austria were among the top performers on this item, with 74 per cent of their students receiving credit on this item.

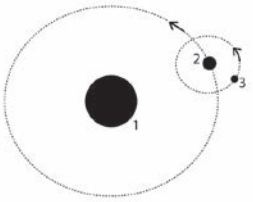
Country	Percent Full Credit		
Portugal	78	(2.2)	h
Russian Federation	74	(2.5)	↑
Korea	73	(1.6)	↑
Slovak Republic	66	(2.4)	↑
United States	65	(1.6)	↑
Finland	65	(2.2)	↑
Sweden	64	(2.7)	↑
England	63	(2.5)	↑
Norway	60	(3.3)	↑
Spain	59	(2.4)	↑
Chile	59	(1.9)	↑
Hong Kong	58	(1.8)	↑
United Arab Emirates	55	(1.2)	↑
Australia	54	(2.5)	↑
Lithuania	54	(2.5)	↑
Japan	53	(2.1)	↑
Austria	53	(2.7)	
Czech Republic	52	(2.2)	
Denmark	52	(2.3)	
Chinese Taipei	52	(2.2)	
Kuwait	51	(2.4)	
Bahrain	51	(2.5)	
Hungary	51	(2.2)	
Malta	50	(1.9)	
Ireland	50	(2.6)	
Kazakhstan	49	(2.9)	
Netherlands	49	(2.6)	
Poland	49	(2.5)	
International Avg.	**49**	**(0.3)**	
Slovenia	48	(2.3)	
Thailand	48	(2.7)	
Singapore	48	(1.8)	
Qatar	47	(2.4)	
Romania	47	(3.0)	
Germany	44	(2.4)	
Italy	44	(2.3)	↓
New Zealand	44	(2.0)	↓
Croatia	43	(2.1)	↓
Iran	42	(2.2)	↓
Georgia	40	(2.4)	↓
Saudi Arabia	39	(2.8)	↓
Belgium (Flemish)	39	(2.5)	↓
Azerbaijan	39	(3.0)	↓
Serbia	39	(2.7)	↓
Turkey	38	(1.8)	↓
Northern Ireland	35	(2.5)	↓
Oman	30	(1.9)	↓
Armenia	27	(2.4)	↓
Tunisia	17	(2.1)	↓
Morocco	16	(2.2)	↓
Yemen	15	(1.7)	↓

Content Domain: Earth Science

Cognitive Domain: Reasoning

Description: Identifies the Earth, Moon, and Sun from a diagram of their orbits

The figure below shows Earth, the Moon, and the Sun. Each body is labeled by a number. The arrows show the direction each body is moving.



Fill in the correct number next to each body (1, 2 or 3).

Earth is body number: 2

The Moon is body number: 3

The Sun is body number: 1

The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.15 High international benchmark - science example 2

On average across the participating TIMSS countries, just under half of the Year 4 students were able to correctly label the Earth, Moon and Sun in the diagram in the stimulus for this item. Australia's percentage, at 54 per cent, was significantly higher than the international average, but still well below that of Portugal, the top performer on this item with 78 per cent of students providing a correct response.

Year 4 science – Performance at the Intermediate international benchmark

Students achieving at the Intermediate international benchmark were able to apply basic knowledge and understanding to practical situations in the sciences. In *life science*, they could demonstrate some knowledge of the characteristics of living things, such as identifying a characteristic that all living things share. In *physical science* they could show knowledge of some of the properties of matter and light, while in *Earth science* they showed initial understanding of Earth's physical characteristics and resources.

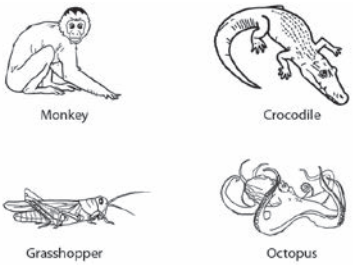
Figure A3.16 presents an item in the content domain of *life science* and the cognitive domain of *applying* that students at the Intermediate benchmark would be expected to be able to complete correctly.

Country	Percent Full Credit		
Korea	88	(1.4)	↑
Singapore	83	(1.4)	↑
Hungary	80	(1.8)	↑
Italy	79	(1.9)	↑
Denmark	76	(1.8)	↑
Slovak Republic	75	(1.9)	↑
Portugal	74	(2.0)	↑
Russian Federation	72	(2.5)	↑
Japan	70	(1.8)	↑
Australia	70	(2.0)	↑
United States	69	(1.3)	↑
Chinese Taipei	69	(2.0)	↑
Hong Kong	69	(2.1)	↑
England	67	(2.4)	↑
Belgium (Flemish)	66	(1.8)	↑
Germany	66	(2.3)	↑
Northern Ireland	66	(2.5)	↑
Sweden	65	(2.4)	↑
Croatia	65	(2.0)	↑
Thailand	64	(3.3)	
Spain	64	(2.3)	↑
Poland	64	(1.9)	↑
Finland	64	(2.4)	↑
Norway	63	(2.2)	↑
Czech Republic	63	(2.5)	
Austria	63	(2.3)	↑
Lithuania	63	(2.4)	↑
Netherlands	60	(2.5)	
Chile	60	(2.2)	
New Zealand	59	(1.9)	
Slovenia	58	(2.5)	
International Avg.	**58**	**(0.3)**	
Ireland	58	(2.0)	
Kazakhstan	57	(2.8)	
Malta	54	(2.1)	
Romania	53	(2.9)	
Turkey	53	(1.6)	↓
Serbia	51	(2.6)	↓
Iran	50	(1.8)	↓
Bahrain	49	(2.5)	↓
Azerbaijan	47	(2.7)	↓
United Arab Emirates	45	(1.2)	↓
Georgia	44	(2.5)	↓
Armenia	38	(2.6)	↓
Qatar	38	(2.3)	↓
Saudi Arabia	33	(2.6)	↓
Oman	31	(1.5)	↓
Kuwait	29	(1.6)	↓
Tunisia	26	(2.0)	↓
Morocco	16	(1.6)	↓
Yemen	14	(1.4)	↓

Content Domain: Life Science

Cognitive Domain: Applying

Description: Pairs pictures of three animals with their distinguishing biological characteristics (skeleton, milk production, number of legs)



Answer the following questions using the animals shown above. Write the name for the correct animal in the spaces below.

Which animal has an internal skeleton and produces milk for its young?

monkey

Which animal has an external skeleton and three pairs of legs?

grasshopper

Which animal has a soft body and no skeleton?

octopus

The answer shown illustrates the type of student response that was given 1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

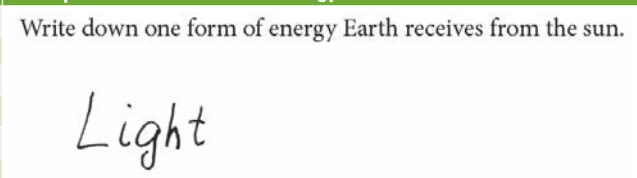
Figure A3.16 Intermediate international benchmark - science example 1

On average across the participating countries, 58 per cent of Year 4 students were able to identify each of the characteristics of the living things in this item. Australian students performed quite well on this item, with 70 per cent receiving credit for their response, which was significantly higher than the international average. Korea was the top performing country on this item, with 88 per cent of its students providing a correct response.

Figure A3.17 is an example of an *Earth science* item in the cognitive domain of *knowing*.

Country	Percent Full Credit		
Singapore	82	(1.5)	↑
Korea	79	(1.7)	↑
Slovak Republic	75	(1.9)	↑
Hong Kong	73	(1.9)	↑
Russian Federation	73	(2.0)	↑
Northern Ireland	69	(2.4)	↑
Netherlands	69	(2.4)	↑
Italy	68	(1.8)	↑
Romania	68	(2.7)	↑
Ireland	68	(2.4)	↑
England	66	(2.6)	↑
Austria	64	(2.5)	↑
Australia	63	(2.3)	↑
United States	63	(1.4)	↑
Kazakhstan	62	(2.5)	↑
Portugal	62	(2.5)	↑
Croatia	62	(2.4)	↑
Serbia	61	(2.1)	↑
Chinese Taipei	61	(2.1)	↑
Denmark	61	(2.2)	↑
Japan	59	(2.0)	↑
Czech Republic	59	(2.5)	↑
Georgia	59	(2.6)	
Belgium (Flemish)	59	(1.9)	↑
Norway	57	(3.1)	
New Zealand	56	(2.0)	
Turkey	55	(1.3)	
Finland	55	(2.5)	
International Avg.	**54**	**(0.3)**	
Hungary	54	(2.0)	
Iran	54	(2.4)	
Slovenia	53	(3.2)	
Chile	53	(1.9)	
Lithuania	53	(2.2)	
Thailand	52	(2.3)	
Spain	51	(2.3)	
Germany	48	(2.1)	↓
Bahrain	47	(2.4)	↓
Saudi Arabia	47	(2.3)	↓
United Arab Emirates	46	(1.4)	↓
Poland	45	(1.7)	↓
Sweden	44	(2.3)	↓
Qatar	40	(1.8)	↓
Malta	38	(2.3)	↓
Azerbaijan	37	(3.0)	↓
Armenia	35	(2.1)	↓
Kuwait	29	(1.9)	↓
Tunisia	29	(2.2)	↓
Oman	24	(1.4)	↓
Yemen	12	(1.3)	↓
Morocco	9	(1.7)	↓

Content Domain: Earth Science
Cognitive Domain: Knowing
Description: States one form of energy Earth receives from the sun



The answer shown illustrates the type of student response that was given1 of 1 points.

↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.17 Intermediate international benchmark - science example 2

Over half of the students across the participating countries were able to identify one of the forms of energy the Earth receives from the sun. In comparison, 63 per cent of Australian Year 4 students provided a correct response, which was significantly higher than the international average, but still lower than the percentage of correct responses in Singapore, with 82 per cent of its students receiving credit for their response.

Year 4 science – Performance at the Low international benchmark

At this level students demonstrated some elementary knowledge of the life and physical sciences. This included simple facts related to human health and the behavioural and physical characteristics of animals and humans.

Figure A3.18 is an example of a *life science* item in the cognitive domain of *applying*.

Country	Percent Correct		
Korea	99	(0.3)	↑
United States	96	(0.5)	↑
Croatia	95	(0.9)	↑
Singapore	95	(0.7)	↑
Finland	95	(0.9)	↑
Sweden	95	(0.9)	↑
Ireland	95	(0.9)	↑
Austria	94	(0.9)	↑
England	94	(1.4)	↑
Norway	93	(1.3)	↑
Germany	93	(1.1)	↑
New Zealand	93	(1.2)	↑
Portugal	92	(1.3)	↑
Russian Federation	92	(1.0)	↑
Australia	92	(1.5)	↑
Slovenia	91	(1.3)	↑
Netherlands	91	(1.5)	↑
Northern Ireland	91	(2.0)	↑
Denmark	91	(1.3)	↑
Serbia	91	(1.4)	↑
Czech Republic	90	(1.6)	↑
Poland	90	(1.4)	↑
Slovak Republic	89	(1.5)	↑
Italy	89	(1.6)	↑
Lithuania	89	(1.4)	↑
Belgium (Flemish)	88	(1.4)	↑
Spain	87	(1.3)	↑
Japan	87	(1.5)	↑
Thailand	86	(1.5)	
Georgia	86	(2.1)	
Hungary	84	(1.6)	
Chile	84	(1.5)	
International Avg.	**83**	**(0.2)**	
Armenia	83	(1.7)	
Chinese Taipei	83	(1.5)	
Romania	83	(2.7)	
Malta	82	(1.6)	
Hong Kong	79	(2.1)	
Kazakhstan	79	(1.8)	↓
Turkey	79	(1.5)	↓
Bahrain	75	(2.1)	↓
Azerbaijan	75	(2.1)	↓
United Arab Emirates	74	(1.1)	↓
Saudi Arabia	70	(1.9)	↓
Iran	62	(2.1)	↓
Qatar	62	(2.1)	↓
Tunisia	61	(2.7)	↓
Oman	61	(1.6)	↓
Kuwait	54	(2.1)	↓
Morocco	47	(2.3)	↓
Yemen	31	(2.3)	↓

Content Domain: Life Science
Cognitive Domain: Applying
Description: Recognizes that wings are common to birds, bats, and butterflies

What do birds, bats and butterflies have in common?

Ⓐ feathers
Ⓑ hair
Ⓒ internal skeleton
● wings

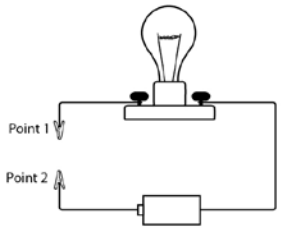
↑ Percent significantly higher than international average
↓ Percent significantly lower than international average
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.18 Low international benchmark - science example 1

This item, which required students to identify the characteristic that all of the listed living things shared, was a fairly straightforward item for many students. On average across the participating countries, 83 per cent of students were able to correctly identify response option D as the answer. Australian students performed above the international average on this item, with 92 per cent of students answering correctly. In Korea, almost all students (99%) selected the correct response to this item.

The next example for the Low international benchmark, Figure A3.19, is a *physical science* item in the cognitive domain of *applying*.

Country	Percent Correct			Content Domain: Physical Science Cognitive Domain: Applying Description: From a simple circuit diagram, recognizes that an iron nail can complete an electrical circuit
Japan	94	(1.1)	↑	The following picture shows a lightbulb connected to a battery in an electrical circuit. Which of the following objects connected to Points 1 and 2 will allow the bulb to glow?
Chinese Taipei	94	(1.1)	↑	
Singapore	94	(1.0)	↑	
Austria	89	(1.3)	↑	
Germany	88	(1.4)	↑	
Slovak Republic	87	(1.7)	↑	
Finland	86	(1.8)	↑	
United States	84	(1.2)	↑	
Hong Kong	84	(1.6)	↑	
England	84	(1.7)	↑	
Korea	83	(1.6)	↑	
Iran	82	(1.8)	↑	
Sweden	79	(2.0)	↑	● iron nail Ⓑ plastic spoon Ⓒ rubber band Ⓓ wooden stick
Portugal	79	(2.1)	↑	
Belgium (Flemish)	78	(1.8)	↑	
Czech Republic	77	(2.2)	↑	
Slovenia	76	(2.3)	↑	
Ireland	76	(2.0)	↑	
Serbia	76	(2.2)	↑	
Northern Ireland	75	(2.2)		
Denmark	75	(2.1)		
Malta	75	(2.1)		
Romania	74	(2.2)		
Poland	74	(2.1)		
Lithuania	74	(2.0)		
New Zealand	74	(1.7)		
Australia	74	(1.9)		
Hungary	73	(2.1)		
Croatia	73	(1.9)		
Russian Federation	72	(2.2)		
International Avg.	**71**	**(0.3)**		
Spain	71	(2.2)		
Oman	68	(1.8)		
Thailand	68	(2.5)		
Norway	67	(2.2)		
Turkey	63	(1.5)	↓	
Kazakhstan	62	(2.7)	↓	
Italy	62	(2.7)	↓	
Netherlands	62	(2.4)	↓	
Qatar	61	(2.1)	↓	
United Arab Emirates	61	(1.4)	↓	
Armenia	60	(2.4)	↓	
Chile	59	(1.9)	↓	
Azerbaijan	57	(3.3)	↓	
Bahrain	57	(2.0)	↓	
Georgia	56	(2.2)	↓	
Saudi Arabia	53	(2.8)	↓	
Tunisia	46	(2.6)	↓	
Morocco	43	(2.3)	↓	
Yemen	36	(1.9)	↓	
Kuwait	34	(2.0)	↓	



↑ Percent significantly higher than international average

↓ Percent significantly lower than international average

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Figure A3.19 Low international benchmark - science example 2

On average across participating countries, around seven in every ten students were able to correctly identify response option A as the only item that would complete the electrical circuit diagrammed in the stimulus. The proportion of Australian students who provided the correct answer (74%) was not significantly different to the international average, whereas Japan, Chinese Taipei and Singapore outperformed all other countries on this item, with 94 per cent of their students selecting the correct option.

Appendix

4

International comparison tables

Table A4.1 International multiple comparison tables – PIRLS 2011 reading

Instructions: Read across the row for a country to compare performance with the countries listed along the top of the chart. The symbols indicate whether the average achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the average achievement of the two countries.

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score		Hong Kong	Russian Federation	Finland	Singapore	Northern Ireland	United States	Denmark	Croatia	Chinese Taipei	Ireland	England	Canada	Netherlands	Czech Republic	Sweden	Italy	Germany	Israel	Portugal	Hungary	Slovak Republic	Bulgaria	New Zealand	Slovenia	Austria	Lithuania	Australia	Poland	France	Spain	Norway	Belgium (French)	Romania	Georgia	Malta	Trinidad and Tobago	Azerbaijan	Iran	Colombia	United Arab Emirates	Saudi Arabia	Indonesia	Qatar	Oman	Morocco
Hong Kong	571	(2.3)					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Russian Federation	568	(2.7)					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Finland	568	(1.9)					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Singapore	567	(3.3)					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Northern Ireland	558	(2.4)	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
United States	556	(1.5)	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Denmark	554	(1.7)	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Croatia	553	(1.9)	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Chinese Taipei	553	(1.9)	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Ireland	552	(2.3)	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
England	552	(2.6)	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Canada	548	(1.6)	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Netherlands	546	(1.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Czech Republic	545	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Sweden	542	(2.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Italy	541	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Germany	541	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Israel	541	(2.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Portugal	541	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Hungary	539	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Slovak Republic	535	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Bulgaria	532	(4.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
New Zealand	531	(1.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score		Hong Kong	Russian Federation	Finland	Singapore	Northern Ireland	United States	Denmark	Croatia	Chinese Taipei	Ireland	England	Canada	Netherlands	Czech Republic	Sweden	Italy	Germany	Israel	Portugal	Hungary	Slovak Republic	Bulgaria	New Zealand	Slovenia	Austria	Lithuania	Australia	Poland	France	Spain	Norway	Belgium (French)	Romania	Georgia	Malta	Trinidad and Tobago	Azerbaijan	Iran	Colombia	United Arab Emirates	Saudi Arabia	Indonesia	Qatar	Oman	Morocco
Slovenia	530	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Austria	529	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Lithuania	528	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Australia	527	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Poland	526	(2.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
France	520	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Spain	513	(2.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Norway	507	(1.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Belgium (French)	506	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Romania	502	(4.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Georgia	488	(3.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Malta	477	(1.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑	↑	↑	↑	↑	↑	↑	↑
Trinidad and Tobago	471	(3.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑
Azerbaijan	462	(3.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
Iran	457	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑
Colombia	448	(4.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑
United Arab Emirates	439	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑
Saudi Arabia	430	(4.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑
Indonesia	428	(4.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑
Qatar	425	(3.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑
Oman	391	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑
Morocco	310	(3.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	

Significance tests were not adjusted for multiple comparisons. Five percent of the comparisons would be statistically significant by chance alone

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Table A4.2 International multiple comparison tables – TIMSS 2011 mathematics

Instructions: Read across the row for a country to compare performance with the countries listed along the top of the chart. The symbols indicate whether the average achievement of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the average achievement of the two countries.

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score		Singapore	Korea	Hong Kong	Chinese Taipei	Japan	Northern Ireland	Belgium (Flemish)	Finland	England	Russian Federation	United States	Netherlands	Denmark	Lithuania	Portugal	Germany	Ireland	Serbia	Australia	Hungary	Slovenia	Czech Republic	Austria	Italy	Slovak Republic	Sweden	Kazakhstan	Malta	Norway	Croatia	New Zealand	Spain	Romania	Poland	Turkey	Azerbaijan	Chile	Thailand	Armenia	Georgia	Bahrain	United Arab Emirates	Iran	Qatar	Saudi Arabia	Oman	Tunisia	Kuwait	Morocco	Yemen
Singapore	606	(3.2)				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Korea	605	(1.9)				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Hong Kong	602	(3.4)				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Chinese Taipei	591	(2.0)	↓	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Japan	585	(1.7)	↓	↓	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Northern Ireland	562	(2.9)	↓	↓	↓	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Belgium (Flemish)	549	(1.9)	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Finland	545	(2.3)	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
England	542	(3.5)	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Russian Federation	542	(3.7)	↓	↓	↓	↓	↓	↓										↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
United States	541	(1.8)	↓	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Netherlands	540	(1.7)	↓	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Denmark	537	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Lithuania	534	(2.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Portugal	532	(3.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Germany	528	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Ireland	527	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Serbia	516	(3.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Australia	516	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Hungary	515	(3.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Slovenia	513	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Czech Republic	511	(2.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Austria	508	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Italy	508	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Slovak Republic	507	(3.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score		Singapore	Korea	Hong Kong	Chinese Taipei	Japan	Northern Ireland	Belgium (Flemish)	Finland	England	Russian Federation	United States	Netherlands	Denmark	Lithuania	Portugal	Germany	Ireland	Serbia	Australia	Hungary	Slovenia	Czech Republic	Austria	Italy	Slovak Republic	Sweden	Kazakhstan	Malta	Norway	Croatia	New Zealand	Spain	Romania	Poland	Turkey	Azerbaijan	Chile	Thailand	Armenia	Georgia	Bahrain	United Arab Emirates	Iran	Qatar	Saudi Arabia	Oman	Tunisia	Kuwait	Morocco	Yemen
Sweden	504	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Kazakhstan	501	(4.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Malta	496	(1.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Norway	495	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Croatia	490	(1.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
New Zealand	486	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Spain	482	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Romania	482	(5.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Poland	481	(2.2)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Turkey	469	(4.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Azerbaijan	463	(5.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Chile	462	(2.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Thailand	458	(4.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Armenia	452	(3.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Georgia	450	(3.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Bahrain	436	(3.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
United Arab Emirates	434	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
Iran	431	(3.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
Qatar	413	(3.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑	↑	↑	↑
Saudi Arabia	410	(5.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑	↑	↑	↑
Oman	385	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑
Tunisia	359	(3.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑
Kuwait	342	(3.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑
Morocco	335	(4.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑
Yemen	248	(6.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	

Significance tests were not adjusted for multiple comparisons. Five percent of the comparisons would be statistically significant by chance alone.
( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.

Table A4.3 International multiple comparison tables – TIMSS 2011 science

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score		Korea	Singapore	Finland	Japan	Russian Federation	Chinese Taipei	United States	Czech Republic	Hong Kong	Hungary	Sweden	Slovak Republic	Austria	Netherlands	England	Denmark	Germany	Italy	Portugal	Slovenia	Northern Ireland	Ireland	Croatia	Australia	Serbia	Lithuania	Belgium (Flemish)	Romania	Spain	Poland	New Zealand	Kazakhstan	Norway	Chile	Thailand	Turkey	Georgia	Iran	Bahrain	Malta	Azerbaijan	Saudi Arabia	United Arab Emirates	Armenia	Qatar	Oman	Kuwait	Tunisia	Morocco	Yemen
Korea	587	(2.0)			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Singapore	583	(3.4)			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Finland	570	(2.6)	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Japan	559	(1.9)	↓	↓	↓			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Russian Federation	552	(3.5)	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Chinese Taipei	552	(2.2)	↓	↓	↓	↓			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
United States	544	(2.1)	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Czech Republic	536	(2.5)	↓	↓	↓	↓	↓	↓	↓								↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Hong Kong	535	(3.8)	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Hungary	534	(3.7)	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Sweden	533	(2.7)	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Slovak Republic	532	(3.8)	↓	↓	↓	↓	↓	↓	↓													↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Austria	532	(2.8)	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Netherlands	531	(2.2)	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
England	529	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Denmark	528	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Germany	528	(2.9)	↓	↓	↓	↓	↓	↓	↓	↓													↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Italy	524	(2.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↓									↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Portugal	522	(3.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓													↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Slovenia	520	(2.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Northern Ireland	517	(2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓										↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Ireland	516	(3.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓												↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Croatia	516	(2.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Australia	516	(2.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓									↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Serbia	516	(3.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Lithuania	515	(2.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓											↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Belgium (Flemish)	509	(2.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

↑ Average achievement significantly higher than comparison country ↓ Average achievement significantly lower than comparison country

Country	Average Scale Score	Korea	Singapore	Finland	Japan	Russian Federation	Chinese Taipei	United States	Czech Republic	Hong Kong	Hungary	Sweden	Slovak Republic	Austria	Netherlands	England	Denmark	Germany	Italy	Portugal	Slovenia	Northern Ireland	Ireland	Croatia	Australia	Serbia	Lithuania	Belgium (Flemish)	Romania	Spain	Poland	New Zealand	Kazakhstan	Norway	Chile	Thailand	Turkey	Georgia	Iran	Bahrain	Malta	Azerbaijan	Saudi Arabia	United Arab Emirates	Armenia	Qatar	Oman	Kuwait	Tunisia	Morocco	Yemen
Romania	505 (5.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓														↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Spain	505 (3.0)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Poland	505 (2.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑		↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
New Zealand	497 (2.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Kazakhstan	495 (5.1)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓							↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Norway	494 (2.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Chile	480 (2.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Thailand	472 (5.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Turkey	463 (4.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Georgia	455 (3.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Iran	453 (3.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Bahrain	449 (3.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑	↑	↑
Malta	446 (1.9)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓					↑	↑	↑	↑	↑	↑	↑	↑	↑
Azerbaijan	438 (5.6)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓						↑	↑	↑	↑	↑	↑	↑
Saudi Arabia	429 (5.4)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
United Arab Emirates	428 (2.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				↑	↑	↑	↑	↑	↑	↑
Armenia	416 (3.8)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑	↑	↑
Qatar	394 (4.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑	↑
Oman	377 (4.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑	↑	↑	↑
Kuwait	347 (4.7)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑
Tunisia	346 (5.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓			↑	↑
Morocco	264 (4.5)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		↑
Yemen	209 (7.3)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	

Significance tests were not adjusted for multiple comparisons. Five percent of the comparisons would be statistically significant by chance alone.

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.