PISA 2006
How ready are our 15-year-olds for tomorrow's world?

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OECD PISA
OECD Programme for International Student Assessment
Monitoring Knowledge and Skills in the New Millennium

An Overview of PISA

What is PISA?

The Programme for International Student Assessment (PISA) is an international standardised study that assesses and compares how well countries are preparing their 15-year-old[1] students to meet real-life opportunities and challenges.

What does PISA assess?

PISA assesses three key areas of knowledge and skills – reading literacy, mathematical literacy and scientific literacy – and has a focus on one of these literacy areas each time PISA is administered. The focus of PISA 2006 is science. The term 'literacy' is used to emphasise that the assessment is not restricted to assessing how well students have mastered the content of a specific school curriculum. PISA focuses on assessing students' ability to apply their knowledge and skills, and their ability to make decisions in real-life situations. PISA defines this approach as assessing "[t]he knowledge, skills, competencies and other attributes embodied in individuals that are relevant to personal, social and economic well-being".[2]

What additional information is gathered?

Background information is also gained from questionnaires completed by students and school principals. In PISA 2006 parents also completed a questionnaire. This allows for the relationship between contextual information and achievement to be examined.

How often is PISA administered?

PISA is administered every three years, beginning in 2000, when reading was the main focus. In 2003 the focus was mathematical literacy, and in 2009 it will be reading literacy again. Rotating the major focus for each administration of PISA provides in-depth and detailed information on the subject of major focus and an ongoing source of achievement data on the two minor subjects.

Who participates in PISA?

PISA assesses 15-year-olds. Around 400,000 15-year-old students from 57[3] countries, including the 30 Organisation for Economic Co-operation and Development (OECD) member countries, participated in PISA 2006. In New Zealand 4,824 students from 170 schools took part. Students and schools were randomly selected. A two-tiered stratified sampling method was used to ensure the sample was representative. Students were sampled from schools of different sizes and decile groupings, and from urban and rural schools. As a result, every 15-year-old had roughly the same chance of selection.

Why participate in PISA?

PISA assesses students who have completed around 10 years of compulsory schooling, which means the PISA results are an important source of information in New Zealand. PISA measures progress towards the government education sector's goals of:

- building an education system that equips New Zealanders with 21st century skills, and
- reducing systemic underachievement in education.

PISA not only allows measurement of New Zealand's progress on these goals over time, but also allows measurement of New Zealand's performance relative to other countries in equipping students with skills and reducing disparities in achievement. The PISA data provides evidence to inform policy and practice in literacy, numeracy and curriculum development.

Who organises PISA?

PISA is an initiative of the OECD and a collaborative effort of the participating countries. A consortium was responsible for developing and overseeing PISA 2006 at the international level. This consortium is led by the Australian Council for Educational Research (ACER), and consists of the Netherlands National Institute for Educational Measurement (Citogroup); Westat (USA); the Educational Testing Service (ETS, USA); and the Japanese National Institute for Educational Policy Research (NIER, Japan). The Comparative Education Research Unit within the Ministry of Education's Research Division is responsible for PISA in New Zealand.

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[1] Students are aged between 15-years-3-months and 16-years-2-months. As most students are aged 15, they are referred to as '15-year-olds' for brevity.

[2] OECD (2006). *Assessing scientific, reading and mathematical literacy – a framework for PISA 2006,* p11. Paris: OECD.

[3] The countries participating in PISA 2006 are listed at the end of this report.

PISA2006

How ready are our 15-year-olds for tomorrow's world?

New Zealand's 15-year-olds are more ready for tomorrow's world than the majority of their international counterparts.

Scientific literacy (main focus)

- Of the 57 countries participating in PISA 2006, only two countries performed better[4] than New Zealand, eight countries were similar, and the other 46 countries were significantly lower.
- New Zealand and Finland achieved the largest proportion of students performing at the highest level of scientific literacy.
- The proportion of students with a low level of scientific proficiency was larger than four high-performing countries, but similar to six other high-performing countries.
- Girls and boys showed similar mean scientific literacy performance, and girls were as likely to achieve the highest level of scientific literacy as boys.
- There were Asian, Māori, Pākehā-European and Pasifika students who performed at the highest level of scientific literacy. However, Pākehā-European and Asian students were more likely to be at the higher end while Māori and Pasifika were over-represented at the lower end.
- Overall New Zealand had high performance in each scientific competency, with particular strengths in *identifying scientific issues* and *using scientific evidence* compared to *explaining phenomena scientifically*.
- Overall New Zealand had high performance in each science content area, with particular strengths in *earth and space systems* and *living systems* compared to *physical systems*.

Reading literacy (minor focus)

- Of the 57[5] countries participating in PISA 2006, the mean reading literacy performance of only three countries was significantly higher than New Zealand, two countries were similar, and the other 50 countries were significantly lower.
- New Zealand's 15-year-olds' performance in reading literacy showed no significant change between 2000 and 2006.

Mathematical literacy (minor focus)

- Of the 57 countries participating in PISA 2006, the mean mathematical literacy performance of only five countries was significantly higher than New Zealand, seven countries were similar, and the other 44 countries were significantly lower.
- New Zealand's 15-year-olds' performance in mathematical literacy showed no significant change between 2003 and 2006.

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[4] The terms such as 'better', 'larger', 'weaker' or 'smaller' are used when results are statistically significant at the 0.05 level.

[5] The United States of America reading literacy results are not reported because mean performance in reading could not be accurately estimated due to a printing error in the test booklets. Some of the reading items had incorrect instructions.

Scientific Literacy (main focus)

What aspects of scientific literacy does PISA 2006 measure and report on?

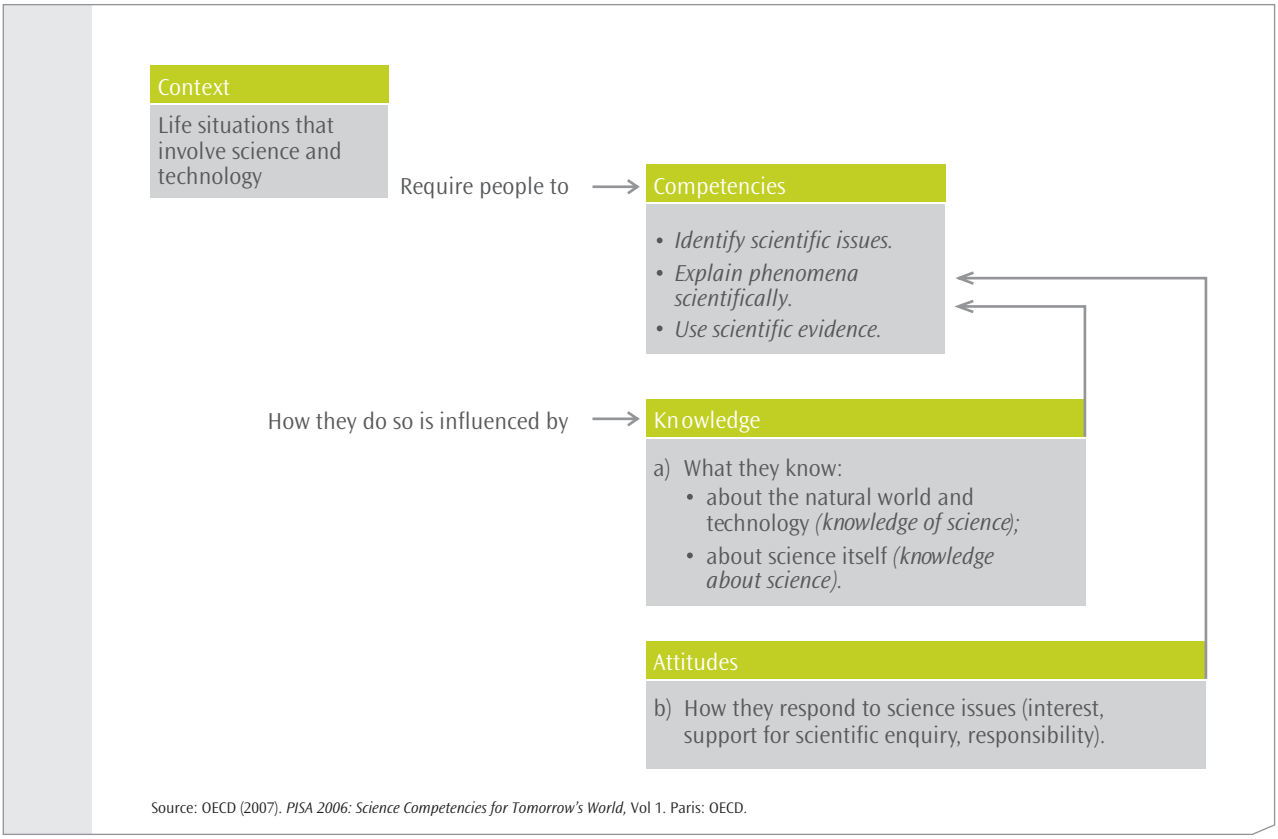
In this summary report student performance is reported on an overall combined measure of scientific literacy. The design of PISA allows for detailed reporting on students science competencies and their scientific knowledge. Three scientific competencies – *identifying scientific issues, explaining phenomena scientifically* and *using scientific evidence* – and two scientific knowledge areas – *knowledge* of *science* and *knowledge* about *science* are reported.

This is the first time science has been the major focus of PISA. Because it was a minor domain in PISA 2000 and PISA 2003, this literacy area has undergone considerable expansion and change. The PISA 2006 assessment therefore establishes the basis for the analysis of trends in science performance in the future, but it means it is not possible to compare science learning outcomes from PISA 2006 with earlier PISA assessments.

To assess scientific literacy, as defined for PISA 2006,[6] the framework looks at four interrelated aspects of scientific literacy (see Figure 1 on opposite page). The aspects of scientific literacy measured through the assessment tasks are based on this framework.

[6] See the Glossary on page 35 for PISA's scientific, reading and mathematical literacy definitions.

Figure 1: The PISA 2006 scientific literacy framework



Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

Scientific Performance in Science
Combined Scientific Literacy Scale

Combined scientific literacy scale

Student performance in the various aspects of scientific literacy in PISA 2006 is summarised on the *combined scientific literacy* scale to provide a high-level picture of student performance.

Mean scores by all students on the combined scientific literacy scale

Overall, New Zealand's 15-year-old students performed very strongly in scientific literacy (see Figure 2).

- Of the 57 countries participating in PISA 2006, only two countries, Finland (563) and Hong Kong-China*[7] (542), achieved a significantly better performance than New Zealand.
- The mean performance of New Zealand students (530) is statistically similar to eight other countries: Canada (534), Chinese Taipei*[8] (532), Estonia*[9] (531), Japan (531), Australia (527), the Netherlands (525), Liechtenstein* (522) and Korea (522).
- New Zealand students' mean performance is statistically better than the 46 other countries participating in PISA, including the United Kingdom (515), the United States of America (489) and the 21 other OECD countries.

[7] Denotes a non-OECD country, referred to as a partner country or economy.

[8] Chinese Taipei is a new country to PISA.

[9] Estonia is a new country to PISA.

Distribution of students on the combined scientific literacy scale: 5th percentile to 95th percentile

Looking at the range or distribution of student scores provides more in-depth information on student performance. Countries that have a wide spread of student achievement will have a larger disparity between high and low achievers within their country. As can be seen in Figure 2, compared with the 10 other high-performing[10] countries, New Zealand has the widest spread of science scores (352 score points) between the 5th and 95th percentile (range 347 to 699).

The mean range of scores between the 5th and 95th percentile across all the OECD countries was 311[11] score points (range 340 to 652), which is significantly narrower than New Zealand's range. It is important to note that New Zealand's top-performing students contribute to this wide range.

Highest-performing students: 95th percentile

- The top 5 percent of 15-year-old students in New Zealand and Finland were the highest performing of all PISA countries, scoring 699 points or higher. This 95th percentile score was better than the nine other high-performing countries, including Australia (685) and Canada (681), and was considerably higher than the OECD 95th percentile mean of 652.

Middle-range-performing students: 25th–75th percentile

- At the 75th percentile, New Zealand's score (608) was significantly greater than six of the high-performing countries, including Australia (598) and Canada (601). Only Finnish (622) students showed a stronger performance at the upper end of this range.
- New Zealand's 25th percentile score (455) was statistically similar to six of the other high-performing countries, including Australia (459), but was lower than that of Finland (506), Hong Kong-China* (482), Estonia* (474) and Canada (472).
- For the 50 percent of students in the middle range of the distribution, the spread of New Zealand scores is wide. Again, it is important to note that New Zealand's score at the upper end of this distribution is high. For example, compared to New Zealand (153 score points, range 455–608), both the Netherlands and Australia show a narrower spread, with a similar 25th percentile score but a lower 75th percentile score; the Netherlands has a 140 score points range (456 to 596) and Australia has a 138[12] score points range (459 to 598).

Lowest-performing students: 5th percentile

- The lowest-performing 5 percent of New Zealand's 15-year-olds achieved a score of 347 or less. This was significantly lower than eight of the ten other high-performing countries.
- New Zealand's 5th percentile score was not significantly different from the 5th percentile mean for OECD countries (340), Australia (358) and Liechtenstein* (358).

As noted already, compared to other high-performing countries New Zealand had one of the biggest spreads of scores between the highest- and lowest-performing students. This can be attributed to the exceptional performance of our highest-achieving students as much as to the performance of the lower achievers. This pattern of performance is also reflected at the middle-range of the distribution.

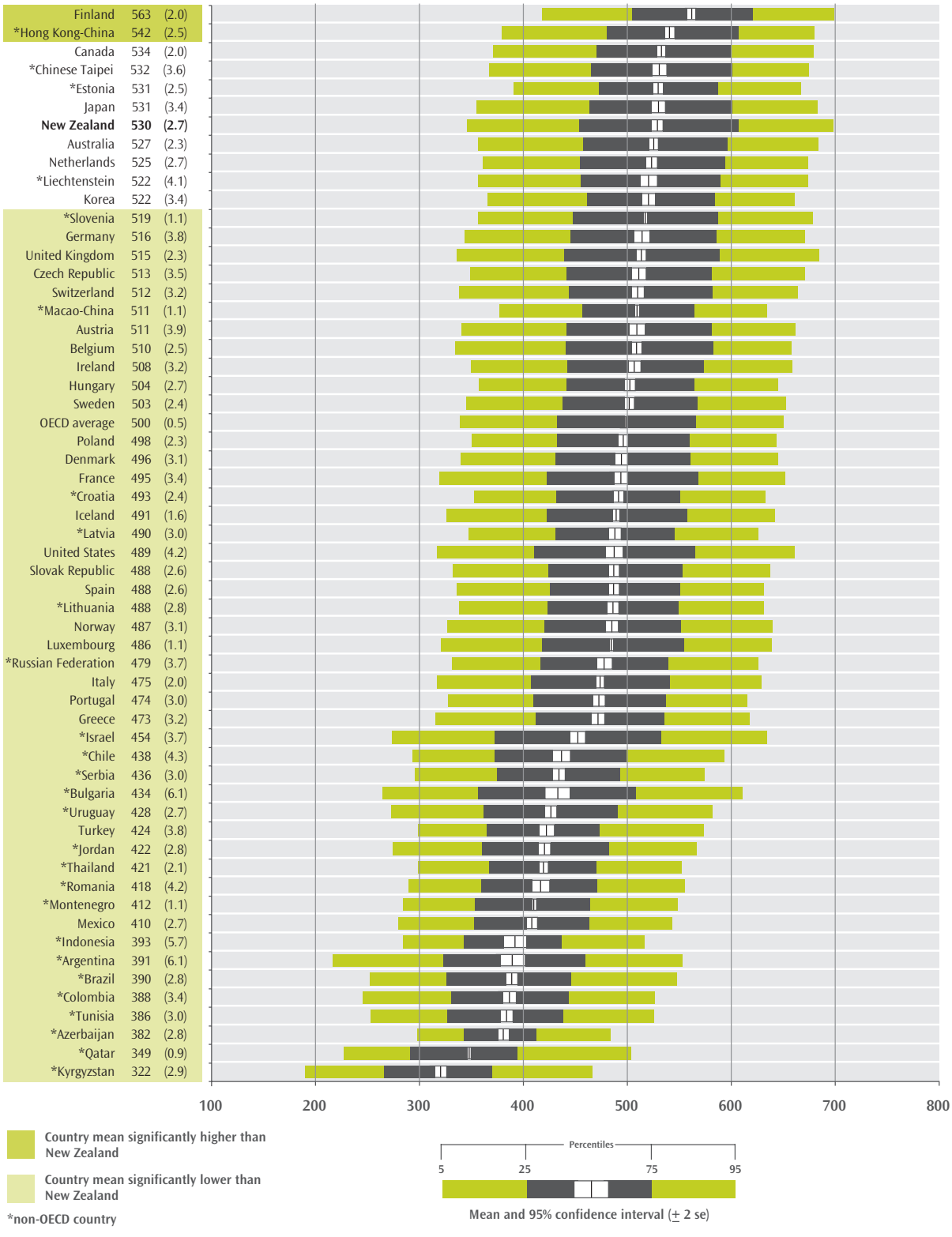
It is important to note that the 5th percentile score of New Zealand's lowest performing students was significantly better than or similar to the 5th percentile for 48 of the other 56 countries participating in PISA 2006 and similar to the OECD to the 5th percentile score.

[10] 'High-performing countries' refers to the two countries that achieved significantly higher than New Zealand and the eight countries that were not statistically different from New Zealand on the combined scientific literacy scale.

[11] Because the results are rounded to the nearest whole number this difference appears inconsistent.

[12] Because the results are rounded to the nearest whole number this difference appears inconsistent.

Figure 2: Combined scientific literacy distribution



Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

In science, New Zealand's education system caters well for the majority of students, in particular students with exceptional scientific knowledge and skills. These evidence-based findings affirm that New Zealand should continue to focus on students at risk of underachieving.

It should also be noted that these results do not show the effects of any recent interventions implemented at the early to mid-primary school level because the students that PISA assesses are aged 15 years and would not have participated in these programmes.

Standard deviation and variance within and between schools

Another measure or the spread of the distribution is the standard deviation which shows how closely scores are clustered around the mean. New Zealand (107), the United Kingdom (107) and the United States of America (106) have the largest standard deviations of all OECD countries.

PISA also measures the extent to which student scores vary within schools ('within school variance') and the extent to which student scores vary between schools ('between school variance'). New Zealand has a smaller between school variance than the OECD average. In contrast, New Zealand's within school variance is very large compared to that of other OECD countries. This finding highlights that there is a very diverse range of student performance in science within a typical New Zealand secondary school, whereas student performance across schools varies less.

Proficiency levels (six levels) of all students on the combined scientific literacy scale

PISA also provides information on students' science proficiency. Six scientific proficiency levels link student achievement scores to the types of tasks that students at each level would typically be expected to perform. Students at a particular level are expected to correctly complete at least half of the tasks at that level, and would also be expected to correctly complete a higher proportion of the tasks at the lower levels. For example, students reaching Level 3 would also be proficient at Level 1 and Level 2. The types of scientific literacy tasks that students would typically be expected to perform at each proficiency level are described in Figure 3: What the scientific literacy proficiency levels measure.

Students at Level 1, the low end of the scientific literacy proficiency continuum, can undertake simple routine tasks, whereas students at the highest level, Level 6, scoring 708 or higher, clearly demonstrate advanced scientific thinking and reasoning.

Students with below 335 score points on any of the science competencies are classified as below Level 1; that is, they did not demonstrate scientific competencies in situations required by the easiest PISA tasks. As noted in the PISA 2006 International Report, "… [t]he implied competencies shown in Figure [3] suggest, such a low level of scientific competency can be regarded as putting them at a serious disadvantage for full participation in society and the economy".[13]

The overall performance of the 57 countries on the six scientific proficiency levels is shown in Figure 4.

Three highest levels of proficiency (Level 4, Level 5 and Level 6)

- New Zealand and Finland achieved the largest proportion (4%) of students achieving at the highest level of scientific proficiency (Level 6) when compared to the other 55 PISA 2006 countries.
- Twenty-one percent of Finland's 15-year-olds and 18 percent of New Zealand's students reached Level 5 or higher. In Hong Kong-China* 16 percent (the other highest-performing country) achieved this level of proficiency.
- Forty-two percent of New Zealand's 15-year-olds achieved at Level 4 or higher. When compared with the other high-performing countries, only Finland

[13] OECD. (2007) *PISA 2006: Science Competencies for Tomorrow's World*, Vol. 1, p.42, Paris: OECD.

Figure 3: What the scientific literacy proficiency levels measure

Level	Lower score limit	Percentage of students able to perform tasks at each level or above (OECD average)	What students can typically do
6	707.9	1.3% of students across the OECD can perform tasks at Level 6 on the science scale	At Level 6, students can consistently identify, explain and apply scientific knowledge and *knowledge about science* in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations.
5	633.3	9.0% of students across the OECD can perform tasks at least at Level 5 on the science scale	At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and *knowledge about science* to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis.
4	558.7	29.3% of students across the OECD can perform tasks at least at Level 4 on the science scale	At Level 4, students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence.
3	484.1	56.7% of students across the OECD can perform tasks at least at Level 3 on the science scale	At Level 3, students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge.
2	409.5	80.8% of students across the OECD can perform tasks at least at Level 2 on the science scale	At Level 2, students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.
1	334.9	94.8% of students across the OECD can perform tasks at least at Level 1 on the science scale	At Level 1, students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and that follow explicitly from given evidence.

Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

(53%) and Hong Kong-China* (46%) had a larger proportion of students achieving at Level 4 or higher.

- Across OECD countries, 29 percent of students were proficient in science at Level 4 or higher, with 8 percent of these students achieving at Level 5 and another 1 percent attaining Level 6.

Two lowest levels of proficiency (Level 1 and below Level 1)

- Four percent of New Zealand' 15-year-olds did not demonstrate Level 1 proficiency as measured by PISA. Three other high-performing countries, Australia (4%), Japan (3%) and Liechtenstein* (3%), had a similar proportion, while the seven other high-performing countries had smaller proportions. However, across all the OECD countries, a larger proportion was observed (5%).
- At this low end of the continuum (Level 1 or lower), New Zealand (14%) had a similar proportion of students as six of the other high-performing countries: Australia (13%), Liechtenstein* (13%), the Netherlands (13%), Japan (12%), Chinese Taipei* (12%) and Korea (11%). Smaller proportions of students were observed at this level in Finland (4%), Estonia* (8%), Hong Kong-China* (9%) and Canada (10%).
- Across the OECD countries, 19 percent of students did not achieve above Level 1, and 5 percent of these students were unable to perform tasks that required Level 1 proficiency.

These findings indicate that the top 18 percent of New Zealand students are doing exceptionally well in science; that is, they are capable of advanced scientific thinking and reasoning.

Nearly half of the 57 countries participating in PISA showed 5 percent or fewer of their 15-year-olds proficient in scientific literacy at Level 5 or higher, whereas six countries, including New Zealand, achieved at least 15 percent. Only in the two highest-performing countries, Finland and Chinese Taipei* were there larger proportions of students achieving proficiency at Level 4 or higher.

The proportion of New Zealand students at the lower end of the continuum was similar to some of the other high-performing countries. However when considering the proportion of New Zealand students performing at the highest level, the number of students not achieving Level 1 is disproportionately large.

Mean scores **by gender on the combined scientific literacy scale**

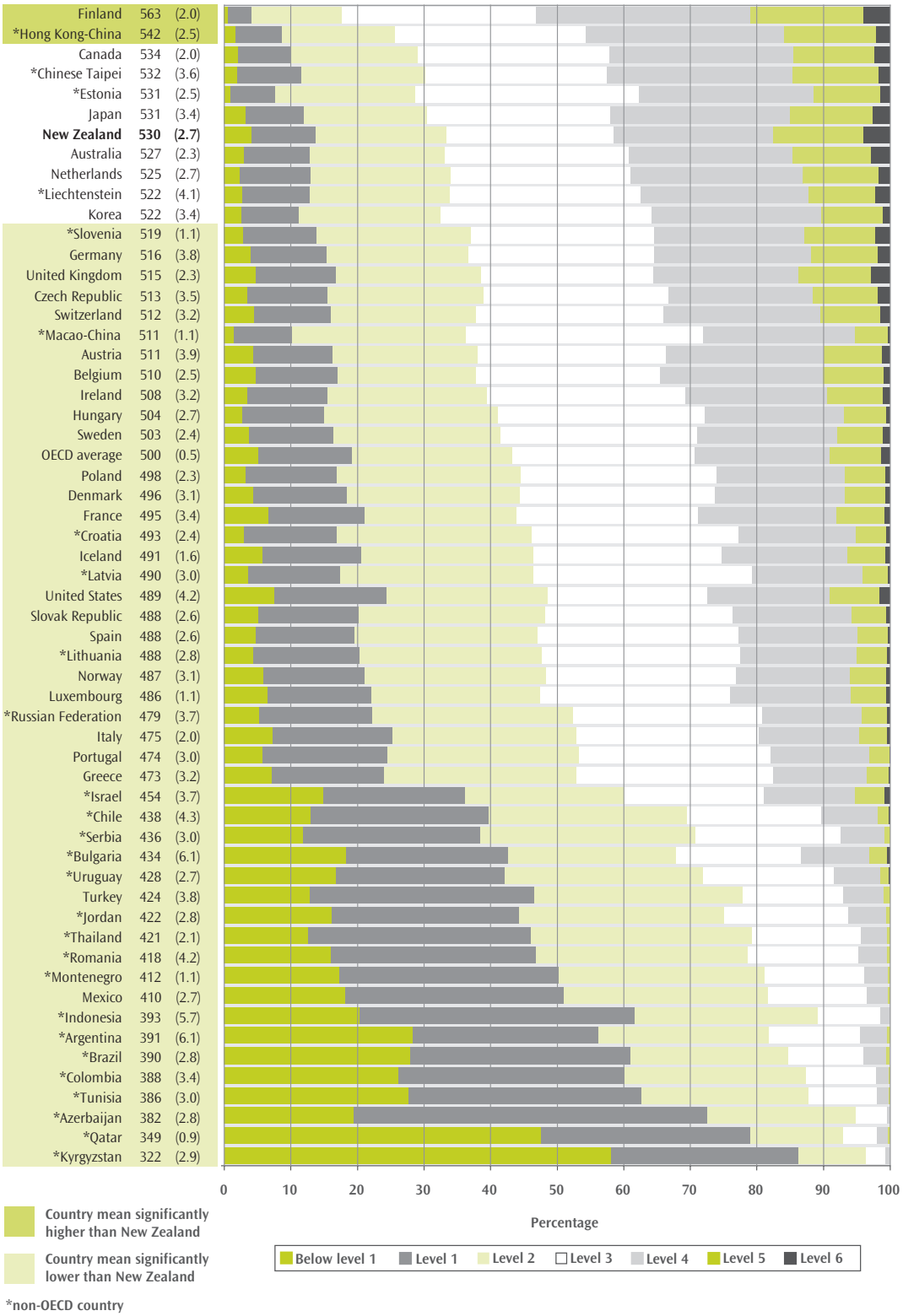
- There was no significant difference in the performance of New Zealand girls (532) and boys (528) on the *combined scientific literacy* scale.
- Only in Finland did both boys (562) and girls (565) achieve significantly higher results than their New Zealand counterparts. Boys in Hong Kong-China* (546) outperformed New Zealand's boys.
- Only eight OECD countries showed a gender difference that was significant, with boys outperforming girls in six OECD countries and girls outperforming boys in two. In both instances the observed differences were relatively small in absolute terms and when compared with reading.

Proficiency levels **by gender on the combined scientific literacy scale**

Three highest levels of proficiency (Level 4, Level 5 and Level 6)

- New Zealand and Finland were the only countries with 3 percent or more girls and 4 percent or more boys reaching the highest level of proficiency, Level 6. Close to one in five girls (17%) and boys (18%) in New Zealand were successful at Level 5 or higher.
- Similar proportions of New Zealand 15-year-old girls (42%) and boys (41%) were proficient at Level 4 or higher.

Figure 4: Combined scientific literacy proficiency levels



Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

Two lowest levels of proficiency (below Level 1 and Level 1)

- Fewer New Zealand girls (12%) than boys (15%) did not demonstrate proficiency above Level 1. This was also the case at below Level 1, with a larger proportion of boys (5%) not showing proficiency at this level than girls (3%).
- Finland had the smallest proportion of girls (3%) and boys (5%) at Level 1 or below proficiency on the *combined scientific literacy* scale. In Hong Kong-China* and Estonia* there were fewer than 10 percent of boys or girls at the lowest levels of proficiency.

In short, a slightly larger proportion of New Zealand boys than girls showed a lower level of scientific proficiency, but across the two upper levels the proportions of boys and girls were not statistically different. At the top end of the proficiency continuum, New Zealand's students who demonstrated exceptional scientific knowledge and skills were as likely to be male as female.

Mean scores by ethnic grouping on the combined scientific literacy scale

The mean performance of students identifying with one of the four ethnic groupings – Asian, Māori, Pākehā-European and Pasifika – provides information on overall group achievement.

- Overall Pākehā-European 15-year-olds performed very strongly in scientific literacy, achieving a mean score more than 50 points higher (554) than the average across the 30 OECD member countries (500).
- Asian students also performed strongly in science, with a mean score of 541 score points. This result was significantly lower than that of Pākehā-European students.
- Māori (480) did not perform strongly on the combined scientific literacy score. Although Māori 15-year-olds achieved a significantly better mean score than Pasifika students, the mean performance of Māori was lower than Pākehā-European and Asian students as well as the OECD mean.
- Pasifika students showed a weaker performance in scientific literacy (454) than the other three ethnic groupings and the OECD average.

Proficiency levels by ethnic grouping on the combined scientific literacy scale

Examining the percentage of students from each of the four ethnic groupings that reached a particular level of proficiency is a clear indicator or reminder that subgroups, like gender and ethnicity, are diverse. Each ethnic grouping shows performance that ranges from poor to advanced.

Three highest levels of proficiency (Level 4, Level 5 and Level 6)

- Five percent of Pākehā-European and 6 percent of Asian students achieved the highest level of scientific proficiency, Level 6. A small proportion of Māori (1%) and Pasifika (1%) students were also successful at this level.
- Seventeen percent of Pākehā-European and 17 percent of Asian students successfully completed Level 5 tasks. The proportions of Māori (6%) and Pasifika (4%) attaining this level of proficiency were small.
- Half of Pākehā-European (50%) and Asian (48%) students were proficient at Level 4 or higher. Approximately one-quarter of Māori (22%) and 17 percent of Pasifika students achieved Level 4 or higher.

Two lowest levels of proficiency (below Level 1 and Level 1)

- Only a very small proportion of Pākehā-European (1%) students did not show proficiency at Level 1, while 5 percent of Asians and 8 percent of Māori did not reach this level. A significantly larger proportion of Pasifika students (13%) did not demonstrate that they were proficient in scientific literacy at Level 1.

- A significantly smaller proportion of Pākehā-European (7%) students than their peers from the other three ethnic groupings did not successfully complete the majority of tasks beyond Level 1 proficiency. Fifteen percent of Asian, one-quarter of Māori (25%) and one-third of Pasifika students (32%) did not show proficiency in tasks beyond Level 1.

The large proportion of Māori and Pasifika 15-year-olds not reaching above Level 1 proficiency in scientific literacy is of concern, providing evidence that New Zealand needs to continue with its initiatives directed towards Māori and Pasifika students who are at risk of underachieving.

It is also important to note here that the proportion of Asian students succeeding at the upper proficiency levels was similar to Pākehā-European students, but the proportion of Asian students not showing scientific literacy proficiency beyond Level 1 was significantly greater. Asian students' lower mean score than Pākehā-European students can partly be explained by the higher proportion of Asian students not reaching beyond Level 1.

It is clear when looking at student performance across the four ethnic groupings that Pākehā-European and Asian students make up the largest proportion of New Zealand students who are achieving a level of scientific literacy that is among the best in the world. Māori and Pasifika 15-year-olds are also performing at this level, but their proportion is very small.

Scientific literacy competencies

Scientific literacy competencies

To provide more detailed information on scientific literacy the PISA 2006 tasks required students to *identify scientific issues, explain phenomena scientifically* and *use scientific evidence*. These three competencies were assessed in PISA because of their importance to the practice of science and their connection to key cognitive abilities.

Mean scores by all students on the three scientific literacy competencies

- New Zealand students performed very strongly on the *identifying scientific issues* (536) and *using scientific evidence* (537) scales, with only one country, Finland, achieving a significantly better result on both competency scales. Only three countries – Australia (535), the Netherlands (533) and Canada (532) – achieved a similar result to New Zealand's 15-year-olds (536) on the *identifying scientific issues* scale. With the exception of the Netherlands, all of the high-performing countries performed at least as well as New Zealand on the *using scientific evidence* scale.
- New Zealand showed a relatively weaker performance (522), on the *explaining phenomena scientifically* scale, with five of the high-performing countries achieving a significantly better result. Four of these countries performed about the same as New Zealand, including Australia with 520 score points, while Korea's (512) mean achievement on this scale was significantly lower.

Mean scores by gender on the three scientific literacy competencies

- The lower mean score for New Zealand overall on *explaining phenomena scientifically* can be partly attributed to the significantly weaker performance of girls (517) on this scale relative to boys (528). This difference in favour of boys was observed in all OECD countries (OECD mean of 508 score points for boys and 493 for girls), and was statistically significant in all but four countries.
- New Zealand girls overall performed very strongly on the *identifying scientific issues* scale (547), a score that was 22 points greater than boys (525). Again, a similar gender pattern in performance to New Zealand was observed in OECD countries, with girls outperforming boys on this scale in all OECD countries (OECD mean of 508 score points for girls and 490 for boys).

- Girls in New Zealand also performed strongly on *using scientific evidence* (541), a score that was larger but not significantly different from the mean score of boys (532). Significant differences between the two gender groups were observed in only two OECD countries.

New Zealand students' overall weaker performance on the *explaining phenomena scientifically* (as noted above) can partly be explained by girls' relatively weaker performance on this competency.

The performance of New Zealand's 15-year-old girls and boys on each of the three scientific literacy competencies largely reflects the gender pattern of performance in other OECD countries.

Proficiency levels on the three competencies will be reported in the national science report, which will be available in 2008. However, it is noted in the PISA 2006 international report[14] that across the countries participating in PISA, only a relatively small proportion of students demonstrated that they were capable of performing tasks in *identifying scientific issues* at the two highest scientific proficiency levels. New Zealand (18%), along with Finland (17%), showed the highest proportion of students achieving at the highest levels in this scientific competency.

[14] OECD (2007). PISA 2006: *Science Competencies for Tomorrow's World*, Vol. 1, p.42, Paris: OECD.

Knowledge domains:
Knowledge *of* science and knowledge *about* science

The two knowledge domains assesses students' *knowledge* of *science* which asks students about their knowledge of the natural world – that is, scientific concepts and theories – and their *knowledge* about *science* itself – that is, understanding the nature of science.

Knowledge *of* science

Student results are reported separately on the three scientific categories: *living systems*, *earth and space systems* and *physical systems.* Results on these three content areas and a fourth content area, *technology systems*,[15] are summarised on the *knowledge* of *science* scale.

[15] Technology systems is not reported as a separate content area because there were insufficient tasks to allow for analysis at an individual content level. Instead, technology is captured on the knowledge of science scale, which summarises student performance on the four content areas.

Mean scores by all students on their knowledge *of* science

- New Zealand (524) performed about the same as Japan (529), Australia (522), Korea (520), the Netherlands (520) and Liechtenstein* (517), with the other five high-performing countries attaining a significantly better result on this scale.

Mean scores by all students on the three knowledge *of* science content areas

- Of the three *knowledge* of *science* content areas reported separately, New Zealand students performed strongly on *living systems* (528) and *earth and space systems* (530). Only three high-performing countries performed significantly better than New Zealand on the *earth and space systems* and four countries on the *living systems*.

- New Zealand students' knowledge of *physical systems* (516) was weaker relative to their knowledge of the other two content areas. Eight of the other high-performing countries and three other countries significantly outperformed New Zealand on this scale, while two of the other high-performing countries achieved a similar result: Australia and Liechtenstein* (both 515).

Mean scores by gender on the three knowledge *of* science content areas

- New Zealand girls (527) and boys (529) achieved a similar result on the *living systems* content area.
- Boys in New Zealand performed significantly better on the other two content areas, the *earth and space systems* scale (536) and *physical systems* scale (529), outperforming girls by 12 score points on the former and 26 on the latter. A result in favour of boys was also observed on these two content areas across the majority of OECD member countries. (OECD mean for *earth and space systems* – girls 491 and boys 508 – and for *physical systems* – girls 487 and boys 513).
- Even though New Zealand girls' result on the *physical systems* content area (503) was significantly lower than boys, their performance was significantly better than the average for girls across all OECD countries.

The gender difference observed in New Zealand on the three content areas reflects the OECD gender pattern of performance. As for the science competency, *explaining phenomena scientifically*, New Zealand's lower mean score on *physical systems* can be partly attributed to New Zealand's lower performance on this content area.

Knowledge *about* science

Two categories are covered: scientific enquiry and scientific explanations. Student results are summarised on the *knowledge* about *science* scale.

Mean scores by all students on their knowledge *about* science

- New Zealand students performed strongly on the *knowledge* about *science* scale (539), with only the two top-performing countries in scientific literacy, Finland (558) and Hong Kong-China* (542), performing significantly better.
- New Zealand students' *knowledge* about *science* was statistically the same as five of the other high-performing countries, including Canada (537) and Australia (533).

Mean scores by gender on their knowledge *about* science

- New Zealand girls (546) outperformed boys (532) on the *knowledge* about *science* domain.
- Three other high-performing countries also showed a gender difference in favour of girls – Estonia* (15), Australia (10) and Canada (7) – and no significant gender difference was observed in the seven other high-performing countries.

While New Zealand performed significantly better on the *knowledge* about *science* (539) than *knowledge* of *science* scales (524), results from the 57 participating countries suggest that any significant difference in country achievement between the two knowledge domains does not appear to be related to overall student performance[16].

[16] OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol. 1, Paris: OECD.

Attitudes Towards and Engagement in Science

In addition to assessing scientific literacy among 15-year-old students, PISA gave students a questionnaire, which included questions on engagement and motivation as well as questions on personal background, learning habits and perceptions of the learning environment. Attitudes are seen by PISA as a key component of an individual's scientific literacy, and include an individual's beliefs, motivational orientations and sense of self-efficacy[17].

Engagement in science

- New Zealand students were generally positive about science with, for example, 71 percent agreeing that they enjoy acquiring new knowledge in science.
- In general, compared with their counterparts in other OECD countries, New Zealand students were more likely to agree that science will be useful for them in their future, and equally likely to report an intention to pursue science in the future. New Zealand students were equally as likely as students in other OECD countries to enjoy science, but less likely to be interested in science.
- Students with higher engagement in science – as measured by statements on enjoyment, interest and motivation – generally had higher achievement in science than those with lower engagement.
- Science was less important to do well in for New Zealand 15-year-old students than mathematics and English (18 percentage points less than English; 19 points less than mathematics). This finding mirrored that for all OECD countries and the majority of non-OECD PISA countries.

Science self-belief

- About half of New Zealand students were positive about statements on self-concept, such as *I learn science topics quickly* (53%), although fewer (40%) agreed that *learning advanced science topics would be easy for me*.
- On average, New Zealand students were less likely to believe they are good at science (have a high self-concept) than their counterparts in the OECD.
- The majority of students agreed that they could perform a selection of science tasks (self-efficacy).
- On average, New Zealand students were just as likely to have a high self-efficacy (agree they could perform a selection of science tasks) as students across OECD countries.
- Students with higher self-belief, as measured by statements about how good they are at science (high self-concept) and statements about the ease of performing a selection of science tasks (high self-efficacy), were likely to show a stronger performance in scientific literacy than their counterparts with lower self-belief.

[17] See page 122, OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol. 1, Paris: OECD.

Value beliefs regarding science

- In general, most New Zealand 15-year-old students felt that science is important for helping us understand the natural world (93%), of value to society (87%), and that advances in science and technology improve life (improve living conditions, 89% and help improve the economy, 86%).
- Fewer New Zealand students (66%) than on average across OECD countries (75%) agreed that *advances in science and technology usually bring social benefits.*
- Students were less likely to agree that science is important to them personally in their current and future life than they were to agree it is important for society in general.
- Students who placed a higher value on science (both for society and for themselves) were more likely to have a higher achievement than their peers who placed a lower value on science. This relationship was particularly strong in New Zealand compared with their international counterparts.

Science activities

- The average New Zealand student was less likely to engage in science-related activities than their peers internationally, but just as likely as their peers in Australia.

Scientific literacy and the environment

- The average New Zealand student was concerned about – and not very optimistic about – the possibility of improvement in environmental issues such as energy shortages, water shortages, air pollution, nuclear waste, and the extinction of plants and animals. However, they were less likely than their OECD counterparts to be concerned about these issues, either for themselves or their country. New Zealand's nuclear-free policy and clean and green image may help to explain the more optimistic views of New Zealand students.
- Environmental awareness and responsibility were positively associated with achievement, whereas concern for environmental issues was not.

School Context of Science Teaching and Learning

PISA is designed to measure the cumulative results of education and the experiences of 15-year-old students. This section looks at some of the information gleaned from principals, parents and students about the school context in which science learning takes place.

Science teaching and learning

Enrolment in science courses at school

- Most New Zealand 15-year-old students (90%) reported they were in some form of science education at school, either compulsory (73%) or optional (17%) science courses. Note that of the students participating in PISA 2006, 6 percent were Year 10, 89 percent were Year 11, and 4 percent were Year 12 students.

Time spent learning science

- New Zealand had the highest proportion of students reporting that they studied science for 4 hours a week or more (65% compared with 29% on average across OECD countries), but was similar to the United Kingdom (62%). Across all OECD countries, the mean performance of students who reported that they studied science for little or no time per week (2 hours or fewer) was much lower than the mean performance of the students who studied science for a larger block of time (4 hours a week or more). New Zealand was among the group of countries for whom the difference between these two groups was large (100 score points or more).

Methods of teaching science

- Student perceptions of the use of four different teaching methods were examined in PISA. A larger proportion of New Zealand 15-year-old students reported activities that related to the

use of *interactive teaching* methods (for example, debating or student explanations – 40% to 71% of students reported activities that were classfied under this type of method) and teacher use of *models and applications* (37% to 66%) in most or all science lessons, compared with *hands-on* activities (23% to 58%) or *student investigations* (12% to 26%). Similarly, on average across OECD countries, students were more likely to report the regular use of *interactive teaching* methods and *models and applications* compared with *hands-on* activities and *student investigations*.

- Although the reported use of *student investigations* was similar to the average across OECD countries, New Zealand students were more likely to report the use of *interactive teaching* methods, *models and applications* and *hands-on* activities than students on average across OECD countries.

Ability grouping within schools

- Most 15-year-old students (96%) in New Zealand reported they were in schools where ability grouping was a school policy for at least one subject, either between classes (i.e., streaming, broad-banding or setting) or within classes (72% where ability grouping both within and between classes is a policy, 15% only between classes, and 9% only within a class).
- On average, across OECD countries a much smaller proportion of students (64% compared with 96% in New Zealand) were in schools where ability grouping was a school policy for at least one subject. However, the United Kingdom (100%), Ireland (98%), Israel (97%), and Australia (94%) also had a larger-than-average use of ability grouping within schools.

Activities to promote science

- The most common type of activity designed to promote science learning and conducted externally to the classroom both in New Zealand schools and across OECD countries, was excursions and field trips (94% of New Zealand students, 89% on average across the OECD). Science competitions were also popular in New Zealand (91%), along with Australia (98%), Poland (100%) and Hong Kong-China* (91%), but less so across OECD countries generally (on average 54%).
- Having a greater variety of activities promoting science within a school did not seem to be associated with higher achievement for New Zealand students, but was associated with achievement among many of the OECD countries.

School preparation for science-related careers

- Most New Zealand students agreed that schools provide useful preparation for a science-related career (at least 74% agreed or strongly agreed with a series of four statements on this). The proportions were similar to Australia (at least 71%), the United Kingdom (at least 77%) and Ireland (at least 74%). Students with higher levels of agreement to these statements (implying higher positive feelings of preparation) generally had higher achievement than those with lower levels of agreement.

Resources invested in education

Teaching resources

- In order to gauge the extent to which schools are able to employ an adequate supply of science teachers, school principals were asked if their school had any vacant Year 11 science teacher positions in the last academic year, and if yes, whether the vacancies had been filled. The results showed that 3 percent of students on average across OECD countries, and 2 percent in New Zealand, were in schools where one or more science teaching positions remained vacant. Seventy-nine percent of New Zealand students (59% across OECD countries) were enrolled in schools which had filled all vacant science teaching positions either with newly appointed staff or by reassigning existing staff.

- New Zealand students were in schools where the impact of a lack of qualified teachers was perceived by the principals to be relatively high compared to the average across the OECD, but lower than in the OECD countries of Belgium, Mexico, Turkey and Luxembourg.

Educational resources

- On average, compared to other OECD countries and consistent with PIRLS[18] and TIMSS[19], New Zealand students were less likely to be in schools where principals were concerned that an inadequacy or shortage of resources hindered science instruction. However, students in Austria, Australia, Liechtenstein* and Switzerland were less likely than New Zealand students to be in schools where principals were concerned about the impact of inadequacies or shortages of resources.

School policies and practices

School admittance policies

- Principals were asked to report on the factors considered when students are admitted to their school. Consistent with the average across OECD countries (47%), about half (49%) of New Zealand principals indicated that residence in a particular area was the most common prerequisite for admittance to schools.
- Students' academic records were used in only a few New Zealand schools (9% of students) as a prerequisite or of high priority for admittance to school, in contrast with some OECD countries (27% on average across the OECD), but similar to Canada (10%), the United Kingdom (10%), Australia (9%) and the United States of America (8%).

School accountability and autonomy

School management

- With the exception of decisions on teacher salaries, which was similar to the average across OECD countries, in New Zealand school principals reported having a lot more autonomy with regard to decision-making on, for example, determining course content and appointing teachers, than many of their counterparts in the OECD. Sixty-nine percent of New Zealand students were in schools where the principal reported that the main responsibility for determining course content lay with the school, compared with 43 percent on average across OECD countries.

School choice and parental influence

- A relatively high proportion of New Zealand 15-year-old students were in schools where principals perceived that there were at least two schools in the area they competed with for students (82% of New Zealand students, compared with 60% on average across OECD countries).
- Principals in New Zealand schools felt they were under pressure from many parents to achieve higher academic standards (44% of students in such schools); this figure is high in comparison to many of the OECD countries (21% on average across the OECD), but similar to Ireland (43%), Sweden (43%), Japan (39%), the United Kingdom (38%), and Australia (37%).

Parents' perception of school quality

- The majority of the parents who returned questionnaires (just under 70%) agreed that their school had competent and dedicated teachers (93%), high academic standards (87%), good discipline (83%), good monitoring of (85%) and reporting back on (82%) achievement, and was doing a good job (91%). Students whose parents agreed with these statements generally had higher achievement than those who disagreed.

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[18] Caygill, R. & Chamberlain, M. (2004). *Progress in International Reading Literacy Study (PIRLS): New Zealand's Year 5 Student Achievement 2001*. Wellington: Ministry of Education.

[19] Chamberlain, M. with Caygill, R. (2002). *The School and Classroom Context for Year 9 Students' Mathematics and Science Achievement: Results from New Zealand's participation in the repeat of the Third International Mathematics and Science Study*. Wellington: Ministry of Education.

Reading Literacy: (minor focus)

What aspects of reading literacy does PISA measure and report on?

PISA measures[20] student performance on three reading processes: *retrieving information* (locating single or multiple pieces of information), *interpreting texts* (constructing meaning and drawing inferences) and *reflecting on and evaluating texts* (relating information to prior knowledge, ideas and experiences) and the results are reported on the *combined reading literacy* scale.

Five reading proficiency levels are reported on the *combined reading literacy* scale providing more in-depth information on students' levels of competencies. The types of tasks that students reaching a particular level in reading literacy can do are described in Figure 5: What the reading literacy proficiency measures.

Reading literacy trend information is available from this cycle of PISA. This information reports any change in student performance since PISA 2000.

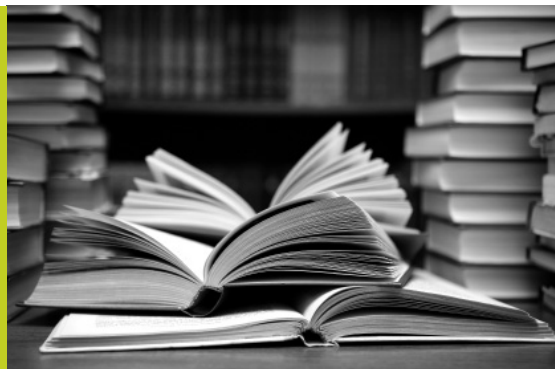
More in-depth information is available from the PISA 2000 assessment, when reading literacy was the main focus, and will be available again from PISA 2009, when reading will be the main focus.

[20] The PISA reading literacy framework has three dimensions: text format (continuous and non-continuous texts), reading processes (noted above) and situations or context (reading for private use, public use, work and education).

Figure 5: What the reading literacy proficiency measures

Level	Lower score limit	What students can typically do
5	625.6	Locate and possibly sequence or combine multiple pieces of deeply embedded information, some of which may be outside the main body of the text. Infer which information in the text is relevant to the task. Deal with highly plausible and/or extensive competing information. Either construe the meaning of nuanced language or demonstrate a full and detailed understanding of a text. Critically evaluate or hypothesise, drawing on specialised knowledge. Deal with concepts that are contrary to expectations and draw on a deep understanding of long or complex texts. In *continuous texts* students can analyse texts whose discourse structure is not obvious or clearly marked, in order to discern the relationship of specific parts of the text to its implicit theme or intention. In *non-continuous texts*, students can identify patterns among many pieces of information presented in a display which may be long and detailed, sometimes by referring to information external to the display. The reader may need to realise independently that a full understanding of the section of text requires reference to a separate part of the same document, such as a footnote.
4	552.9	Locate and possibly sequence or combine multiple pieces of embedded information, each of which may need to meet multiple criteria, in a text with familiar context or form. Infer which information in the text is relevant to the task. Use a high level of text-based inference to understand and apply categories in an unfamiliar context, and to construe the meaning of a section of text by taking into account the text as a whole. Deal with ambiguities, ideas that are contrary to expectation and ideas that are negatively worded. Use formal or public knowledge to hypothesise about or critically evaluate a text. Show accurate understanding of long or complex texts. In *continuous texts* students can follow linguistic or thematic links over several paragraphs, often in the absence of clear discourse markers, in order to locate, interpret or evaluate embedded information or to infer psychological or metaphysical meaning. In *non-continuous texts* students can scan a long, detailed text in order to find relevant information, often with little or no assistance from organisers such as labels or special formatting, to locate several pieces of information to be compared or combined.
3	480.2	Locate, and in some cases recognise, the relationship between pieces of information, each of which may need to meet multiple criteria. Deal with prominent competing information. Integrate several parts of a text in order to identify a main idea, understand a relationship or construe the meaning of a word or phrase. Compare, contrast or categorise taking many criteria into account. Deal with competing information. Make connections or comparisons, give explanations, or evaluate a feature of text. Demonstrate a detailed understanding of the text in relation to familiar, everyday knowledge, or draw on less common knowledge. In *continuous texts* students can use conventions of text organisation, where present, and follow implicit or explicit logical links such as cause and effect relationships across sentences or paragraphs in order to locate, interpret or evaluate information. In *non-continuous texts* students can consider one display in the light of a second, separate documents or displays, possibly in a different format, or combine several pieces of spatial, verbal and numeric information in a graph or map to draw conclusions about the information represented.
2	407.5	Locate one or more pieces of information, each of which may be required to meet multiple criteria. Deal with competing information. Identify the main idea in a text, understand relationships, form or apply simple categories, or construe meaning within a limited part of the text when the information is not prominent and low-level inferences are required. Make a comparison or connections between the text and outside knowledge, or explain a feature of the text by drawing on personal experience and attitudes. In *continuous texts* students can follow logical and linguistic connections within a paragraph in order to locate or interpret information; or synthesise information across texts or parts of a text in order to infer the author s purpose. In *non-continuous texts* students demonstrate a grasp of the underlying structure of a visual display such as a simple tree diagram or table, or combine two pieces of information from a graph or table.
1	334.8	Locate one or more independent pieces of explicitly stated information, typically meeting a single criterion, with little or no competing information in the text. Recognise the main theme or author s purpose in a text about a familiar topic, when the required information in the text is prominent. Make a simple connection between information in the text and common, everyday knowledge. In *continuous texts* students can use redundancy, paragraph headings or common print conventions to form an impression of the main idea of the text, or to locate information stated explicitly within a short section of text. In *non-continuous texts* students can focus on discrete pieces of information, usually within a single display such as a simple map, a line graph or a bar graph that presents only a small amount of information in a straightforward way, and in which most of the verbal text is limited to a small number of words or phrases.

Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World,* Vol 1. Paris: OECD.



Student Performance in Reading
Combined Reading Literacy Scale

Combined reading literacy scale

As for PISA 2003, reading is a minor area in PISA 2006. A shorter amount of time is given to the subjects of minor focus, which allows for reporting on a single combined scale only. The three reading processes are summarised on the *combined reading literacy* scale. This approach provides an ongoing high-level picture of student performance in reading literacy.

The overall performance of the 56[21] countries on the five reading proficiency levels and mean performance on the *combined reading literacy* scale are shown in Figure 6.

Mean scores by all students on the combined reading literacy scale

New Zealand 15-year-old students performed very strongly in reading literacy.

- Only three countries – Korea (556), Finland (547) and Hong-Kong China* (536) – achieved significantly better results than New Zealand.
- New Zealand's (521) mean performance is statistically similar to Canada (527) and Ireland (517).
- New Zealand 15-year-olds' mean performance was significantly better than 50 of the participating countries, including Australia (513)[22], the United Kingdom (495) and the 21 other OECD member countries.

Proficiency levels (5 levels) by all students on the combined reading literacy scale

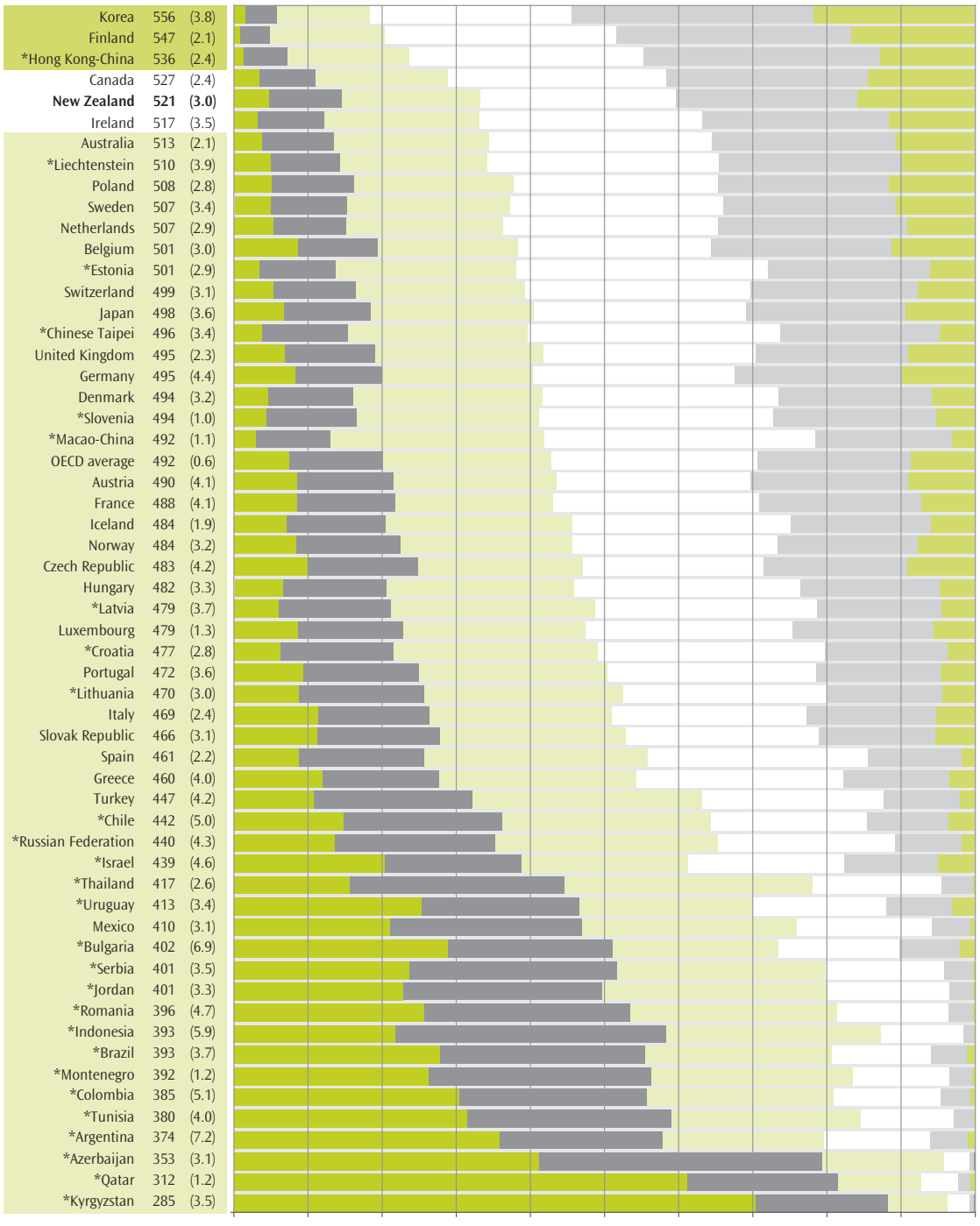
Two highest levels of proficiency (Level 4 and Level 5)

- Korea (22%) had the largest proportion of students achieving at the highest level of reading proficiency (Level 5). Finland (17%), New Zealand (16%) and Canada (14%) also achieved a high proportion of students proficient at this level. A significantly smaller proportion of students from Hong Kong-China* (13%), Ireland (12%), and Australia (11%) showed reading proficiency at Level 5.
- More than half of the students from Korea (54%) showed proficiency at Level 4 or higher, while at least 40 percent of students from Finland (48%), Hong Kong-China* (45%), Canada (42%) and New Zealand (40%) demonstrated proficiency at these levels. A smaller proportion of Australian students (36%) were proficient at Level 4 or higher.
- Across OECD countries, on average 9 percent achieved the highest level of reading proficiency, with another 21 percent showing proficiency at Level 4.

[21] As noted earlier, the United States of America reading literacy results are not reported because mean performance in reading could not be accurately estimated due to a printing error in the test booklets. Some of the reading items had incorrect instructions.

[22] Although New Zealand's 15-year-old students achieved a significantly better result than Australia in reading, New Zealand's results are compared to Australia in this report given the similarities in population, performance in reading literacy in earlier PISA administrations and education systems.

Figure 6: Combined reading literacy proficiency levels



Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

Two lowest levels of proficiency (below Level 1 and Level 1)

- The three top-performing countries in reading literacy – Korea, Finland and Hong Kong-China* – had 1 percent or less of their students unable to reach Level 1, while New Zealand had 5 percent of students at this level, Australia 4 percent, and Canada and Ireland had even smaller proportions (3%).
- Fifteen percent of New Zealand students did not reach beyond Level 1, proportions that were statistically similar to Australia (13%) and Ireland (12%). Smaller proportion of students were at the two lowest levels in Finland (5%), Korea (6%), Hong Kong-China* (7%) and Canada (11%).
- Across the OECD countries, 20 percent of students did not achieve beyond Level 1 and 7 percent of these students were unable to reach Level 1.

Korea's reading achievement clearly stands out from the other 55 countries reported for reading in PISA, with the highest mean reading performance and the largest proportion of students with exceptional reading skills. The proportion of New Zealand students reaching the highest level of reading remains very strong, and shows no change from the strong performance observed in PISA 2003 (16%).

The proportion of New Zealand's weaker readers is similar to that found in PISA 2003, but is significantly larger than in the three highest-performing countries.

Mean scores by gender on the combined reading literacy scale

Girls showed a significantly stronger reading performance than boys in all of the 56 countries reported for reading.

- New Zealand girls achieved a mean of 539 score points, 37 points greater than the average score for boys (502).
- Girls in New Zealand showed a similar performance in reading to the girls in the two countries that performed at about the same level as New Zealand, Canada (543) and Ireland (534). Australian girls also showed a similar performance to New Zealand's 15-year-old girls (532). In Korea (574), Finland (572) and Hong Kong-China* (511) girls' mean performance was significantly stronger.
- Although boys in New Zealand and Ireland (500) showed significantly lower scores than boys in Korea (539), Finland (521), Hong Kong-China* (520) and Canada (511), their performance was significantly better than the OECD mean of 473. Australian boys showed a similar mean score (495) to their New Zealand peers.
- The score point difference in favour of New Zealand's 15-year-old girls when compared with boys was the same as in Australia and broadly similar to that of other high-performing countries[23] (ranging between 31 and 37 score points), with the exception of Finland, where it was larger (51 score points).

New Zealand's boys showed a weaker performance when compared to girls. This gender difference in favour of girls is observed in all PISA countries. Overall, boys participating in PISA showed a weak performance, with an OECD average of 473 compared to the girls' OECD average of 511.

[23] 'High-performing countries' refers to the three countries that achieved significantly higher than New Zealand and the two countries that were not statistically different from New Zealand on the *combined reading literacy* scale.

Proficiency levels by gender on the combined reading literacy scale

Girls: two highest levels of reading proficiency (Level 4 and Level 5)

- Forty-six percent of New Zealand girls showed proficiency in reading literacy at Level 4 or higher, and 19 percent of these girls demonstrated competency at the highest level. The proportion of girls at these two upper levels in Canada (48%) and Ireland (43%) was similar to New Zealand, while Australia (42%) had a slightly smaller proportion.
- Sixty-two percent of Korean and 61 percent of Finnish 15-year-old girls reached Level 4 or higher reading proficiency, with around a quarter of these students showing proficiency at the highest level. Hong Kong-China* (52%) also achieved a significantly larger proportion of students than New Zealand achieving Level 4 or higher.

Boys: two highest levels of reading proficiency (Level 4 and Level 5)

- About one-third (34%) of New Zealand boys achieved Level 4 or higher, a similar proportion to Hong-Kong China* (37%), Canada (36%), Finland (36%) and Ireland (30%), while Australia (29%) showed a smaller proportion of boys at these levels than New Zealand. A significantly larger proportion of Korean boys (47%) showed proficiency at Level 4 or higher.
- Korea (16%) had the largest proportion of boys at Level 5. New Zealand boys (12%) achieved a similar proportion at this level to some of the other high-performing countries, including Canada (11%), Finland (10%), and Hong-Kong China* (9%). Australia (9%) also showed a similar proportion.

Girls: two lowest levels of reading proficiency (below Level 1 and Level 1)

- Less than 1 percent of girls from the three highest-performing countries were unable to show proficiency at Level 1, and between 2 and 3 percent of girls from the other high-performing countries, including New Zealand (3%) and Australia (2%), did not reach Level 1.
- Ten percent of New Zealand's girls did not demonstrate that they were proficient in reading tasks above Level 1. A similar proportion was observed in Australia (8%), and Ireland (8%). Canada (7%) had a slightly smaller proportion of students unable to achieve above Level 1, while the proportion in Hong Kong-China* (4%), Korea (3%) and Finland (2%) was considerably smaller.

Boys: two lowest levels of reading proficiency (below Level 1 and Level 1)

- Seven percent of New Zealand boys did not reach Level 1, a similar proportion to Australia (6%). Significantly smaller proportions of boys were observed at below Level 1 in the three highest-performing countries: Finland less than one percent, Hong Kong-China* and Korea, both with 2 percent.
- The proportion of New Zealand boys (20%) not reaching above Level 1 was about the same as Ireland (17%), one of the two countries with a similar mean reading performance as New Zealand. This was also the case for Australia (18%). The other country with a similar mean performance, Canada (15%), had a relatively smaller proportion of boys with very low proficiency. Korea (8%), Finland (8%) and Hong-Kong China* (10%) had a significantly smaller proportion, with 10 percent or less of 15-year-old boys having low reading proficiency.

When comparing the proportion of girls and boys from the highest-performing countries not achieving Level 1 boys are over-represented in New Zealand as they are in the other high-performing countries. This is also the case for the proportion at Level 1 or below.

Mean scores by ethnicity on the combined reading literacy scale

- Pākehā-European students achieved a mean score of 542 score points in reading literacy, which is significantly higher than the average of students who identified that they belonged to one of the other three ethnic groupings.
- Asian students' mean score (528) was also significantly larger than the OECD reading mean of 492 score points and that achieved by Māori and Pasifika students, but significantly lower than for Pākehā-European students.
- The mean performance of Māori students (477) was weak when compared to the OECD mean and the Pākehā-European and Asian ethnic groupings.
- A weak mean performance was also observed for Pasifika students (461), a score that was significantly below the OECD mean and the mean performance of Pākehā-European and Asian students.

Proficiency levels by ethnicity on the combined reading literacy scale

Two highest levels of proficiency (Level 4 and Level 5)

- Nearly one in five (19%) Pākehā-European and Asian students reached the highest proficiency level. A significantly smaller proportion of Māori (8%) and Pasifika (6%) students achieved this level.
- Close to half of Pākehā-European (47%) and Asian (45%) 15-year-olds reached Level 4 or higher. Smaller proportions of Māori (24%) and Pasifika (19%) students were also proficient at these levels.

Two lowest levels of reading proficiency (below Level 1 and Level 1)

- Thirty percent of Pasifika and one-quarter of Māori students did not show proficiency in reading above Level 1. A significantly smaller proportion of students identifying as Asian (16%) and Pākehā-European (9%) were at this low level of proficiency.

As for scientific literacy, the mean score for Māori and Pasifika students in reading literacy was lower than for Pākehā-European and Asian students. A lower proportion of Māori and Pasifika students achieved at the highest levels of proficiency, and they were over-represented at the lower levels when compared with students from the other two ethnic groupings.

Changes in reading literacy performance since 2000

Reading was the main focus of PISA 2000 and a minor domain in PISA 2003, so it is possible to look at 15-year-olds' performance in reading literacy over the six year period.

All students

- New Zealand's 15-year-olds' performance in reading literacy showed no significant change between 2000 and 2006.
- Australia was the only country achieving above the OECD mean that showed a decline (-14) in performance over the six years; this was attributed "… to a decline at the higher end of the performance spectrum"[24].
- In contrast, Korea achieved a significantly stronger performance by 31 score points. Korea attributes its improvement in reading performance to a new curriculum that puts greater emphasis on essay tests. Korean universities have also introduced and expanded reflection of essay test scores in admission screenings, which has provided additional incentives for better-performing high school students to enhance their reading and reasoning skills in order to gain entry to the university of their choosing[25].
- Hong Kong-China* (11 score points difference) also showed an improvement in reading in 2006 when compared with their performance in 2000.

Gender

- No change in New Zealand's 15-year-old boys' performance in reading literacy was observed between 2000 and 2006.
- However, New Zealand girls' performance showed a decrease of 14 score points over this period. A decrease of the same magnitude was also observed for girls in Australia, but this was also the case for Australian boys (-18).
- Both girls (31 points) and boys (20) showed a significant increase in performance in Korea. In Hong Kong-China* girls also achieved a significant improvement in performance (18 points) over the six-year period.

[24] OECD (2007). PISA 2006 *Science Competencies for Tomorrow's World*. Vol 1, p.302, Paris: OECD.

[25] OECD (2007). PISA 2006 *Science Competencies for Tomorrow's World*. Vol 1, p.302, Paris: OECD.

- Of the high-performing countries in reading literacy, Hong-Kong China* (16) and Korea (21) showed a significant difference in performance in favour of girls when compared with boys between 2000 and 2006.
- Although girls' performance in reading literacy decreased over the six year period, there was no significant change in the gender difference between the performance of girls and boys, with New Zealand girls continuing to perform significantly better than boys.

Mathematical Literacy: (minor focus)

What aspects of mathematical literacy does PISA measure and report on?

PISA measures[26] student performance on four content areas: *quantity* (related to number), *change and relationships* (related to algebra), *space and shape* (related to geometry) and *uncertainty* (related to statistics) and the results are reported on the *combined mathematical literacy* scale.

The PISA 2006 and PISA 2003 mathematical literacy results are not comparable with the PISA 2000 mathematical results. In the last two administrations of PISA (2003 and 2006) four mathematical content areas were assessed, but in PISA 2000 only two were assessed (*change and relationships* and *certainty*).

Student proficiency in mathematical performance is reported on six proficiency levels, providing more in-depth information on students' levels of competency. A description of the types of tasks that students reaching a particular level in mathematical literacy can typically do is shown in Figure 7: What the mathematical literacy proficiency measures.

[26] The PISA mathematical literacy framework has three dimensions: content (noted above), mathematical processes (reproduction, connection and reflection) and situations or context (mathematics for personal, educational, occupational, scientific and public use).

Figure 7: What the mathematical literacy proficiency measures

Level	Lower score limit	What students can typically do
6	669.3	At Level 6 students can conceptualise, generalise, and utilise information based on their investigations and modelling of complex problem situations. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understandings along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situations.
5	607.0	At Level 5 students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning.
4	544.7	At Level 4 students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic ones, linking them directly to aspects of real-world situations. Students at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions.
3	482.4	At Level 3 students can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications reporting their interpretations, results and reasoning.
2	420.1	At Level 2 students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and making literal interpretations of the results.
1	357.8	At Level 1 students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.

Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

Student Performance in Mathematics
Combined Mathematical Literacy Scale

Combined mathematical literacy scale

As mathematical literacy is a minor domain of PISA 2006 student performance on the four mathematical content areas are summarised on the *combined mathematical literacy* scale. This approach provides an ongoing high-level picture of student performance in mathematical literacy.

The 57 countries overall mean performance on the *combined mathematical literacy* scale and performance on the six mathematical proficiency levels is shown in Figure 8.

Mean scores by all students on the combined mathematical literacy scale

New Zealand students performed strongly in mathematical literacy.

- Five countries achieved significantly higher mean scores when compared with New Zealand: Chinese Taipei*[27] (549), Finland (548), Hong Kong-China* (547), Korea (547) and the Netherlands (531).
- New Zealand's mean score (522) was statistically the same as seven other countries: Switzerland (530), Canada (527), Liechtenstein* (525), Macao-China* (525), Japan (523), Australia (520) and Belgium (520).
- Forty-four countries, including 21 of the other 29 OECD countries, including the United Kingdom (495) and the United States of America (474) had significantly lower mean mathematical literacy scores than New Zealand 15-year-old students.

Proficiency levels by all students on the combined mathematical literacy scale

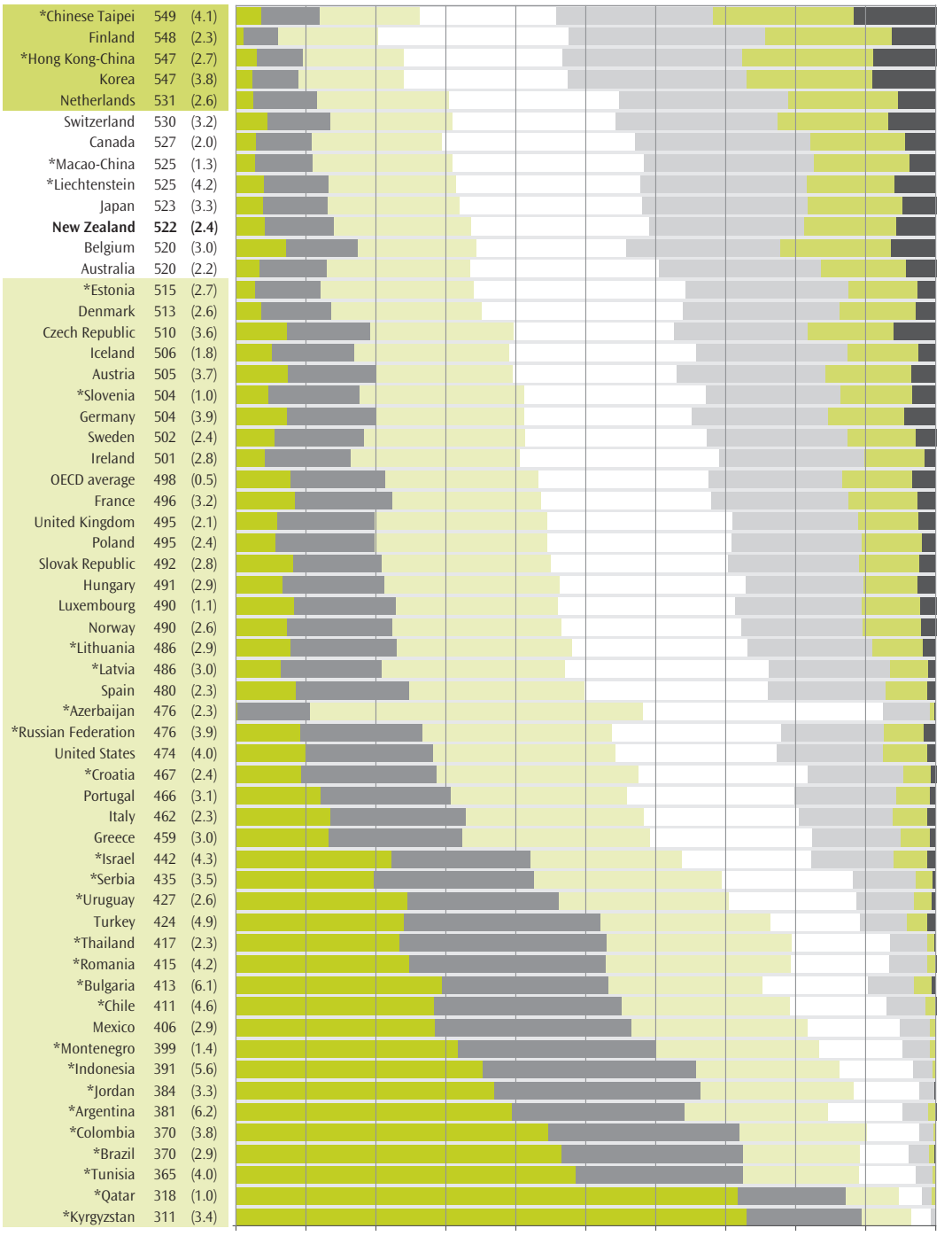
Three highest levels of proficiency (Levels 4, 5 and 6)

- Three of the highest-performing countries – Chinese Taipei* (12%), Hong Kong-China* (9%) and Korea (9%) – showed the largest proportion of students achieving Level 6, the highest level of proficiency. Six percent of New Zealand students achieved Level 6 mathematical literacy proficiency, a similar proportion to Finland, the Netherlands, Switzerland, Liechtenstein* and Japan. The four other high-performing countries[28] had a smaller proportion (4%) of students achieving Level 6.
- Nineteen percent of New Zealand students were in the highest mathematical literacy levels, having attained at or above Level 5. This is a higher proportion than on average across OECD countries (13%) and in Australia (16%), but lower than in Chinese Taipei* (32%), Hong Kong-China* (28%), Korea (27%), Finland (24%), Switzerland (23%) and Belgium (22%).
- At Level 4 or higher, 41 percent of New Zealand students are proficient in mathematical literacy, a similar proportion to Australia (40%), the Netherlands (41%), Japan (42%), Liechtenstein*

[27] Chinese Taipei is a new country to PISA.

[28] 'High-performing countries' refers to the five countries that achieved significantly higher than New Zealand and the seven countries that were not statistically different from New Zealand on the *combined mathematical literacy scale*.

Figure 8: Combined mathematical literacy proficiency levels



*non-OECD country

Source: OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*, Vol 1. Paris: OECD.

(42%), Macao China* (42%) and Canada (43%). In four of the five top-performing countries - Chinese Taipei* (54%), Finland (53%), Korea (53%) and Hong Kong-China* (53%) - more than half of the students were proficient in mathematical literacy at Level 4 or higher.

Two lowest levels of proficiency (below Level 1 and Level 1)

- Fourteen percent of New Zealand students are in the lowest mathematical literacy levels, having attained at or below Level 1 (10% at Level 1 and 4% below Level 1). This proportion is similar to Australia (13%) and five other high performing countries, but significantly less than on average across OECD countries (21%) and Belgium (17%).
- Finland (6%), Korea (9%), Hong Kong-China* (10%), Canada (11%) and Macao China* (11%) had a smaller proportion of students who did not demonstrate proficiency in mathematical tasks above Level 1 than New Zealand.

Although New Zealand students continued to show a strong performance in mathematical literacy, New Zealand showed a smaller proportion of 15-year-olds students at Level 6 than three of the five countries that achieved a significantly better performance than New Zealand. Nevertheless, the proportion of New Zealand students' performing at the highest level was significantly larger than three of the countries that achieved a similar result.

Mean scores by gender on the combined mathematical literacy scale

- On average, boys (527) had significantly higher mathematical literacy than girls (517), both in New Zealand and across OECD countries (11 scale score point difference in each case).
- In nine of the other high-performing countries, boys outperformed girls in mathematical literacy as measured by PISA. Only Liechtenstein*, Belgium and Korea showed no significant gender difference in performance in mathematical literacy.
- Across all of the countries participating in PISA 2006, Qatar* was the only country that showed a significant difference in favour of girls.

Proficiency levels by gender on the combined mathematical literacy scale

Three highest levels of proficiency (Levels 4, 5 and 6)

- Only three of the other twelve high-performing countries – Chinese Taipei* (13%), Hong Kong-China* (11%) and Korea (11%) – achieved a larger proportion of boys reaching Level 6 than New Zealand (7%). The proportion of boys achieving the highest level was significantly lower in Macao-China* when compared with New Zealand boys.
- A larger proportion of New Zealand boys (44%) were proficient in mathematical literacy at Level 4 or higher compared with girls (38%). A significantly larger proportion of boys (7%) reached the highest level, Level 6, compared with the girls (4%).
- The difference between boys and girls observed for the three highest proficiency levels was consistent with other high-performing countries; for example, Australia (43% of boys and 36% of girls), Macao-China* (45% of boys and 39% of girls) and Finland (56% of boys and 49% of girls).

Two lowest levels of proficiency (below Level 1 and Level 1)

- The same proportion of New Zealand's 15-year-old boys and girls (14%) were proficient at the lowest levels of mathematical literacy, with 4 percent of these students from both gender groupings not achieving Level 1.

New Zealand boys showed a stronger performance in mathematical literacy when compared to girls. This difference in favour of boys was observed across the majority of OECD countries.

Mean scores by ethnicity on the mathematical literacy scale

- Asian students (548) showed a strong performance in mathematical literacy, achieving a result that was 50 score points above the OECD mathematical literacy mean of 498.
- Pākehā-European students (539) also performed strongly in mathematical literacy, achieving a score that was not statistically different from Asian students and performing significantly above the OECD average.
- The mean mathematical literacy score for Māori students (479) was significantly below the mean performance of Pākehā-European and Asian students, and the OECD mean.
- Pasifika students (463) showed a significantly weaker performance than students from the three other ethnic groupings and the OECD mean.

Proficiency levels by ethnicity on the combined mathematical literacy scale

Three highest levels of proficiency (Levels 4, 5 and 6)

- A larger proportion of Asian students (11%) were proficient at the highest level of mathematical literacy, Level 6. A smaller proportion of Pākehā-European students (7%) were proficient at this level. Very few Māori (1%) and Pasifika (1%) students were successful at this level.
- A similar pattern was observed at Level 5 with 19 percent of Asian, 16 percent of Pākehā-European, six percent of Māori and five percent of Pasifika attaining this level of performance.
- About half of Asian (52%) and Pākehā-European (48%) 15-year-old students reached Level 4 or higher. Twenty-three percent of Māori students and 17 percent of Pasifika students reached Level 4 or higher.

Two lowest levels of proficiency (below Level 1 and Level 1)

- Nine percent of Pākehā-European and 11 percent of Asian students achieved at only Level 1 or below Level 1. Twenty-six percent of Māori students and 30 percent of Pasifika students achieved at only Level 1 or below Level 1.

As for scientific and reading literacy, the mean score for Māori and Pasifika students on mathematical literacy was lower than for Pākehā-European and Asian students. A lower proportion of Māori and Pasifika students achieved at the highest levels of proficiency and they were over-represented at the lower levels when compared with students from the other two ethnic groupings.

Changes in mathematical literacy since 2003

Mathematics was the main focus of PISA 2003 assessing four mathematical content areas, so it is possible to look at changes in 15-year-olds' performance in mathematical literacy since 2003.

All students

- New Zealand's 15-year-olds' performance in mathematical literacy showed no significant change between 2003 and 2006.
- Across OECD countries performance in mathematical literacy has remained about the same. A number of countries that achieved above the OECD mean showed a small but significant decrease in performance between 2003 and 2006; these countries were Belgium (-9), Canada (-5), Iceland (-10), Japan (-11), the Netherlands (-7), Sweden (-7) and Liechtenstein* (-11).

Gender

- No change in New Zealand's 15-year-old boys' or girls' performance in mathematical literacy was observed between 2003 and 2006.
- A significant change in the difference between boys and girls was observed in six countries between 2003 and 2006. Four countries – Australia (9), Austria (15), Germany (11) and Iceland (11) – had an increase in the gap between the boys and girls, while Greece (-15) and Liechtenstein* (-29) had a decrease in the observable gender difference.
- No change in the gender difference between the performance of girls and boys in mathematical literacy was observed in New Zealand, with boys continuing to perform better than girls in 2006 as they did in 2003.

Further information

The OECD's PISA 2006 International Report can be accessed from New Zealand's PISA 2006 webpage at www.educationcounts.govt.nz/goto/pisa. An interactive data selection facility which allows selected analyses of international contextual information to student performance is also available from this site, along with the international versions of the student, school and parent questionnaires. More detailed information is also available from the link on this page to the OECD PISA website www.pisa.oecd.org. Further reporting of New Zealand PISA 2006 results will be available later in 2008.

PISA will be administered in New Zealand again in 2009 during July and August. The PISA 2009 results will be published by the OECD in December 2010.

Glossary

PISA 2006 literacy definitions

PISA 2006 (OECD, 2006)[29] defines each of the literacies, mathematical literacy, reading literacy and scientific literacy, as follows.

Mathematical literacy

An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements, and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

Reading literacy

An individual's capacity to understand, use and reflect on written texts, in order to achieve one's goals, and to develop one's knowledge and potential to participate in society.

Scientific literacy

An individual's scientific knowledge and use of that knowledge to identify questions to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science-related issues, understanding of the characteristic features of science as a form of human knowledge and enquiry, awareness of how science and technology shape our material, intellectual, and cultural environments, and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen.

Technical terms

Mean

Student performances in PISA are reported using means, which is a type of average, for groupings of students. In general, the mean of a set of scores is the sum of the scores divided by the number of scores, and is often referred to as 'the average'. Note that for PISA, as with other large-scale studies, the means for a country are adjusted slightly to reflect the population of 15-year-olds rather than the sample.

Percentile

The percentages of students performing below or above particular points on the scale are given in this report. The lowest outer limit of achievement is the 5th percentile – the score at which only 5 percent of students achieved a lower score and 95 percent of students achieved a higher score. The highest outer limit is the 95th percentile – the score at which only 5 percent of students achieved a higher score and 95 percent of students a lower score; thus 90 percent of the 15-year-old student scores lie between the 5th and 95th percentiles.

Proficiency scale

PISA developed proficiency levels to describe the range in literacy across 15-year-old students. The proficiency levels describe the competencies of students achieving at that level and are anchored at certain score points on the achievement scale. Figures 3, 5, and 7 provide descriptions of the levels, along with the associated score points at the boundary of the levels. Note that students were considered to be proficient at a particular level if they had answered at least half of the items in that level correctly. Typically, students who were proficient at higher levels had also demonstrated their abilities and knowledge at lower levels.

Standard error

Because of the technical nature of PISA, the calculation of statistics such as means and proportions have some uncertainty due to (i) generalising from the sample to the total 15-year-old school population, and (ii) inferring each student's proficiency from their performance on a subset of items. The standard errors provide a measure of this uncertainty.

Statistically significant

In order to determine whether a difference between two means is actual, it is usual to undertake tests of significance. These tests take into account the means and the error associated with them. If a result is reported as not statistically significant, then although the means might be slightly different, we do not have sufficient evidence to infer that they are different.

[29] OECD (2006). *Assessing Scientific, Reading and Mathematical Literacy – A Framework for PISA 2006*. Paris: OECD.

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List of countries participating in PISA 2006

Argentina*
Australia
Austria
Azerbaijan*
Belgium
Brazil*
Bulgaria*
Canada
Chile*
Colombia*
Croatia*
Czech Republic
Denmark
Estonia*
Finland
France
Germany
Greece
Hong Kong-China*
Hungary
Iceland
Indonesia*
Ireland
Israel*
Italy
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Korea
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Serbia & Montenegro*
Slovak Republic
Slovenia*
Spain
Sweden
Switzerland
Chinese Taipei*
Thailand*
Tunisia*
Turkey
United Kingdom
United States
Uruguay*

* Non-OECD countries

Note: Serbia and Montenegro equal two countries.

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