Highlights from TIMSS & PIRLS 2011 from Australia's perspective

Highlights from the reports:

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

and

Monitoring Australian Year 8 student achievement internationally: TIMSS 2011

Sue Thomson
Kylie Hillman
Nicole Wernert
Marina Schmid
Sarah Buckley
Ann Munene

ACER

TIMSS & PIRLS 2011

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. In Australia, TIMSS is part of the National Assessment Program.

TIMSS has been conducted at Year 4 and Year 8 on a four-year cycle since 1995 and PIRLS at Year 4 on a five-year cycle since 2001. In 2011, 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. Australia was one of a group of countries that chose to have the same sample of Year 4 students participate in TIMSS and PIRLS, thus obtaining results for students in reading, mathematics and science. As in previous cycles, Australia also participated in TIMSS at Year 8.

Australia has participated in TIMSS since its inception, providing rich data about trends in mathematics and science achievement over 16 years. This is the first time that Australia has participated in PIRLS, or indeed any international study of reading achievement at this level.

To inform educational policy in the participating countries, these world-wide assessment and research projects also routinely collect extensive background information that address concerns about the quantity, quality, and content of instruction.

The internationally standard Student Questionnaire sought information on students and their family background, aspects of learning and instruction in mathematics, science and reading (Year 4) and contexts of instruction.

The Home Questionnaire, called the Learning to Read survey, is designed to be answered by Year 4 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.

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, sought descriptive information about the school and information about instructional practices. For example, questions were asked about recruitment of teachers and numbers of staff, teacher morale, school and teacher autonomy, school resources, and school policies and practices such as use of student assessments.

What is the focus of these studies?

The main goal of TIMSS and PIRLS is to assist countries to monitor and evaluate their reading, mathematics and science teaching across time and across year levels.

TIMSS and PIRLS have a curriculum focus. The three levels of the curriculum, which have been defined in previous studies, and considered in relation to the context in which they occur, are:

The *intended* curriculum – defined as the curriculum as specified at national or system level.

- *What are students around the world expected to learn in mathematics and science? To what level are they expected to learn to read?*
- *How do countries vary in their intended goals, and*
- *What characteristics of education systems, schools and students influence the development of these goals?*

The *implemented* curriculum – defined as the curriculum as interpreted and delivered by classroom teachers.

- *What opportunities are provided for students to learn to read, and 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 reading, 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' achievement?*

Who participated in TIMSS and PIRLS?

Internationally

Forty-eight countries (including a number of countries who tested older or younger students and are not reported here) and 9 benchmarking[1] participants participated in the PIRLS assessment, while 52 countries and 7 benchmarking participants participated in the Year 4 TIMSS assessment and 45 countries and 14 benchmarking participants participated in the Year 8 TIMSS assessment. These are shown in Figure 1.

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 the international mean and are not included in the report.

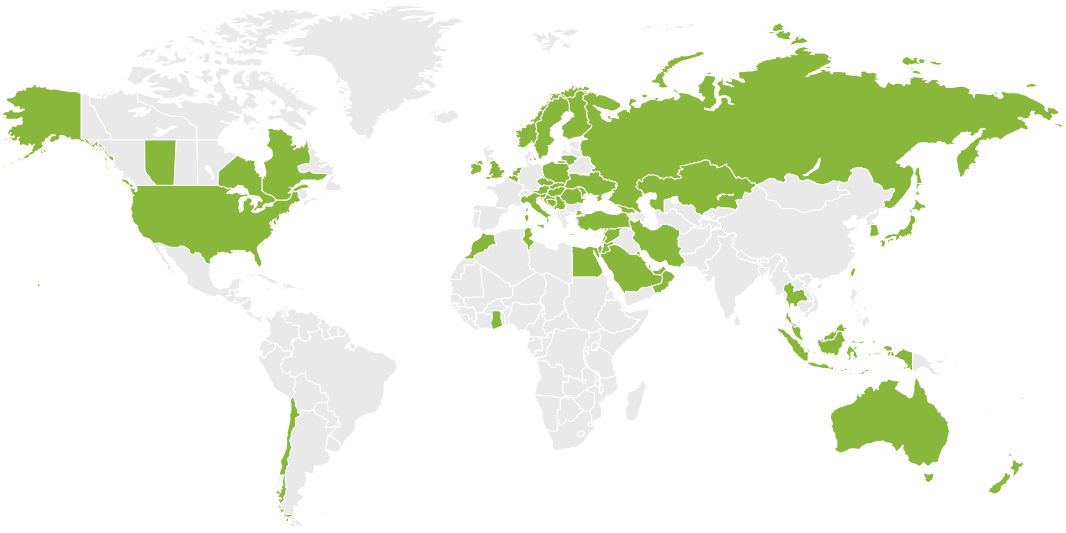


Figure 1 Map of participating countries

In Australia

A stratified random sample of 280 primary schools and 290 secondary schools participated in the data collection for TIMSS and PIRLS 2011. Table 1 provides the sample details for each of the states for the Year 4 sample, and Table 2 for the Year 8 sample.

Table 1 Australian designed and achieved school sample, Year 4

State	Designed school sample	Year 4							
		PIRLS				TIMSS			
		N schools	N students	Weighted N	Weighted per cent	N schools	N students	Weighted N	Weighted per cent
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

Table 2 Australian designed and achieved school sample, Year 8

State	Designed school sample	Year 8			
		N schools	N students	Weighted N	Weighted per cent
ACT	30	30	1302	4961	2.0
NSW	45	42	1134	84570	33.6
VIC	45	43	958	65361	25.9
QLD	45	43	1198	52199	20.7
SA	40	39	888	18792	7.5
WA	40	38	872	17114	6.8
TAS	30	30	752	6691	2.7
NT	15	10	452	2297	0.9
TOTAL	290	275	7556	251985	100.0

Some Explanatory Notes:

Sample surveys

TIMSS is conducted as a sample survey in most countries. In surveys such as TIMSS or PIRLS, a sample of students is selected to represent the population of students at a particular grade in that country. The samples are designed and conducted so that they provide reliable estimates about the population that they represent. Sample surveys are cheaper to undertake and less intrusive on 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 consisted of a sample of schools and the second stage consisted of a single mathematics classroom selected at random from the target year level in sampled schools.

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

How is reading literacy assessed in PIRLS?

Reading is probably the most important skill for children to develop in their early years, underpinning learning in all other areas. 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.

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

Students' reading literacy is assessed by having participating students read selected texts and respond to a variety of questions about the texts they have read. To reflect the broad range of literacy requirements, the PIRLS assessment reflects the two different purposes for reading described in Box 1, and incorporates the processes described in Box 2, using

- Literary texts, which comprise short stories with one or two episodes of problem/resolution and two central characters
- Informational texts, which include sets of short informational materials involving texts, maps, illustrations, diagrams and photographs.

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

Box 1 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.

Box 2 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.

How are mathematics and science assessed in TIMSS?

A content dimension and a cognitive dimension framed the mathematics and science assessment for TIMSS 2011. There are three content domains in mathematics and in science at Year 4 and four at Year 8. 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.

A description of the content domains is shown in Box 3 and Box 4, and includes proportions of each topic area tested in the TIMSS assessments.

Box 3 TIMSS content domains at Year 4

Mathematics Year 4		Science Year 4	
Content Domains	**Topic areas**	**Content Domains**	**Topic areas**
Number (50%)	▌ Whole numbers	Life science (45%)	▌ Characteristics and life processes of living things
	▌ Fractions and decimals		▌ Life cycles, reproduction and heredity
	▌ Number sentences		▌ Interaction with the environment
	▌ Patterns and relationships		▌ Ecosystems
Geometric shapes and measurement (35%)	▌ Lines and angles	Physical science (35%)	▌ Human health
	▌ Two- and three-dimensional shapes		▌ Classification and properties of matter
	▌ Location and movement		▌ Physical states and changes in matter
Data display (15%)	▌ Reading and interpreting	Earth science (20%)	▌ Energy sources, heat, and temperature
	▌ Organising and representing		▌ Light and sound
			▌ Electricity and magnetism
			▌ Forces and motion
			▌ Earth's structure, physical characteristics, and resources
			▌ Earth's processes, cycles, and history
			▌ Earth in the solar system

Box 4 TIMSS content domains at Year 8

Mathematics Year 8		Science Year 8	
Content Domains	**Topic areas**	**Content Domains**	**Topic areas**
Number (30%)	▌ Whole numbers	Biology (35%)	▌ Characteristics, classification, and life processes of organisms
	▌ Fractions and decimals		▌ Cells and their functions
	▌ Integers		▌ Life cycles, reproduction, and heredity
	▌ Ratio, proportion and per cent		▌ Diversity, adaptation, and natural selection
Algebra (30%)	▌ Patterns	Physics (20%)	▌ Ecosystems
	▌ Algebraic expressions		▌ Human health
	▌ Equations/formulas and functions		▌ Classification and composition of matter
Geometry (20%)	▌ Geometric shapes	Chemistry (25%)	▌ Properties of matter
	▌ Geometric measurement		▌ Chemical change
	▌ Location and movement		▌ Physical states and changes in matter
Data and Chance (20%)	▌ Data organisation and representation	Earth science (20%)	▌ Energy transformations, heat, and temperature
	▌ Data interpretation		▌ Light
	▌ Chance		▌ Sound
			▌ Electricity and magnetism
			▌ Forces and motion
			▌ Earth's structure and physical features
			▌ Earth's processes, cycles, and history
			▌ Earth's resources, their use and conservation
			▌ Earth in the solar system and the universe

What does PIRLS tell us about Year 4 reading?

	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

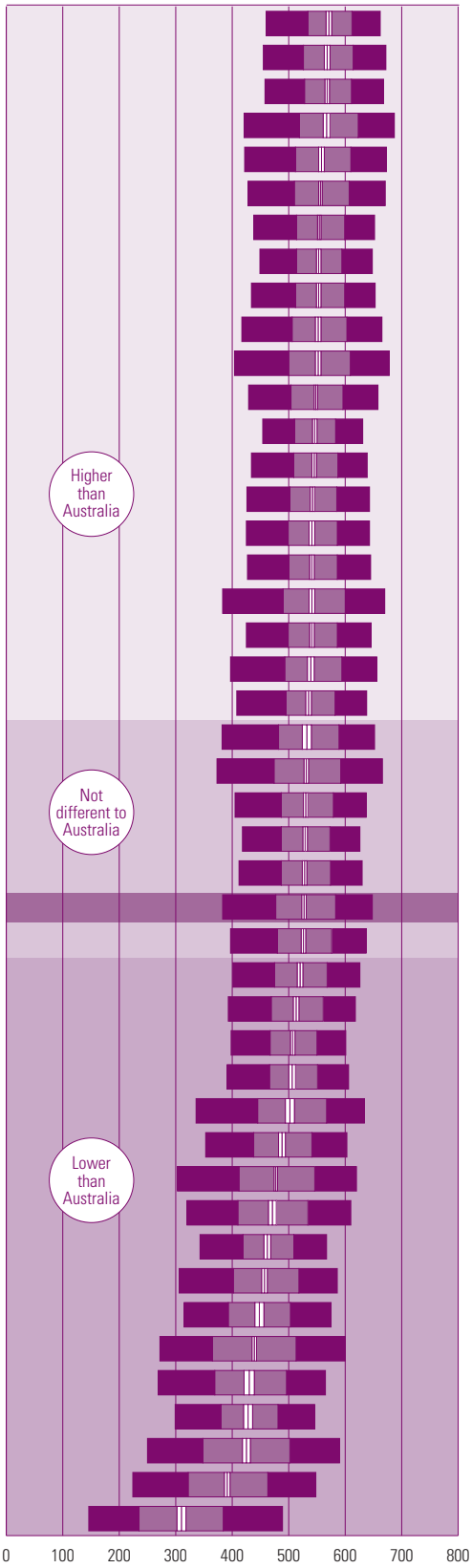


Figure 2 International achievement in reading – Year 4

- 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 was similar to the score for Bulgaria, New Zealand, Slovenia, Austria, Lithuania and Poland. It was, 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.
- Internationally, female students performed at a significantly higher level in PIRLS than male students, other than in Columbia, Italy, France, Spain and Israel. The gender gap was, on average, 17 score points, and it was 17 score points in Australia.

Across the states

- The range of average scores across the states was 49 score points 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 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.

Table 3 Multiple comparisons of average reading achievement by state, Year 4

	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.

What does TIMSS tell us about Year 4 mathematics?

	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

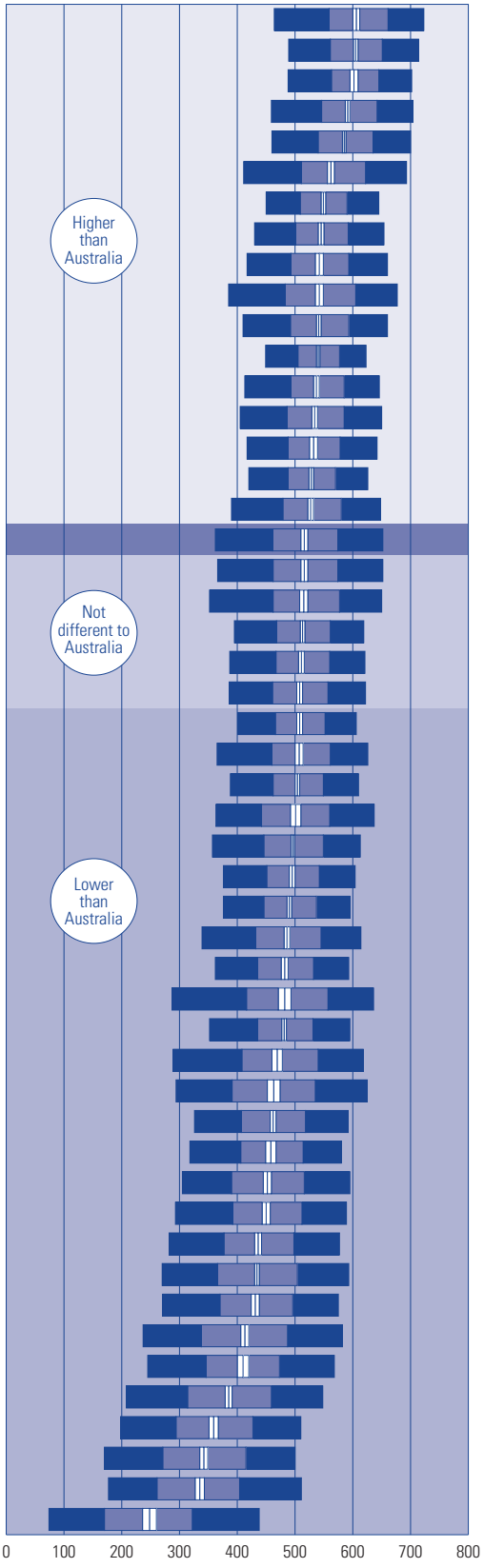


Figure 3 International achievement in mathematics – Year 4

- 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 achievement score of 516 was significantly higher than that of 27 countries, including Sweden and New Zealand, but below that of 17 countries, including most of the Asian countries, England and the United States.
- Australia's average Year 4 mathematics score in TIMSS 2011 was not significantly different to the achieved score in TIMSS 2007, but Australia's 2011 score was a significant 21 points higher than in TIMSS 1995.

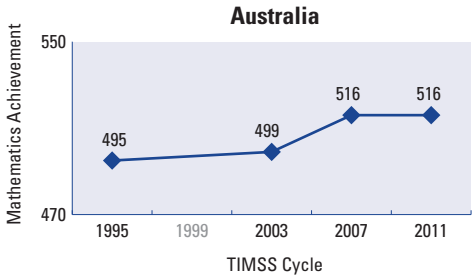


Figure 4 Trends in mathematics achievement, 1995 – 2011, Year 4

Across the states

- The range of scores was 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 were not significantly different to each other, but were significantly higher than performance of students in all remaining states with the exception of Tasmania.

Table 4 Multiple comparisons of average mathematics achievement by state, Year 4

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.

What does TIMSS tell us about Year 4 science?

	Mean	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

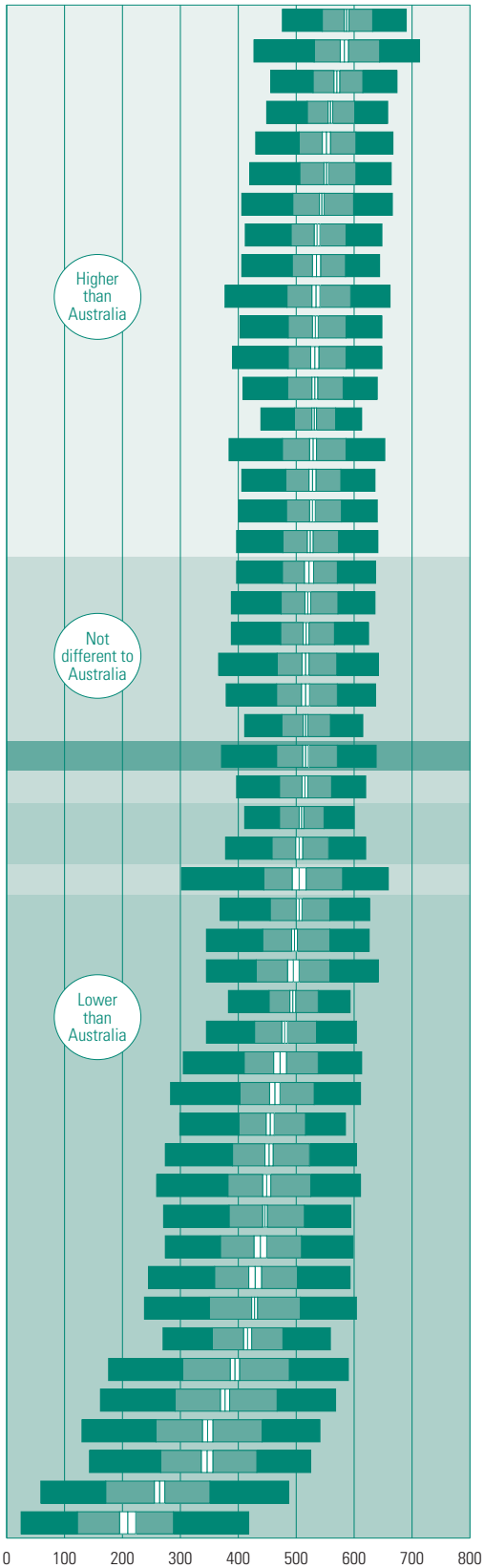


Figure 5 International achievement in science – Year 4

- 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 achievement score of 516 was significantly higher than that of 23 countries, including Belgium and New Zealand, but below that of 18 countries, including most of the Asian countries, England and the United States.
- Australia's average Year 4 science score in TIMSS 2011 was significantly lower than the achieved score in TIMSS 2007, but Australia's 2011 score was not significantly different to the score in TIMSS 1995.

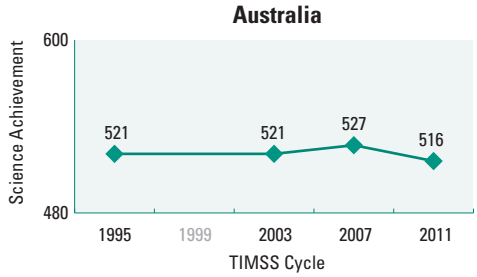


Figure 6 Trends in science achievement, 1995 – 2011, Year 4

Across the states

- The range of scores was 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 other states. 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.

Table 5 Multiple comparisons of average science achievement by state, Year 4

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.

What does TIMSS tell us about Year 8 mathematics?

	Mean	SE	Average age at time of testing	Gap 95th – 5th percentiles
Korea	613	2.9	14.3	295
Singapore	611	3.8	14.4	281
Chinese Taipei	609	3.2	14.2	352
Hong Kong	586	3.8	14.2	278
Japan	570	2.6	14.5	276
Russian Federation	539	3.6	14.7	267
Israel	516	4.1	14.0	325
Finland	514	2.5	13.8	212
United States	509	2.6	14.2	254
England	507	5.5	14.2	279
Hungary	505	3.5	14.7	232
Australia	505	5.1	14.0	283
Slovenia	505	2.2	13.9	294
Lithuania	502	2.5	14.7	256
Italy	498	2.4	13.8	243
New Zealand	488	5.5	14.1	278
Kazakhstan	487	4.0	14.6	258
Sweden	484	1.9	14.8	222
Ukraine	479	3.9	14.2	295
Norway	475	2.4	13.7	211
Armenia	467	2.7	14.6	298
Romania	458	4.0	14.9	335
United Arab Emirates	456	2.1	13.9	289
Turkey	452	3.9	14.0	372
Lebanon	449	3.7	14.3	246
Malaysia	440	5.4	14.4	299
Georgia	431	3.8	14.2	344
Thailand	427	4.3	14.3	283
Macedonia	426	5.2	14.7	357
Tunisia	425	2.8	14.3	249
Chile	416	2.6	14.2	263
Iran	415	4.3	14.3	312
Qatar	410	3.1	14.0	359
Bahrain	409	2.0	14.4	324
Jordan	406	3.7	13.9	324
Palestinian Nat'l Auth.	404	3.5	13.9	326
Saudi Arabia	394	4.6	14.1	308
Indonesia	386	4.3	13.9	276
Syrian Arab Republic	380	4.5	13.9	318
Morocco	371	2.0	14.7	284
Oman	366	2.8	14.1	355
Ghana	331	4.3	15.8	280

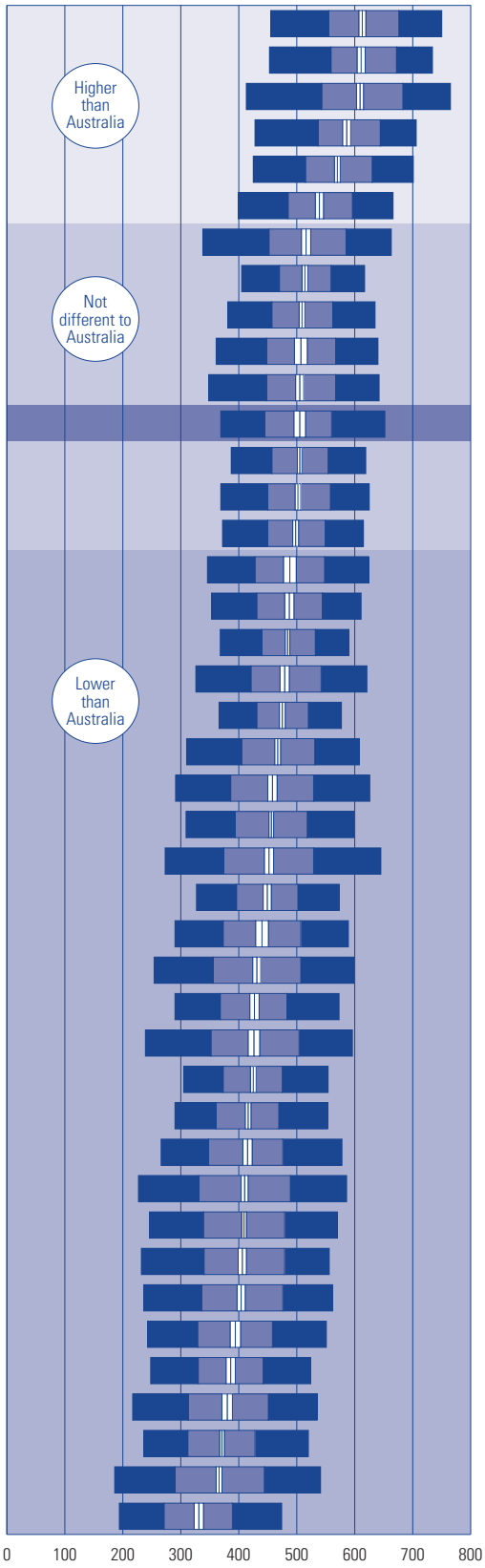


Figure 7 International achievement in mathematics – Year 8

- Korea, Singapore and Chinese Taipei were the top-performing countries of TIMSS 2011, with an average score higher than 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 achievement score of 505 was significantly higher than that of 27 countries, including New Zealand and Sweden, and below that of 6 countries, including the high-performing Asian countries listed above as well as the Russian Federation.
- Australia's average Year 8 mathematics score in TIMSS 2011 was not significantly different to the achieved score in TIMSS 1995, although there have been some small fluctuations over the 16 years.

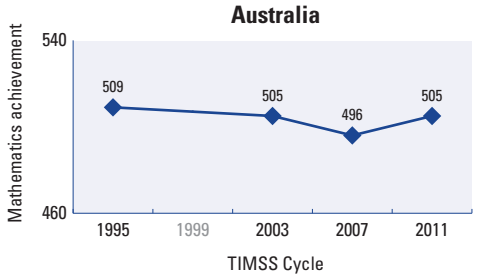


Figure 8 Trends in mathematics achievement, 1995 – 2011, Year 8

Across the states

- The range of scores was 70 score points, almost three-quarters of 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 other than New South Wales.
- Students in New South Wales significantly outperformed students in South Australia, Tasmania and the Northern Territory, and students in Victoria and Queensland also significantly outperformed students in Tasmania and the Northern Territory.

Table 6 Multiple comparisons of average mathematics achievement by state, Year 8

	Mean	SE	ACT	NSW	VIC	QLD	WA	SA	TAS	NT
ACT	532	9.9		●	▲	▲	▲	▲	▲	▲
NSW	518	11.1	●		●	●	●	▲	▲	▲
VIC	504	8.0	▼	●		●	●	●	▲	▲
QLD	497	8.0	▼	●	●		●	●	▲	▲
WA	493	10.6	▼	●	●	●		●	●	●
SA	489	5.8	▼	▼	●	●	●		●	●
TAS	475	6.9	▼	▼	▼	▼	●	●		●
NT	462	14.4	▼	▼	▼	▼	●	●	●	

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.

What does TIMSS tell us about Year 8 science?

	Mean Score	Standard Error	Average age at time of testing	Gap 95th – 5th percentiles
Singapore	590	4.3	14.4	321
Chinese Taipei	564	2.3	14.2	274
Korea	560	2.0	14.3	256
Japan	558	2.4	14.5	252
Finland	552	2.5	13.8	212
Slovenia	543	2.7	13.9	249
Russian Federation	542	3.2	14.7	251
Hong Kong	535	3.4	14.2	245
England	533	4.9	14.2	279
United States	525	2.6	14.2	267
Hungary	522	3.1	14.7	269
Australia	**519**	**4.8**	**14.0**	**277**
Israel	516	4.0	14.0	309
Lithuania	514	2.6	14.7	249
New Zealand	512	4.6	14.1	282
Sweden	509	2.5	14.8	265
Italy	501	2.5	13.8	249
Ukraine	501	3.4	14.2	274
Norway	494	2.6	13.7	241
Kazakhstan	490	4.3	14.6	258
Turkey	483	3.4	14.0	336
Iran	474	4.0	14.3	296
Romania	465	3.5	14.9	285
United Arab Emirates	465	2.4	13.9	320
Chile	461	2.5	14.2	242
Bahrain	452	2.0	14.4	335
Thailand	451	3.9	14.3	264
Jordan	449	4.0	13.9	337
Tunisia	439	2.5	14.3	221
Armenia	437	3.1	14.6	312
Saudi Arabia	436	3.9	14.1	272
Malaysia	426	6.3	14.4	334
Syrian Arab Republic	426	3.9	13.9	276
Georgia	420	3.0	14.2	297
Oman	420	3.2	14.1	361
Palestinian Nat'l Auth.	420	3.2	13.9	343
Qatar	419	3.4	14.0	394
Macedonia	407	5.4	14.7	372
Indonesia	406	4.5	13.9	258
Lebanon	406	4.9	14.3	319
Morocco	376	2.2	14.7	283
Ghana	306	5.2	15.8	367

Figure 9 International achievement in science – Year 8

- Singapore had the highest average achievement across participating countries, with a score about halfway between the High and Advanced benchmarks. The next highest-performing countries – Chinese Taipei, Korea and Japan – had higher levels of achievement than all countries other than Singapore, with average scores just higher than the High benchmark.
- Australia's achievement score of 519 was significantly higher than that of 26 countries, including Italy and the Ukraine, and below that of 9 countries, including the high-performing Asian countries listed above as well as Finland, Slovenia, the Russian Federation, Hong Kong, and England. The score for New Zealand and the United Sates was not significantly different to that of Australia.
- Australia's average Year 8 science score in TIMSS 2011 was not significantly different to the achieved score in TIMSS 1995, although there have been some fluctuations over the 16 years.
- Science is the only cognitive area in which there has been a significant gender difference in Australia in each assessment since 1995, in favour of males.

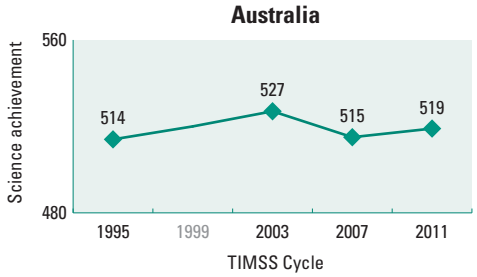


Figure 10 Trends in science achievement, 1995 – 2011, Year 8

Across the states

- The range of scores was 70 score points, almost three-quarters of a standard deviation, between the Australian Capital Territory and the Northern Territory.
- The score for students in the Australian Capital Territory was not significantly different to that of students in New South Wales, but was significantly higher than that of students in all other states.
- Students in New South Wales significantly outperformed students in South Australia, Tasmania and the Northern Territory, and students in Queensland also significantly outperformed students in Tasmania and the Northern Territory.

Table 7 Multiple comparisons of average science achievement by state, Year 8

STATE	Mean	SE	ACT	NSW	QLD	WA	VIC	SA	TAS	NT
ACT	551	9.2		●	▲	▲	▲	▲	▲	▲
NSW	532	10.1	●		●	●	●	▲	▲	▲
QLD	516	7.5	▼	●		●	●	●	▲	▲
WA	514	9.2	▼	●	●		●	●	●	●
VIC	513	7.5	▼	●	●	●		●	●	●
SA	506	5.0	▼	▼	●	●	●		●	●
TAS	496	6.4	▼	▼	▼	●	●	●		●
NT	481	14.4	▼	▼	▼	●	●	●	●	

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.

PIRLS Reading Benchmarks

What are the TIMSS and PIRLS Benchmarks?

While the achievement scales in reading, mathematics and science summarise student performance on the cognitive processes and content knowledge measured by the PIRLS and TIMSS tests, the international benchmarks help put these scores in context.

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.

Benchmarks are only one way of examining student performance. The benchmarks discussed in this report are based solely on student performance in TIMSS and PIRLS 2011, on items that were developed specifically for the purpose of obtaining information on the reading, mathematics and science domains in the TIMSS and PIRLS frameworks.

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).

Table 8 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.

Reading examples

This example is an item from the literary text '*Fly eagle fly*', part of which is shown in Box 5.

Box 5 Excerpt from 'Fly eagle fly' item

So, the eagle lived among the chickens, learning their ways. As it grew, it began to look quite different from any chicken they had ever seen.

One day a friend dropped in for a visit. The friend saw the bird among the chickens.

"Hey! That is not a chicken. It's an eagle!"

The farmer smiled at him and said, "Of course it's a chicken. Look—it walks like a chicken, it eats like a chicken. It thinks like a chicken. Of course it's a chicken."

But the friend was not convinced. "I will show you that it is an eagle," he said.

The farmer's children helped his friend catch the bird. It was fairly heavy, but the farmer's friend lifted it above his head and said, "You are not a chicken but an eagle. You belong not to the earth but to the sky. Fly, Eagle, fly!"

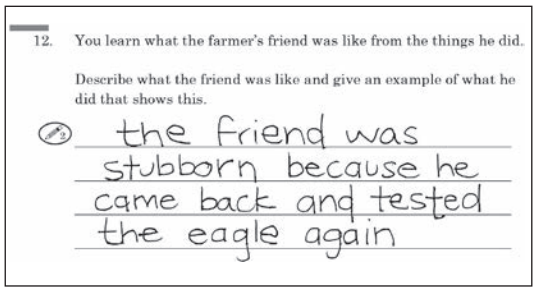
The bird stretched out its wings, looked about, saw the chickens feeding, and jumped down to scratch with them for food.

"I told you it was a chicken," the farmer said, and he roared with laughter.

Shown in Box 6 is an example of an item at the Advanced benchmark. 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. In Hong Kong 59 per cent of students were able to answer this item correctly, in Australia 25 per cent were able to answer correctly, significantly lower than the average over all countries.

Box 6 Advanced international benchmark – Example item


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

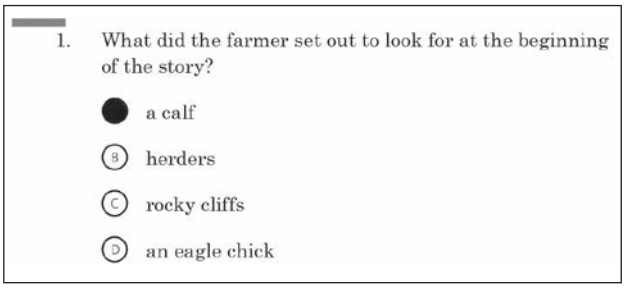
Describe what the friend was like and give an example of what he did that shows this.

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 7 provides an example of this, also from '*Fly eagle fly*', in which students were asked to retrieve an explicitly stated detail from the beginning of the text.

Internationally, 89 per cent of students were able to answer this correctly. In Australia a similar proportion, 91 per cent, and in the Russian Federation, 99 per cent, responded correctly.

Box 7 Low international benchmark – Example item


1. What did the farmer set out to look for at the beginning of the story?

● a calf

B herders

C rocky cliffs

D an eagle chick

PIRLS Benchmarks – Year 4 Reading

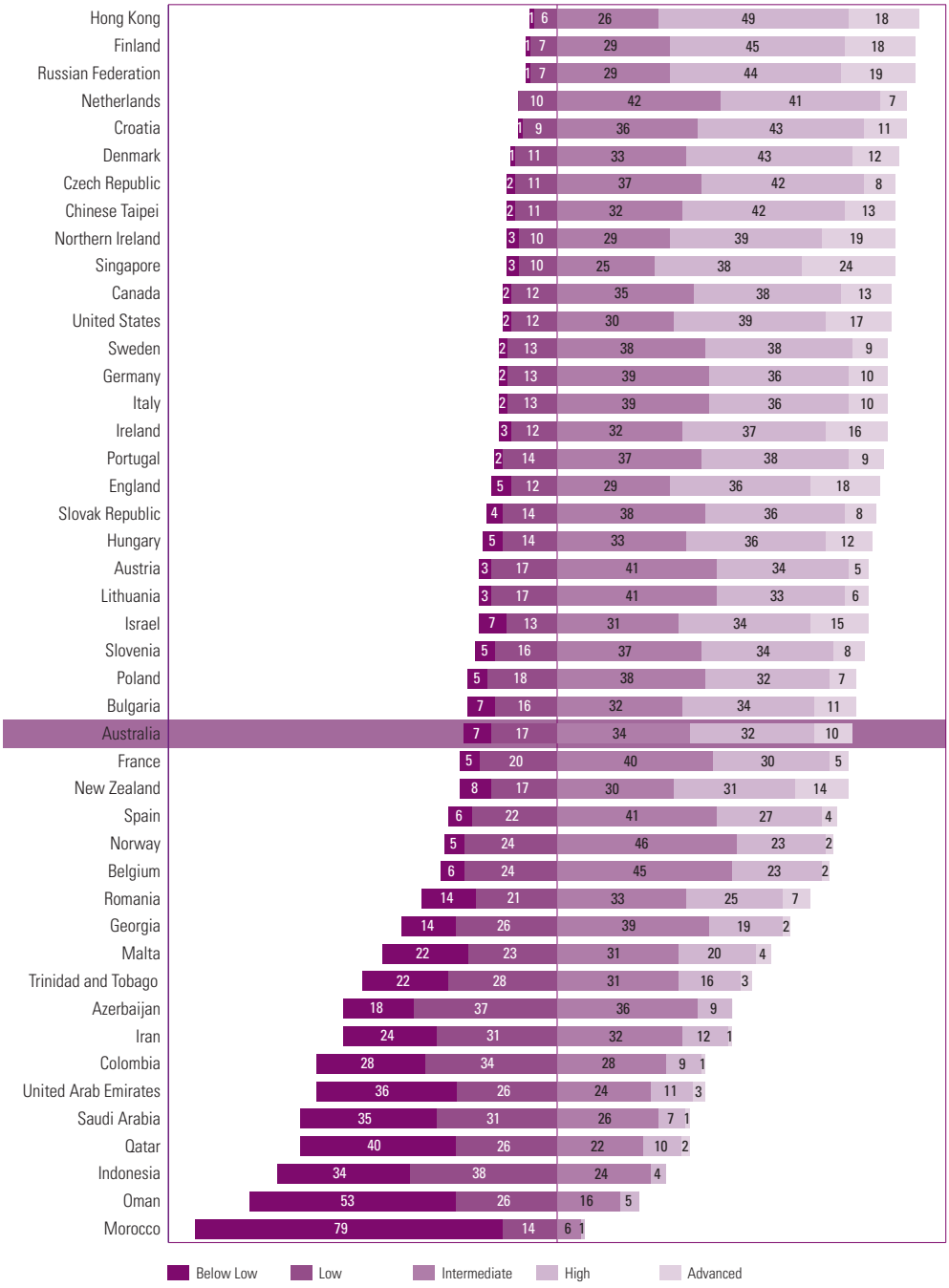


Figure 11 Percentages of students reaching the international benchmarks for reading by country, Year 4

The countries are ordered in all benchmarking graphs 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 had 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.

- 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.
- 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.
- Seventeen per cent of Australian Year 4 students achieved 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 achieved at least this level (that is, no students from the Netherlands were in the Below Low group).

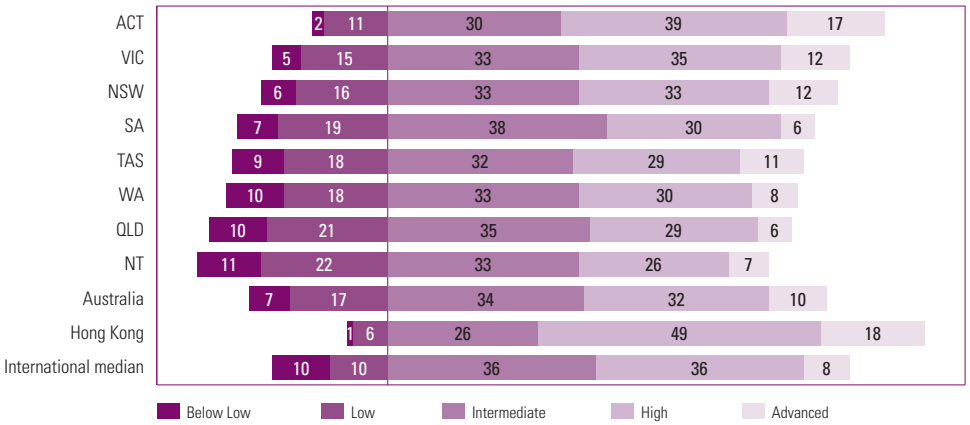


Figure 12 Percentages of students reaching the international reading benchmarks, by state

- 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 87 per cent achieving 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, while 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

TIMSS Mathematics Benchmarks

In Year 4 mathematics, students at the Advanced international benchmark were able to apply 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 8, students at the Advanced international benchmark were able to organise and draw conclusions from information, make generalisations, and solve non-routine problems involving numeric, algebraic, and geometric concepts and relationships. In comparison, those at the Low international benchmark demonstrated some knowledge of whole numbers and decimals, operations, and basic graphs.

Table 9 International Benchmarks for Mathematics

	Year 4	Year 8
Advanced International Benchmark – 625	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.	Students can organise and draw conclusions from information, make generalisations, and solve non-routine problems. Students can solve a variety of fraction, proportion, and percent problems and justify their conclusions. Students can express generalizations algebraically and model situations. They can solve a variety of problems involving equations, formulas, and functions. Students can reason with geometric figures to solve problems. Students can reason with data from several sources or unfamiliar representations to solve multi-step problems.
High International Benchmark – 550	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. Students can use information from several sources to solve problems involving different types of numbers and operations. Students can relate fractions, decimals, and percents to each other. Students at this level show basic procedural knowledge related to algebraic expressions. They can use properties of lines, angles, triangles, rectangles, and rectangular prisms to solve problems. They can analyse data in a variety of graphs.
Intermediate International Benchmark – 475	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 basic mathematical knowledge in straightforward situations. Students can solve problems involving decimals, fractions, proportions, and percentages. They understand simple algebraic relationships. Students can relate a two-dimensional drawing to a three-dimensional object. They can read, interpret, and construct graphs and tables. They recognise basic notions of likelihood.
Low International Benchmark – 400	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 have some knowledge of whole numbers and decimals, operations, and basic graphs. They have an elementary understanding of whole numbers and decimals and can do basic computations. They can match tables to bar graphs and pictographs and read a simple line graph.

Mathematics Examples

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. As an example, Box 8 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 8 Advanced International Benchmark- Example item Year 4

Figure A

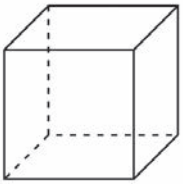
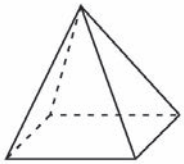


Figure B



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

Box 9 provides an example of the type of item likely to be answered correctly by students achieving at Low international benchmark at Year 8. In the example shown in Box 9, from the content domain *number*, students are asked to show their understanding of basic operations with decimals, and add a two-place and a three-place decimal.

Internationally, 72 per cent of students answered correctly. In Australia 82 per cent, and in Singapore 92 per cent of students also answered correctly.

Box 9 Low International Benchmark-Example Item Year 8

42.65 + 5.748 =

Answer: 48.398

TIMSS Benchmarks – Year 4 mathematics

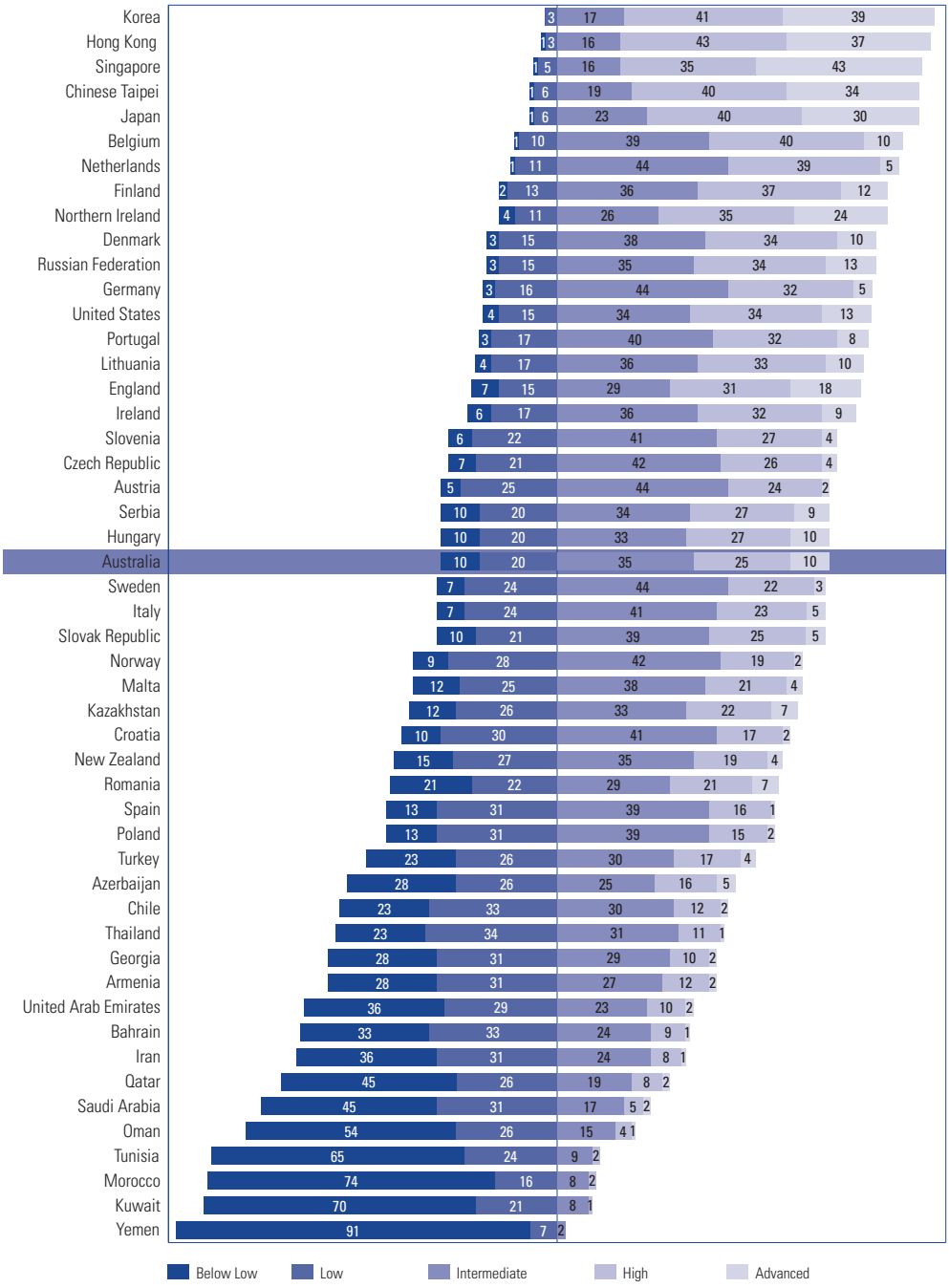


Figure 13 Percentages of students reaching the international benchmarks for mathematics achievement by country, Year 4

- Korea, Hong Kong, Singapore, Chinese Taipei and Japan had 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, respectively, 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 least this level.

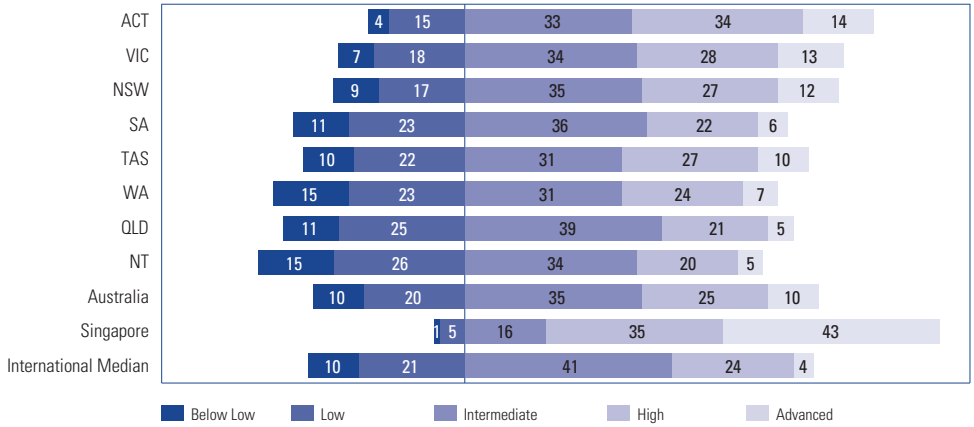


Figure 14 Percentages of students reaching the international benchmarks for mathematics achievement by state, Year 4

- The Australian Capital Territory had 14 per cent of students achieving the Advanced international benchmark, almost half (48%) reaching the High international benchmark, and 81 per cent achieving at least 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 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.

TIMSS Benchmarks – Year 8 mathematics

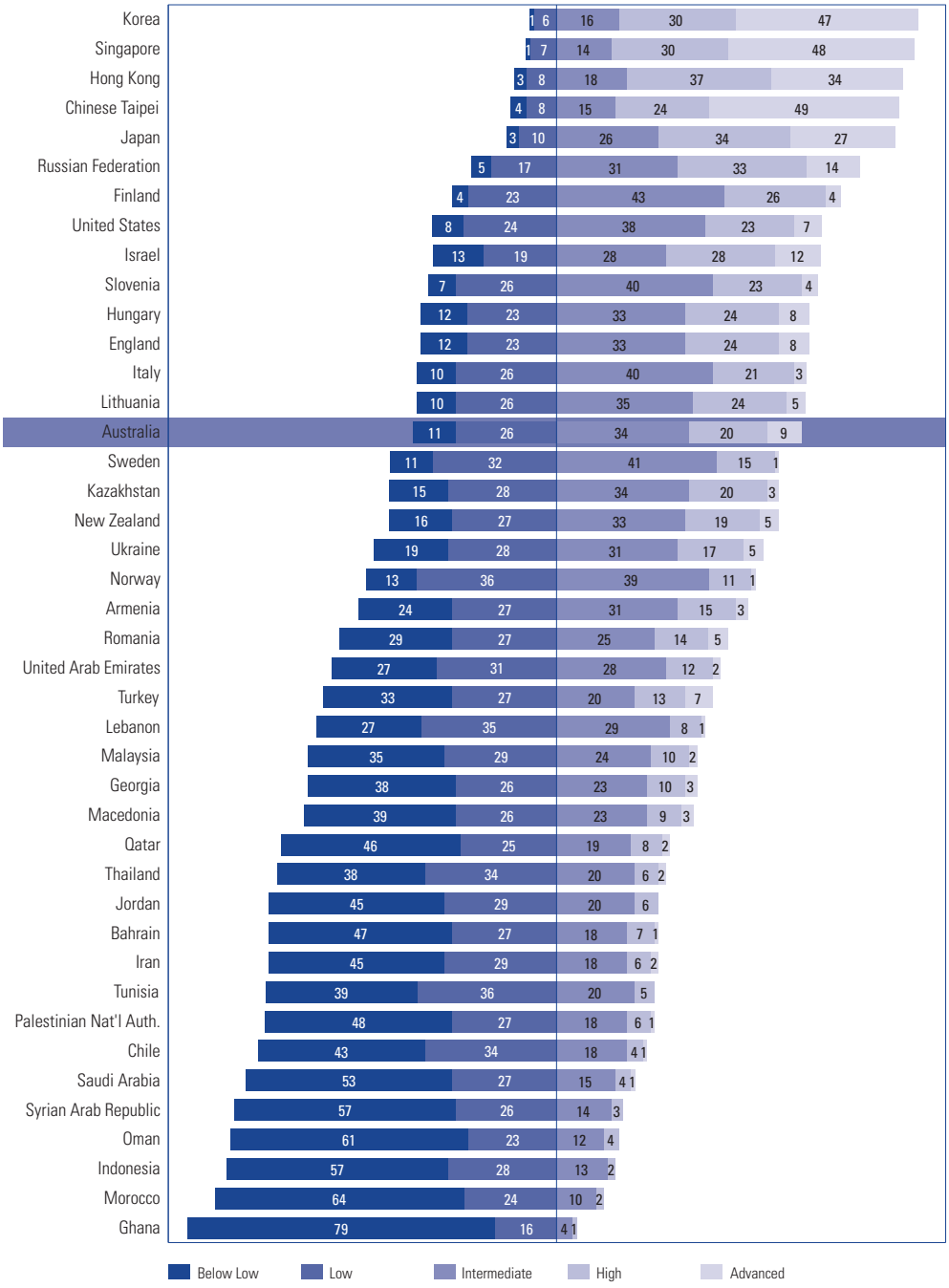


Figure 15 Percentages of students reaching the international benchmarks for mathematics achievement by country, Year 8

- Korea, Singapore and Chinese Taipei showed their international dominance in mathematics. In these three countries, almost half of the students assessed (47–49%) reached the Advanced benchmark. In Hong Kong around one third (34%) and in Japan around one quarter (27%) of students reached this level. The Russian Federation (14%) and Israel (12%) were the next best at reaching the Advanced benchmark, but for all other countries the proportion of students reaching this level was less than 10 per cent.
- In Australia, nine per cent of students reached the Advanced benchmark, with a further 20 per cent reaching the High benchmark.

- In Australia, 89 per cent of students achieved the Low benchmark, however 37 per cent failed to achieve the Intermediate benchmark and thus the proficient standard expected.

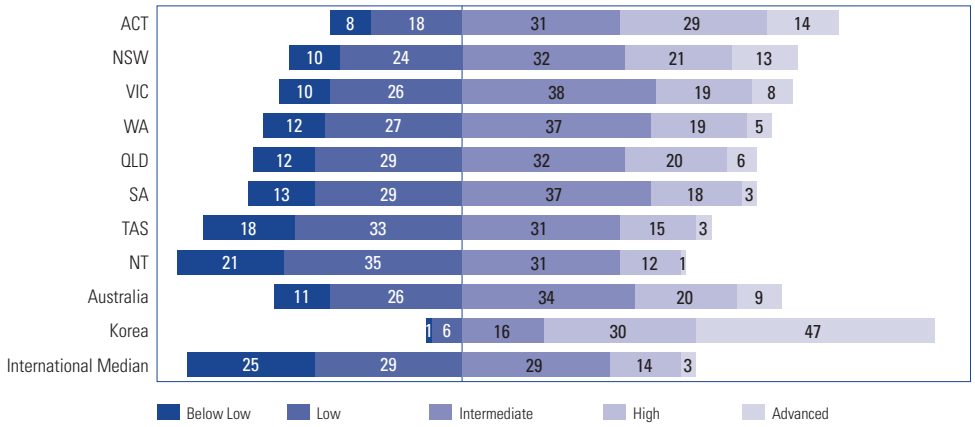


Figure 16 Percentages of students reaching the international benchmarks for mathematics achievement by state, Year 8

- Fourteen per cent of Year 8 students in the Australian Capital Territory and 13 per cent of students in New South Wales reached the Advanced benchmark, but in all other states the proportion at this level was less than 10 per cent.
- The other end of the achievement distribution, however, shows that a worrying 56 per cent of students in the Northern Territory and 51 per cent of students in Tasmania did not reach the Intermediate benchmark.
- In the other states this proportion ranged from between 39 and 42 per cent in Western Australia, South Australia and Queensland through to 26 per cent in the Australian Capital Territory

TIMSS Science Benchmarks

In Year 4 science, students at the Advanced international benchmark were able to apply their knowledge and understanding of scientific processes and relationships in beginning scientific inquiry, whereas those at the Low international benchmark displayed only elementary knowledge of *life science* and *physical science*.

At Year 8, students at the Advanced international benchmark in demonstrated a grasp of some complex and abstract concepts in *biology*, *chemistry*, *physics*, and *Earth science*. In comparison, those at the Low international benchmark simply recognised some basic facts from the life and physical sciences.

Table 10 International Benchmarks for Science

	Year 4	Year 8
Advanced International Benchmark – 625	Students can apply knowledge and understanding of scientific processes and relationships in beginning 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.	Students can demonstrate a grasp of some complex and abstract concepts in biology, chemistry, physics, and Earth science. Students demonstrate some conceptual knowledge about cells and the characteristics, classification, and life processes of organisms. They communicate an understanding of the complexity of ecosystems and adaptations of organisms, and apply an understanding of life cycles and heredity. Students also communicate an understanding of the structure of matter and physical and chemical properties and changes and apply knowledge of forces, pressure, motion, sound, and light. They reason about electrical circuits and properties of magnets. Students apply knowledge and communicate understanding of the solar system and Earth's processes, structures, and physical features.
High International Benchmark – 550	Students can apply knowledge and understanding to explain everyday phenomena. 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.	Students can demonstrate conceptual understanding of some science cycles, systems, and principles. They demonstrate understanding of aspects of human biology, and of the characteristics, classification, and life processes of organisms. Students communicate understanding of processes and relationships in ecosystems. They show an understanding of the classification and compositions of matter and chemical and physical properties and changes. They apply knowledge to situations related to light and sound and demonstrate basic knowledge of heat and temperature, forces and motion, and electrical circuits and magnets. Students demonstrate an understanding of the solar system and of Earth's processes, physical features, and resources.
Intermediate International Benchmark – 475	Students can apply basic knowledge and understanding to 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.	Students can recognise and communicate basic scientific knowledge across a range of topics. Students apply knowledge and communicate an understanding of human health, life cycles, adaptation, and heredity, and analyse information about ecosystems. They have some knowledge of chemistry in everyday life and elementary knowledge of properties of solutions and the concept of concentration. They are acquainted with some aspects of force, motion, and energy. They demonstrate an understanding of Earth's processes and physical features, including the water cycle and atmosphere.
Low International Benchmark – 400	Students have some elementary knowledge of life science and physical 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 can recognise some basic facts from the life and physical sciences. They have some knowledge of biology, and demonstrate some familiarity with physical phenomena. Students interpret simple pictorial diagrams, complete simple tables, and apply basic knowledge to practical situations.

Science examples

This example illustrates the Advanced international benchmark at Year 8. Students at the Advanced benchmark are asked to apply their knowledge to what may be unfamiliar situations. For the example shown in Box 10, students would have to understand that gravity acts on a person regardless of position and movement in order to get the question correct.

Box 10 Advanced international benchmark – Example item Year 8

The figure shows a parachute jumper in four positions.

1. In the aircraft before the jump

2. In freefall immediately after jumping before parachute opens

3. Falling to the ground after the parachute opens

4. On the ground just after landing

In which of the positions does the force of gravity act on the jumper?

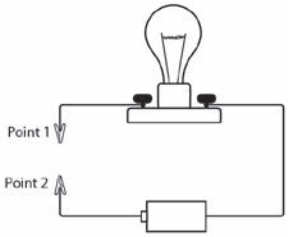
Ⓐ Position 2 only.
Ⓑ Positions 2 and 3 only.
Ⓒ Positions 1, 2 and 3 only.
● Positions 1, 2, 3, and 4.

On average internationally, 32 per cent of Year 8 students answered this correctly. In Australia, 30 per cent did so, and in Korea, 63 per cent of students answered correctly.

Box 11 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 at Year 4. 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 11 Low international benchmark – Example item Year 4

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

TIMSS Benchmarks – Year 4 science

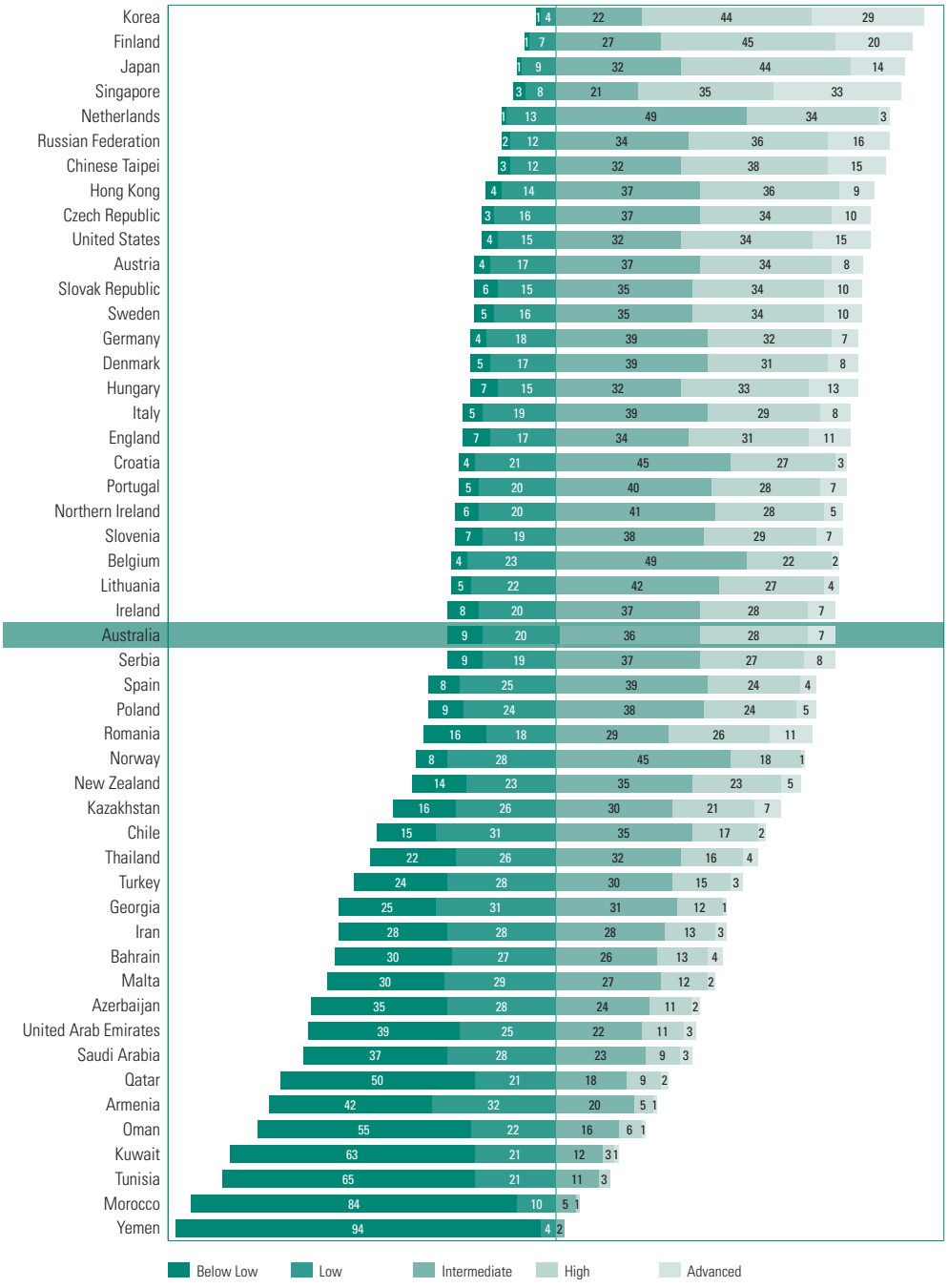


Figure 17 Percentages of students reaching the international benchmarks for science achievement by country, Year 4

- Korea, Finland and Japan had 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.
- 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.

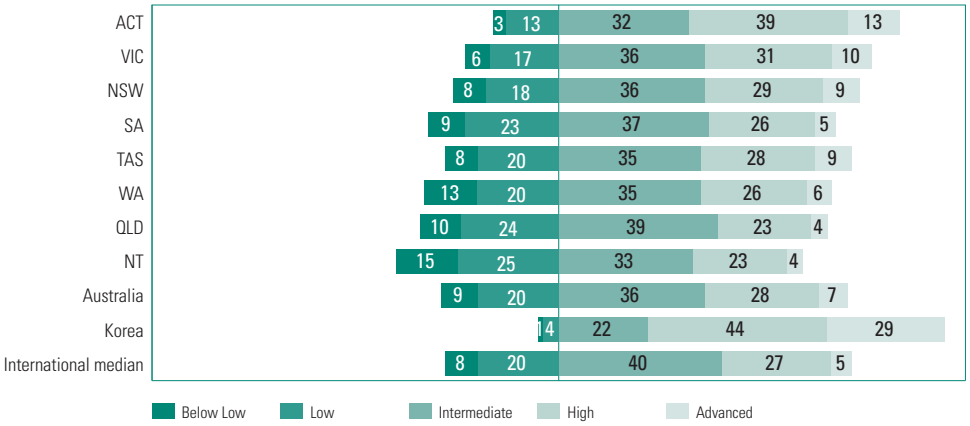


Figure 18 Percentages of students reaching the international benchmarks for science achievement by state, Year 4

- The Australian Capital Territory was the highest performing state, with 13 per cent of students reaching the Advanced 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. 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.

TIMSS Benchmarks – Year 8 science

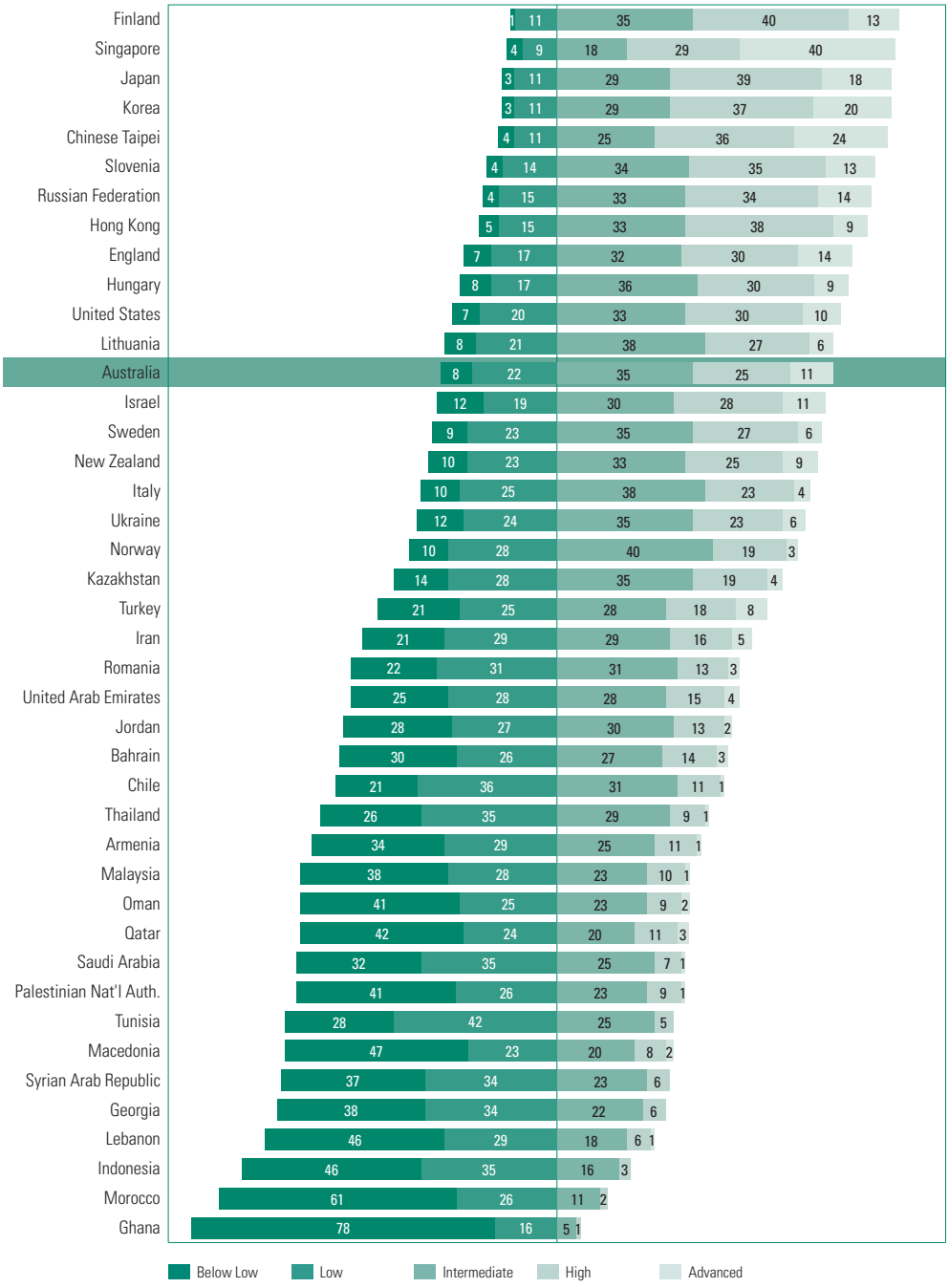


Figure 19 Percentages of students reaching the international benchmarks for science achievement by country, Year 8

- The Asian countries, Japan, Chinese Taipei, Korea and particularly Singapore, showed their international dominance in science. In Singapore, 40 per cent of students reached the Advanced benchmark. In the other three countries, between 18 and 24 per cent of students achieved at this very high level.
- In a range of other countries, including Australia (11%), the United States (10%) and England (14%), more than 10 per cent of students achieved the Advanced benchmark.
- Finland places on top of the figure because although they did not achieve the highest proportion of students achieving the Advanced benchmark, almost all (99%) of their students achieved the Low benchmark.

- At the lower ends of achievement, eight per cent of Australian students did not achieve the Low benchmark, and a further 22 per cent of students did not attain the Intermediate benchmark. While this compares favourably with the proportion of students internationally who did not achieve this level (48%), it leaves a great deal of room for improvement.

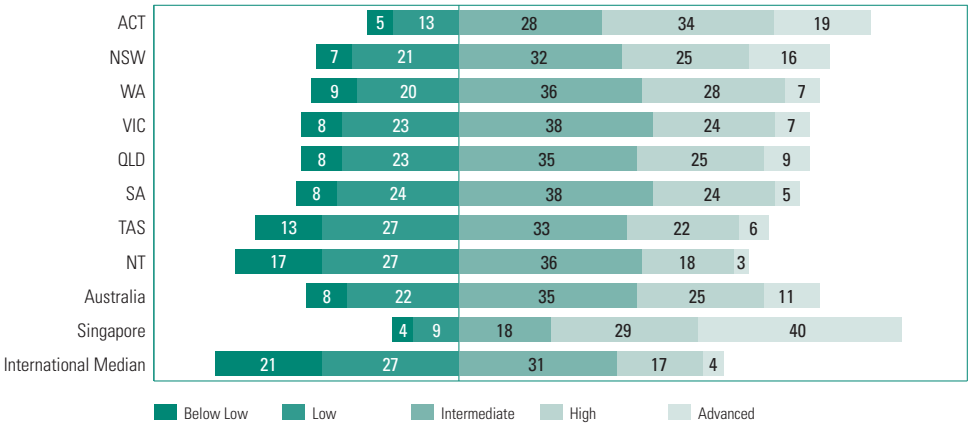


Figure 20 Percentages of students reaching the international benchmarks for science achievement by state, Year 8

- Nineteen per cent of Year 8 students in the Australian Capital Territory and 16 per cent of students in New South Wales reached the Advanced benchmark, but in all other states the proportion at this level was less than 10 per cent.
- The other end of the achievement distribution shows that a worrying 44 per cent of students in the Northern Territory and 40 per cent of students in Tasmania did not reach the Intermediate benchmark.
- In the other states this proportion ranged from around 32 per cent in South Australia, Queensland and Victoria, through to 18 per cent in the Australian Capital Territory.

Home influences on early learning

The coincidence of the TIMSS and PIRLS assessments enabled the Home questionnaire to be expanded and questions asked of the parents of Year 4 students about early literacy and numeracy activities, as well as early childhood education and aspirations.

Parents or guardians were asked how often they participated in particular activities with their child before the child began formal schooling. These were

- Early literacy activities: Read books, tell stories, sing songs, play with alphabet toys, talk about things you had done, talk about things you had read, play word games, write letters or words, and;
- Early numeracy activities: Say counting rhymes or sing counting songs, play with number toys, count different things, play games involving shapes, play with building blocks or construction toys, play board games or card games.

Internationally, students whose parents said that they frequently participated in such activities were found to score higher on the cognitive assessments. Just over half (52%) of the students whose parents responded to the questionnaire in Australia said that they had participated in early literacy activities "often", while a further 46 per cent had parents who had participated "sometimes". More Australian students had parents who said they frequently participated in early numeracy activities, with 61 per cent having parents who "often" participated and 36 per cent having parents who "sometimes" participated.

More than half (55%) of the children whose parents responded had attended preschool for less than three years but more than one year. Year 4 children who had attended preschool for this length of time significantly outperformed children who had attended preschool for one year or less (26% of students), and those who did not attend preschool at all (5% of students) in both reading and mathematics.

Parents or guardians were also asked the extent to which they enjoyed reading, as there is evidence that modelling behaviour is important and that parents who read will be more likely to provide an environment in which there are many books for a child to read.

Almost half the Australian students (48%) had parents who reported liking reading, with a further 42 per cent having parents who were more lukewarm, somewhat liking reading. Internationally and within Australia, students whose parents reported liking reading scored significantly higher in reading themselves than those whose parents were lukewarm or reported not liking reading.

Parents' aspirations for their children have been found to strongly predict a student's own educational aspirations, and in turn these strongly predict student achievement. Results from the Home questionnaire provided evidence for a relationship between parents' aspirations for their 10-year-old child and student achievement. Students whose parents expected that they would complete at least a university degree significantly and substantially (44 points in reading, 47 points in mathematics, 48 points in science) outperformed students whose parents expected their child to complete a TAFE qualification or similar (post-secondary but not university), as well as those whose parents did not expect them to complete anything past secondary education.

Perhaps surprising is that gender differences were apparent in parental aspirations for their children: a higher proportion of male students than female students (at 10 years old) have parents who expect that they would complete post-secondary but not university education, and a higher proportion of female than male students have parents who expect that they would complete a university degree.

Gender differences

Among Australian students:

- Female students achieved at a significantly higher level than male students in reading (17 score points);
- A higher proportion of female than male students achieved at the Advanced benchmark in reading (12% compared to 8%);
- In mathematics there were no significant gender differences at either Year 4 or Year 8;
- In science there were no significant gender differences at Year 4, but males significantly outperformed females at Year 8, as has been the case in every TIMSS assessment.

Students who indicated that they liked reading, mathematics or science scored higher on the cognitive assessments than students who indicated that they did not like the area. Similarly, students who felt confident in an area also scored higher in that area on the cognitive assessment.

- Female students were more likely to like reading and less likely to express a lack of confidence in their reading ability than male students.
- At Year 4, male students liked learning mathematics to a greater degree than female students, and expressed greater confidence in learning mathematics. There were no gender differences in science.
- At Year 8, male students liked learning mathematics and science, and expressed greater confidence in learning mathematics and science than their female peers – almost half the female students surveyed said they did not like mathematics.
- At Year 8, male students valued mathematics to a greater extent than their female peers, but there were no gender differences in the valuing of science.

School resources

More than half (57%) of Australian Year 4 students were reported to be "somewhat affected" by resource shortages related to reading, 54 per cent by resource shortages related to mathematics and 68 per cent by resource shortages related to science. Forty-six per cent of the principals of Australian Year 8 students reported similar levels of shortages in mathematics and 52 per cent in science.

Students attending schools in which principals reported that there were no resource shortages scored significantly higher than students from schools where principals reported being "somewhat affected" by shortages in Year 4 reading and mathematics and Year 8 mathematics. This trend was not found for science achievement.

School climate

In Australia, achievement in reading, mathematics and science at Year 4, and in mathematics and science at Year 8, was found to be higher on average:

Among students who

- Liked school and felt that they belong;
- Were engaged during lessons;
- Felt that they were safe; and
- Were almost never bullied.

In schools in which

- Principals and teachers reported a high emphasis on academic success;
- Teachers thought were safe and orderly;
- Principals reported few problems with discipline or attendance;
- Students had adequate prerequisite knowledge;
- Disruptive or disinterested students did not impact learning; and
- Lack of nutrition and sleep deprivation did not impact student learning.

To access the full report or more information about TIMSS or PIRLS in Australia, visit www.acer.edu.au/timss.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