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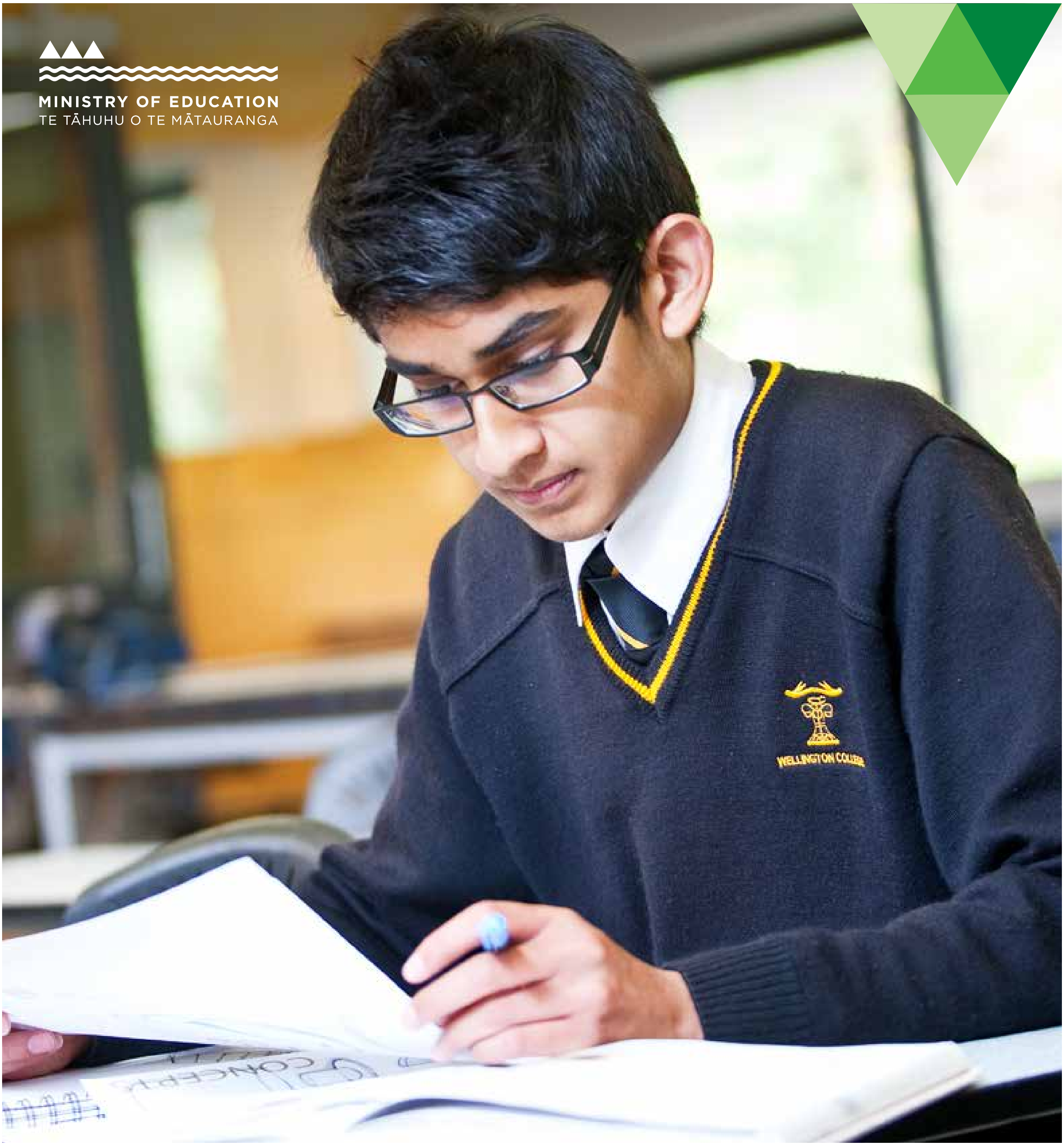

PISA2015

New Zealand Summary Report

by Steve May with Jonathan Flockton and Sarah Kirkham

New Zealand Government

OECD
BETTER POLICIES FOR BETTER LIVES

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An overview of PISA 2015

What is PISA?

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

PISA provides countries with information on student achievement and how this relates to student and family, school-level, teaching and learning, and system-related factors. This information can be used to better understand student achievement both within and across countries.

What does PISA 2015 assess?

The PISA assessment looks at three key areas of knowledge and skills: scientific literacy, reading literacy and mathematical literacy, with a focus on one of these areas.[2] The term 'literacy' is used to capture "...students' capacity to apply knowledge and skills in key subjects, and to analyse, reason and communicate effectively as they identify, interpret and solve problems in a variety of situations.[3]

As such, PISA is not restricted to assessing how well students have mastered the content of a specific school curriculum. Instead, PISA uses a broad approach to assess "the extent to which 15-year-old students, near the end of their compulsory education, have acquired key knowledge and skills that are essential for full participation in modern societies."[4]

In each cycle, one of the literacy areas becomes the main focus of the assessment. In PISA 2015, this focus was scientific literacy.

Rotating the main focus for each cycle of PISA provides in-depth and detailed information on one main subject along with an ongoing source of achievement data on the other two subjects. Each time a subject is the main focus the assessment framework is revised and descriptions of the types of tasks students can do (proficiency levels) are revisited and updated. New tasks developed for the main subject may also reflect revisions in the framework.[5]

In each cycle, student proficiency in an additional innovative domain (area of knowledge and skills) is tested as well. Results for the PISA 2015 innovative domain of collaborative problem solving will be reported later in 2017.

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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 In other sections of this report scientific, reading and mathematical literacy are referred to as science, reading and mathematics.

3 PISA 2015 Assessment and Analytical Framework (OECD, 2016, p.11)

4 Ibid, p.10

5 See Definitions and technical notes for summary descriptions of proficiency levels.

What additional information is gathered?

Background information is also gathered in each PISA cycle from questionnaires completed by students and school principals. These questionnaires allow for the relationship between related information and achievement to be examined.

PISA 2015 questionnaires focused on background information related to scientific literacy along with some questions related to collaborative problem solving.

How often is PISA administered?

PISA has been administered every three years since it began in 2000, with one of either reading, mathematics or science being the main focus. The first time scientific literacy was the main focus was in 2006; PISA 2015 is the second time.

The in-depth information on scientific literacy from the 2006 and 2015 administrations of PISA provide an opportunity to look at changes in scientific literacy, and changes in the relationship between related factors and achievement.

Who participates in PISA?

Approximately half a million 15-year-old students from 72 participating countries and economies[6] participated in PISA 2015, including the 35 Organisation for Economic Co-operation and Development (OECD) member countries. In New Zealand, over 4,500 students from 183 schools took part. The vast majority of New Zealand students who took part in PISA 2015 started school in 2004. A small proportion will have started in 2005.

Schools and students are randomly selected to ensure the sample is representative of the New Zealand 15-year-old population. Schools are selected by the international consortium that carries out PISA based on the following characteristics: size, decile, location (urban or rural), authority (state or independent) and type (co-educational or single-sex). Students are selected randomly from all students in these schools within a specific age group (between 15 years 3 months and 16 years 2 months).

How was PISA administered?

In each country students completed a two-hour assessment in their language of instruction.[7] PISA 2015 marks the transition from a paper-based to a computer-based assessment.[8] This change has enabled PISA to expand what it can assess and allows for a greater variety of more meaningful contexts to be included in the assessment.

A mode effect study was completed during the PISA 2015 field trial to investigate the continued ability of PISA to provide trend information. This involved testing the comparability of all questions used to link to earlier assessment cycles. Each question was tested as a paper-based question and as a computer-based question. The mode effect study concluded that there were sufficient comparable questions that provided linkage for trend measures in PISA.[9]

6 PISA participants include both countries and economies. Examples of economies or regions are Hong Kong (China) and Macao (China). For brevity the word countries in this report will refer to both countries and economies. Although 72 countries/economies participated, results for only the 70 countries/economies that met sampling requirements are reported.

7 In New Zealand PISA was administered only in English.

8 PISA 2015 was fully computer-based in 57 countries including all OECD countries. PISA 2015 was administered as a paper-based assessment in 15 countries/economies using only questions from previous cycles of PISA.

9 Further information on the mode effect study and methodology used for establishing trend will be available in the PISA 2015 Technical report (OECD, forthcoming).

Why participate in PISA?

PISA assesses students who have completed around 10 years of compulsory schooling. PISA results are an important source of information in New Zealand, measuring progress toward:

- » building a world-leading education system that equips all New Zealanders with the knowledge, skills and values to be successful citizens in the 21st century;
- » reducing underachievement in education; and
- » driving the improvement of educational performance across our education system to improve education outcomes for all young New Zealanders.
- » PISA not only provides measurement of New Zealand's progress toward these goals over time, but also our performance in equipping students with skills and reducing disparities in achievement relative to other countries.

PISA results help to inform future policy developments and contribute to the sector's understanding of the teaching of reading, mathematics and science.

Who organises PISA?

PISA is an initiative of the OECD and a collaborative effort of participating countries. A group of international research organisations was responsible for developing and overseeing PISA 2015 internationally.

This consortium was led by the Education Testing Service (ETS, USA), and included: cApStAn Linguistic Quality Control (Belgium); Deutsches Institut für Internationale Pädagogische Forschung (DIPF, Germany); Pearson (United Kingdom); Australian Council for Educational Research (ACER); Statistics Canada; The Tao Initiative: CRP - Henri Tudor and Université de Luxembourg EMACS (Luxembourg); and Westat (USA).

In New Zealand, the Comparative Education Research Unit within the Ministry of Education's Evidence, Data and Knowledge Group is responsible for implementing PISA and analysing the New Zealand PISA data, as well as reporting on results.

How does the OECD ensure the quality of data?

A number of quality assurance procedures are put in place, both nationally and internationally, to ensure that high-quality data are obtained. These include:

- » rigorous training of staff;
- » detailed documentation;
- » monitoring of sampling procedures;
- » quality checks and tracking progress at a number of stages, such as test administration; and
- » strict procedures for coding, data entry, data cleaning, and checking.

Further details will be outlined in the PISA 2015 technical report (OECD, forthcoming).

Key results

New Zealand's average scores in science, reading and mathematics after declining between 2009 and 2012 have remained similar to the 2012 results. New Zealand's average achievement in mathematics, science and reading remains above the OECD average.

New Zealand's relative standing compared to other countries in science and reading has improved since 2012.

Compared to 2012, there has been no increase in the proportion of low achievers in reading, mathematics or science. There are larger proportions of students with low performance in science, reading and mathematics than there were before 2012.

The proportion of top performers in reading and science is similar to 2012. There has been a small drop in the proportion of top performers in mathematics. The proportion of top performers in each subject is lower than it was before 2012.

Our very best students continue to do well. The proportion of New Zealand students that are top performers in at least one of science, reading and mathematics is above the OECD average and we still have one of the largest proportions of students that are top performers in all three subjects.

On average in New Zealand boys did slightly better than girls in mathematics and girls did much better than boys in reading. There was no significant difference between boys and girls in science achievement.

On average Pākehā/European and Asian students scored above the OECD average in science, reading and mathematics, though Asian students' average performance has decreased from 2012 in reading and mathematics. Māori and Pasifika students scored below the OECD average in all three subjects.

A relatively high proportion of Māori and Pasifika students score in the lower proficiency levels in all three subjects compared to New Zealand students overall. However, Māori and Pasifika students are represented at all proficiency levels.

The distribution of student performance in New Zealand shows that we have relatively low equality (equity) in learning outcomes. There is a wider gap between the top ten percent and bottom ten percent of our students than in most other OECD countries.

Compared to the OECD average there is a larger difference in achievement between students from advantaged and disadvantaged backgrounds in New Zealand. However, compared to earlier cycles of PISA a student's socio-economic background is not such a strong predictor of how well they will achieve.

Introduction

This report covers the achievement of 15-year-old New Zealanders in science, reading and mathematics. Each cycle of PISA has a focus on one of these key subject areas assessed. In PISA 2015 the focus was on Science.

The wider context for Science

The importance of developing and nurturing scientists is recognised by both the OECD and in New Zealand as critical in addressing future needs of society. Documents such as Sir Peter Gluckman's report *Looking ahead: Science education for the twenty-first century* (2011), and projects such as Science and Society, spear-headed by the strategic plan *A nation of curious minds – He Whenua Hihiri i te Mahara*, describe and aim to enhance the role of education in encouraging and enabling "*better engagement with science and technology across all sectors of New Zealand society*".[10]

A nation of curious minds – He Whenua Hihiri i te Mahara identifies three specific goals for the project over a ten year period.

These goals are:

- More learners who are competent in science and technology and more who go on to a career in science, technology, engineering and mathematics (STEM) related jobs.
- A more scientifically and technologically engaged public and a more publicly engaged science sector.
- A more skilled workforce and science and technology that is more responsive to New Zealanders needs.

This report

This cycle of PISA with its focus on science is one indicator of how well we are achieving the goals listed above. This report not only provides a summary of 15-year-old students' achievement in science but also looks at the key subject areas of reading and mathematics.

The report covers New Zealand performance relative to other countries in 2015, trends in New Zealand performance, the performance of sub-groups of the New Zealand population and equity.

The international findings for PISA 2015 were published by the OECD in two volumes in 2016 (OECD, 2016b & 2016c). This report is part of a series on New Zealand's participation in PISA 2015. A report on the science context for PISA from this study is also available.[11]

Data in this report are sourced from either the two OECD volumes above or analysis of the PISA 2015 database.

10 Ministry of Business, Innovation and Employment, 2014.

11 *PISA 2015: The Science Context of PISA*, Ministry of Education, 2016.

New Zealand achievement in an international context

Science

How well did New Zealand students perform in science?

The average science score of New Zealand students (513 points) was higher than the OECD average (493 points).

Figure 1.1 shows that 53 countries, of which 24 are OECD members, had significantly lower average science scores than New Zealand. New Zealand's average science score was significantly below Singapore and eight other countries, four of which are OECD members (Japan, Estonia, Finland and Canada). Seven countries, including six OECD countries (Korea, Slovenia, Australia, the United Kingdom, Germany and the Netherlands) had similar scores to New Zealand.

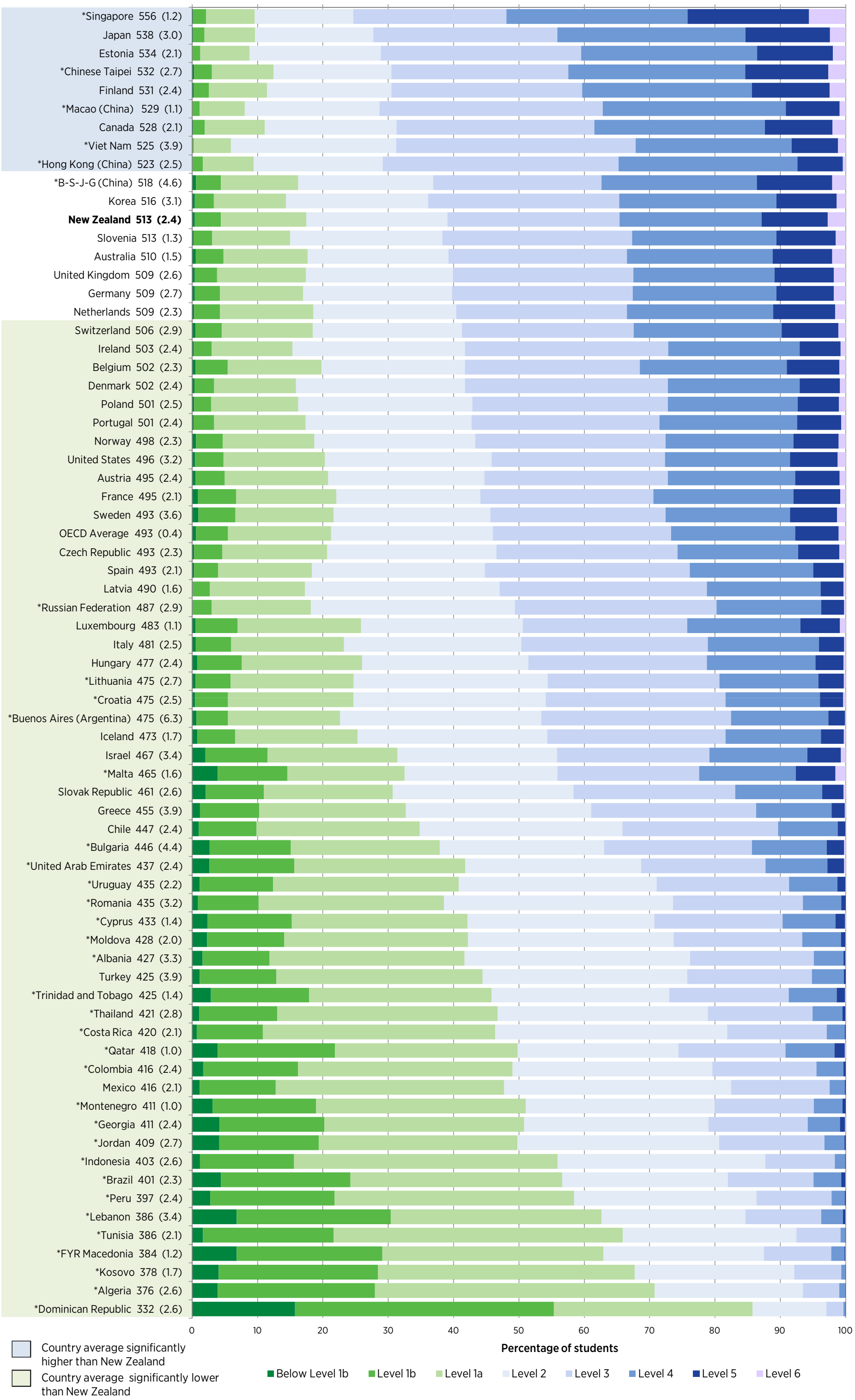
Proficiency levels describe the types of science tasks that students can do. Students performing at Level 6 are adept at using their scientific knowledge in a variety of complex situations. Students performing below Level 2 have limited scientific knowledge that can only be applied in a few familiar situations. A summary description of the science proficiency levels are in the Definitions and technical notes section at the end of this report.[12]

As can be seen in Figure 1.1 the proportion of New Zealand students performing below Level 2 (17%) was smaller than the OECD average (21%). New Zealand also had a slightly larger proportion of top performing students who were at Level 5 or above (1%) compared to the OECD average (8%). Only Singapore (6%) had more students performing at Level 6 than New Zealand (3%).

Compared to countries with a similar average score, New Zealand has a larger combined proportion of both students who can complete only relatively basic science tasks (below Level 2) and students who are capable of advanced science thinking (Level 5 and above).

12 A full description of proficiency levels is provided in PISA 2015 Assessment and Analytical Framework (OECD, 2016a).

Figure 1.1: Average Science scores and proficiency levels



Notes: Standard errors are presented in parentheses.

* before country name denotes a non-OECD country/economy

B-S-J-G (China) refers to the four participating China provinces: Beijing, Shanghai, Jiangsu, Guangdong.

FYR Macedonia refers to the Former Yugoslav Republic of Macedonia.

How has science performance changed over time?

The trend in science achievement is measured from PISA 2006, as this was the first time science was the main focus area of the PISA assessment. In the first two cycles of PISA (2000 and 2003) science was a minor focus and had only a limited number of test questions. These questions did not cover the full breadth of the science framework developed for PISA 2006.

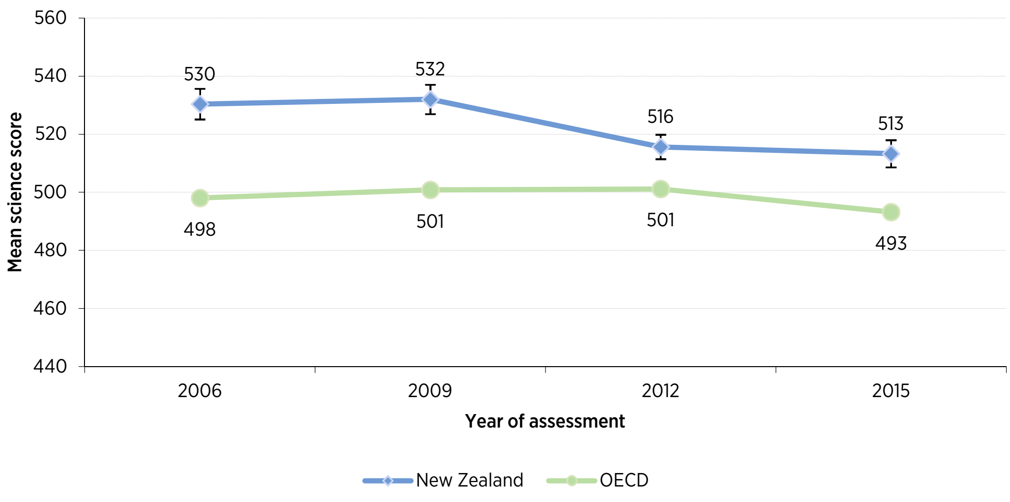
There has been very little change in New Zealand's average science score from 2012 (516 points) to 2015 (513 points). However the average science score of New Zealand students declined 17 points between 2006 and 2015 (from 530 points in 2006 to 513 points in 2015). The majority of New Zealand's decline occurred between 2009 and 2012 (16 points).

Figure 1.2 shows that the difference between New Zealand and the OECD average has increased from 2012 where New Zealand was 14 points above the OECD average. New Zealand is now 20 points above the OECD average in 2015.[13] This has happened because decreases in average achievement for several OECD countries has lowered the OECD average. This means that compared to PISA 2012, New Zealand's position relative to other participating countries has improved.

Because the country averages are derived from samples, it is not possible to determine a country's precise ranking among all participating countries and economies.[14] However, it is possible to determine with confidence a range of rankings in which the country's performance level lies. In 2012, New Zealand range of rankings was 10th to 14th among OECD countries. The 2015 level is now in the range 5th to 9th.[15]

Figure 1.3 shows there has been little change since PISA 2012 in the proportion of students who are low achievers (below Level 2) in science or the proportion of students who are top performers in science. However, Figure 1.3 shows an increase in the proportion of low achievers, from 14 percent in 2006 to 17 percent in 2015. Over the same period the proportion of top performers has declined from 18 percent in 2006 to 13 percent in 2015.

Figure 1.2: Trends in New Zealand average science scores



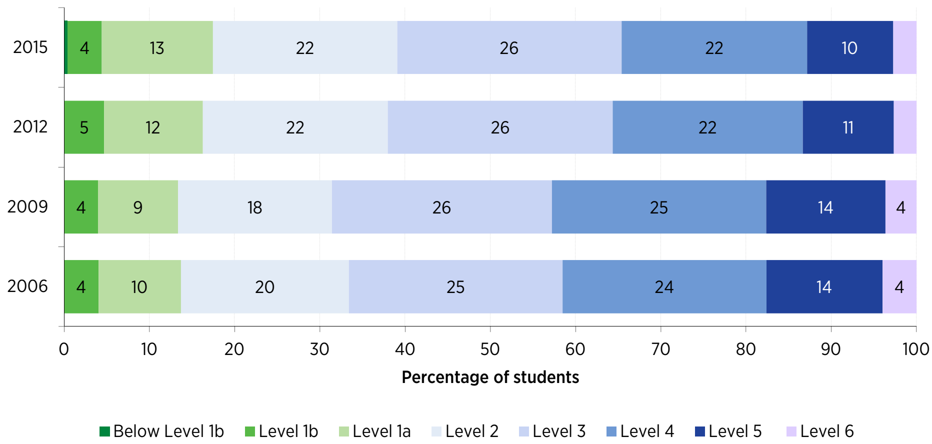
Note: error bars on the graph provide a 95 percent confidence interval for the estimate of the average.

13 Note that the figures in the graph are rounded and the actual difference in 2012 is closer to 14.

14 For example seven countries are within a five point difference of New Zealand.

15 The range of ranks among all participating countries has improved from 17th to 21st in 2012 to 10th to 15th in 2015.

Figure 1.3: Trends in New Zealand science proficiency levels



Notes: percentages *less* than four are not labelled on the graph.

Level 1b was added in 2015 to provide a finer distinction of the proficiency level of students that were previously classified as below Level 1 for earlier assessments.

What are the areas of strength of New Zealand students in science?

Determining the scientific literacy of students in PISA 2015 provides information on three of the aspects of the PISA scientific literacy framework to understand in greater detail what students know and what they are able to do with this knowledge in a variety of contexts. These aspects are:

- *Scientific competencies;*
- *Knowledge types; and*
- *Content areas.*[16]

Within each of these aspects, assessment scores (subscales) are calculated to provide measures of students' scientific knowledge and competencies, as well as their ability to engage with science related issues and with the ideas of science.

In all aspects, New Zealand's average score on each subscale is higher than the respective OECD average.

16 Other aspects used to ensure a balanced assessment in PISA included: response type (simple multiple choice, complex multiple choice and constructed response); cognitive demand (high, medium and low); and context (personal, local/national, and global). For further detail on the definition and make up of scientific literacy, see the PISA 2015 Assessment and Analytical Framework (OECD, 2016a).

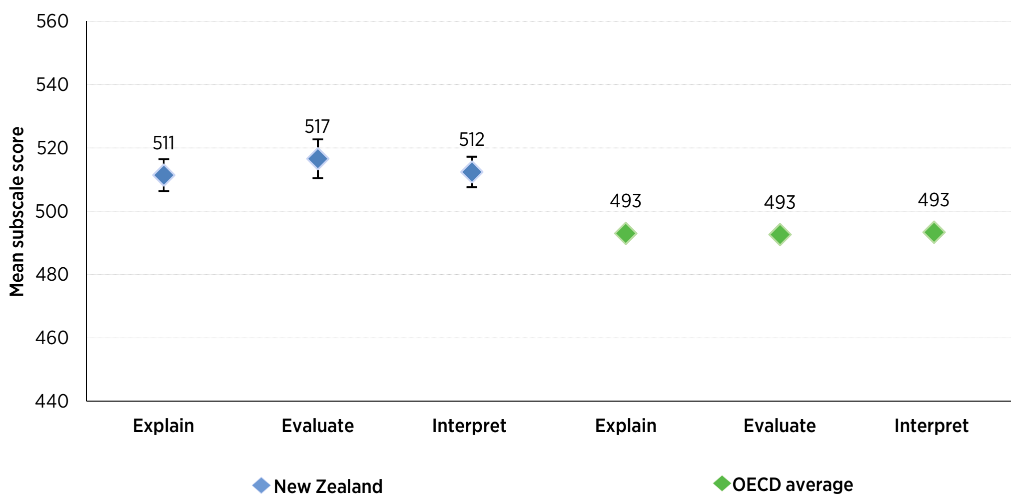
The three science competencies measured in PISA are:

- *Explain phenomena scientifically* – the ability to recognise, offer and evaluate explanations for a range of natural and technological phenomena;
- *Evaluate and design scientific enquiry* – the ability to describe and appraise scientific investigations and propose ways of addressing questions scientifically; and
- *Interpret data and evidence scientifically* – the ability to analyse and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions.

Nearly half of the PISA questions measured the competency *explain phenomena scientifically*, with about 20 percent of the questions measuring *evaluate and design scientific enquiry* and about 30 percent measuring *interpret data and evidence scientifically*. Figure 1.4 shows that, of the three scientific competencies, New Zealand students do best on Evaluate tasks.

New Zealand students perform on average higher on all scientific competencies than the respective OECD averages for each of these competencies. For New Zealand *evaluate and design scientific enquiry* (517 points) is an area of relative strength compared to *explain phenomena scientifically* (511 points) and *interpret data and evidence scientifically* (512 points). This pattern is similar to Singapore.

Figure 1.4: Science Competencies



The scientific knowledge types assessed in PISA are:

» *Content Knowledge:* the knowledge of theories, explanatory ideas, information and facts;

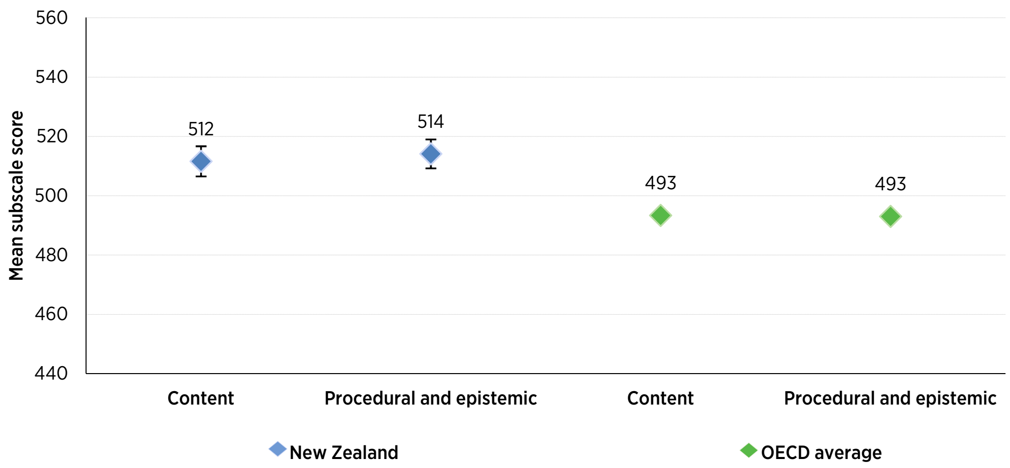
» *Procedural and epistemic knowledge:*[17]

» *Procedural Knowledge* is about the concepts and procedures that are essential for scientific enquiry, and that underpin the collection, analysis and interpretation of scientific data; and

» *Epistemic knowledge* is the understanding of the nature and origin of knowledge in science, and reflects the capacity of students to think and engage in reasoned discourse as scientists do.

Figure 1.5 shows that New Zealand performed similarly on the content (512 points) and procedural and epistemic (514 points) knowledge scales.

Figure 1.5: Knowledge types



17 For reporting purposes procedural and epistemic knowledge were combined as there were too few questions in the epistemic knowledge category.

Content knowledge is also classified into three broad subject areas:

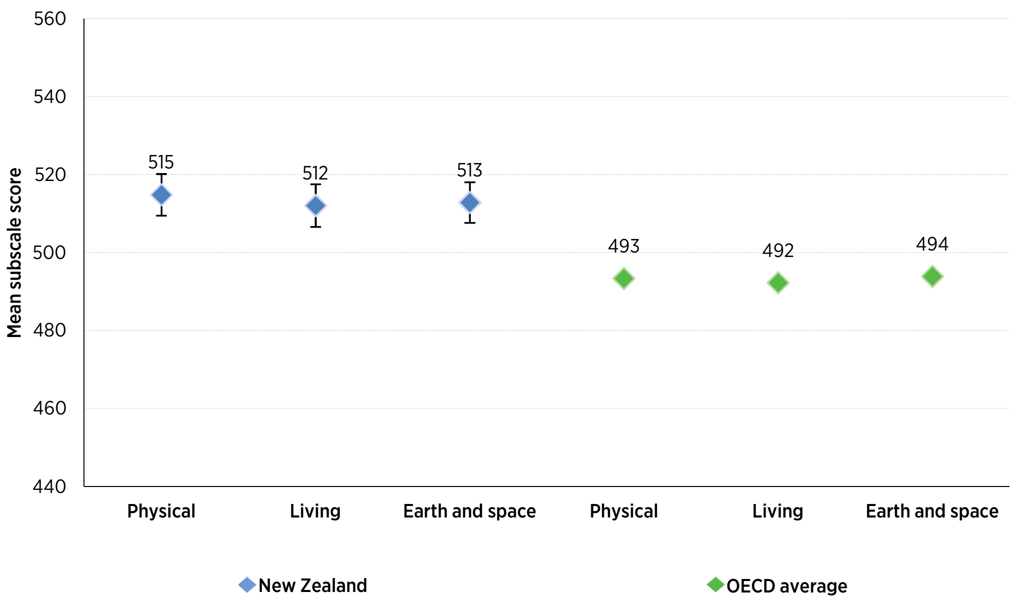
- *Physical systems;*
- *Living systems; and*
- *Earth and space systems.*
- About one third of the questions in the PISA assessment assess *Physical systems*, about 40 percent on *Living systems*, and the remainder (just over one quarter) on *Earth and space systems*.

Figure 1.6 shows that New Zealand students perform equally well on tasks related to *Physical systems* (515 points) and *Living systems* (512 points) and *Earth and space systems* (513 points).

In PISA 2006, *Earth and space systems* was an area of relative strength and *Physical systems* was an area of relative weakness in New Zealand.[18]

The PISA assessment also draws on scientific skills and competencies that are covered by other areas of the New Zealand curriculum. For example, the interpretation of data may be taught within the context of social studies, geography or mathematics.

Figure 1.6: Content Areas



18 Changes in the PISA Science framework mean that we cannot compare the other two aspects directly.

Reading

How well did New Zealand students perform in reading?

New Zealand students' average score for reading in PISA 2015 (509 points) was higher than the OECD average (493 points).

Figure 2.1 shows there were 55 countries with lower average reading scores than New Zealand, of which 23 are OECD members. New Zealand's average reading score was significantly below six countries, including four OECD countries (Canada, Finland, Ireland and Estonia). Eight countries, of which seven are OECD members, had similar scores to New Zealand.

Proficiency levels in the PISA assessment describe the types of reading tasks that students can do. Students at Level 6 are capable of the most complex reading tasks and those below Level 2 have difficulty with all but the simplest reading tasks measured by PISA. Level 2 is considered a baseline level at which students begin to demonstrate the reading skills and competencies that will enable them to participate effectively later in life[19].

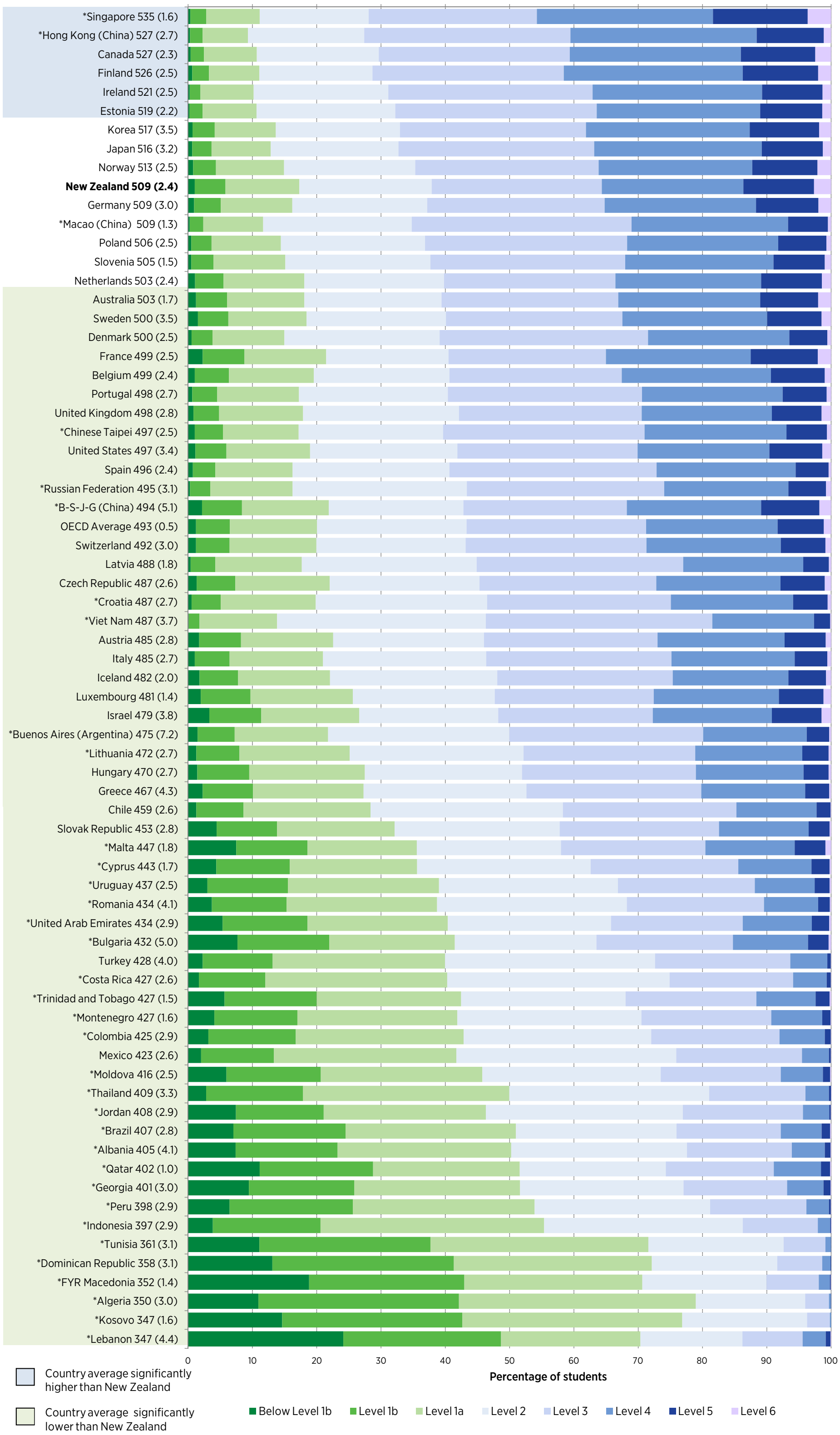
The proportion of New Zealand students performing below Level 2 (17%) was less than the OECD average (20%). The proportion of low achievers was similar to Germany and the Netherlands, countries with similar average scores, but also similar to countries such as Spain, Portugal and Chinese Taipei who have lower average scores than New Zealand.

Korea (13%), Finland (14%), and Canada (14%) had similar proportions of top performing students who were at Level 5 or above compared to New Zealand (14%). Only Singapore (18%) had a larger proportion. At Level 6, New Zealand (3%) had a similar proportion of advanced readers as Singapore (4%).

Compared to countries with a similar average score, New Zealand tends to have a larger proportion of both students who can complete only relatively basic reading tasks (below Level 2) and students who are capable of advanced reading tasks (Level 5 and above).

19 A full description of proficiency levels is provided in PISA 2015 Assessment and Analytical Framework (OECD, 2016a).

Figure 2.1: Average reading scores and proficiency levels



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B-S-J-G (China) refers to the four participating China provinces: Beijing, Shanghai, Jiangsu, Guangdong.

FYR Macedonia refers to the Former Yugoslav Republic of Macedonia.

How has reading performance changed over time?

PISA was first administered in 2000 with reading as the main focus. New Zealand's average reading score (509 points) in PISA 2015 was similar to the PISA 2012 score (512 points) but lower than the reading score in 2000 (529 points).

Figure 2.2 shows that most of the decline in reading literacy occurred between 2009 and 2012. In 2009, New Zealand's average score for reading (521 points) was not very different from the average score in PISA 2000 (529 points).

Compared to 2012, New Zealand's position relative to other OECD countries and the OECD average has not changed. The difference between the New Zealand average and the OECD average remains at 16 points and the range of rankings[20] (7th to 11th) is very similar to 2012 (7th to 12th). Relative to all participating countries there is a slight improvement (from 11th to 19th in 2012 to 9th to 14th in 2015) as only two non-OECD countries scored significantly higher than New Zealand in 2015 compared to four in 2012.

Looking at longer term trends, two countries that scored above the OECD average in 2000 and have demonstrated similar or larger declines than New Zealand (20 points) include Finland (20 points), and Australia (25 points). Finland still remains significantly higher than New Zealand but Australia's average score is now lower than New Zealand's. In contrast, the increase in average reading scores for Poland (27 points) and Germany (25 points) means both these countries, who were below New Zealand in reading in 2000, are now on par.

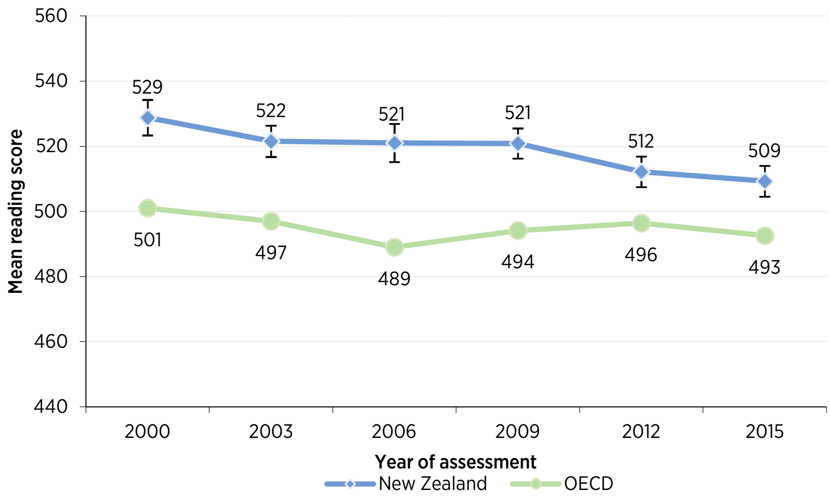
Figure 2.3 illustrates changes in the proportion of students below Level 2 and above Level 5 since PISA 2000. In 2000, just under 14 percent of students in New Zealand were poor readers whose reading skills were unlikely to support their learning (below Level 2). This has increased to just over 17 percent of students in 2015.

Over the same period, the proportion of students who are advanced readers (Level 5 and above) has declined from 19 percent to 14 percent. The proportion of students who are advanced readers (Level 6) has remained the same (3%) between PISA 2009 and PISA 2015.[21]

20 Because the figures are derived from samples, it is not possible to determine a country's/economy's precise ranking. However, it is possible to determine with confidence a range of rankings in which the country's/economy's performance level lies.

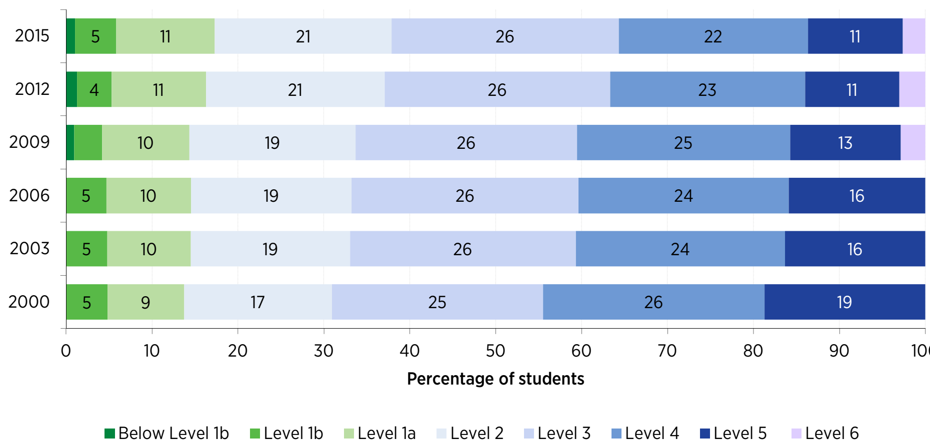
21 Level 6 proficiency was introduced into the reading proficiency levels in 2009.

Figure 2.2: Trends in New Zealand average reading scores



Note: error bars on the graph provide a 95 percent confidence interval for the estimate of the average.

Figure 2.3: Trends in New Zealand reading proficiency levels



Notes: In 2009 Level 1b and Level 6 were added to provide a finer distinction of the proficiency levels of students that were previously classified as below Level 1 and at Level 5 and above for the 2000, 2003 and 2006 assessments.

percentages less than four are not labelled on the graph.

Mathematics

How well did New Zealand students perform in mathematics?

New Zealand students, at 495 points on the PISA mathematics scale, performed above the OECD average of 490 points.

Figure 3.1 shows that forty countries scored lower than New Zealand in mathematics. Twelve of these countries are OECD members. New Zealand's average mathematics score was significantly below 19 countries, including 14 OECD members. New Zealand had similar average scores to 10 other countries including Australia, the United Kingdom and six other OECD members.

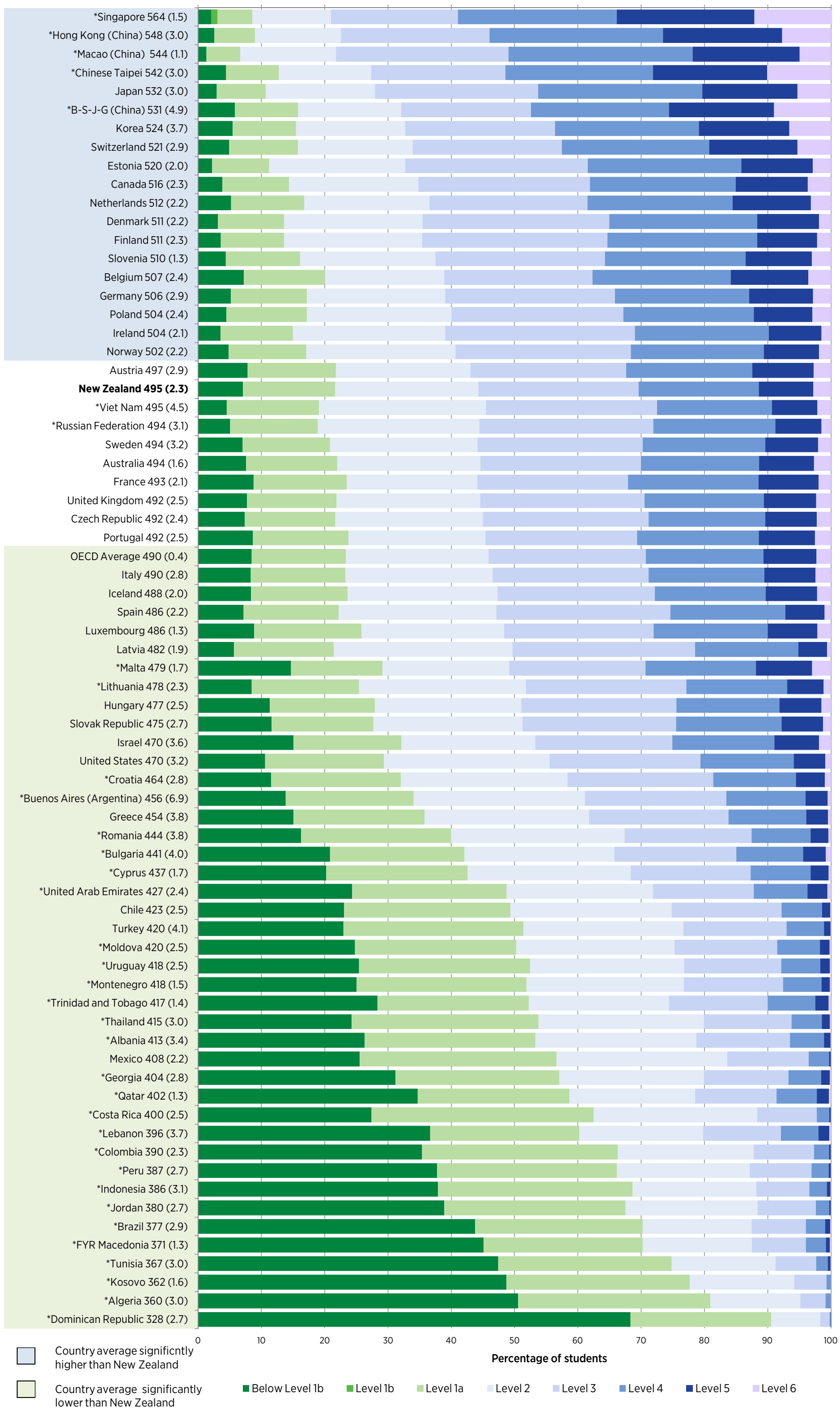
PISA proficiency levels describe the types of mathematics tasks that students can do and relate this to the mathematics scale. Students at Level 6 are capable of advanced mathematical thinking and reasoning, whereas those at Level 1 can only complete relatively basic mathematical tasks.[22] Level 2 is considered to be a baseline level at which students begin to demonstrate the competencies that will enable them to participate actively in mathematics-related life situations.

The proportion of New Zealand students performing below Level 2 (22%) was the same as the OECD average (23%). Similarly the proportion of high-performing students who were at Level 5 or above (11%) in New Zealand was the same as the OECD average (11%).

New Zealand tends to have similar proportions of students who are relatively poor performers in mathematics (below Level 2) and students who are high performers in mathematics (Level 5 or above) when compared to other countries with a similar average score.

22 A full description of proficiency levels is provided in PISA 2015 Assessment and Analytical Framework (OECD, 2016a).

Figure 3.1: Average mathematics scores and proficiency levels



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How has mathematics performance changed over time?

The trend in mathematics achievement is measured from PISA 2003, as this is the first time mathematics was the focus area of the PISA assessment and all four content areas of the current PISA mathematics framework were covered[23]. The average mathematics score of New Zealand students declined between 2003 and 2015 from 523 to 495 points. Figure 3.2 shows that most of the decline occurred between 2009 and 2012.

There was very little change in the New Zealand average mathematics score from PISA 2012 (500 points) to PISA 2015 (495 points). The OECD average went from 494 points in 2012 to 490 points in 2015. Several East Asian countries (Korea, Vietnam and Chinese Taipei) had sizeable decreases in mathematics performance from 2012 to 2015 but they still remain above New Zealand. New Zealand's relative position compared to these East Asian countries and to all other participating countries (20th to 28th) remains similar to 2012 (19th to 25th).[24] [25]

Looking at the longer term New Zealand's mathematics score has dropped 28 score points since 2003.[26] Other countries with a similar decrease in mathematics scores include Finland (decrease of 33 points) and Australia (decrease of 30 points). During this time, some countries have made gains. Germany and Poland, below New Zealand in 2003, now have higher average scores than New Zealand.

Figure 3.3 shows that the change in average score since 2003 for New Zealand reflects a larger proportion of New Zealand students performing below Level 2. These are students that can complete only relatively basic mathematics tasks and whose lack of skills is a barrier to learning. In 2015, 22 percent of New Zealand students were below Level 2 compared with 15 percent in 2003.

The proportion of New Zealand students who attained Level 5 and above also declined between 2003 (21%) and 2015 (11%). The proportion of students who attained Level 6 and are able to do complex mathematical tasks is also lower in 2015 (3%) than in 2003 (7%).

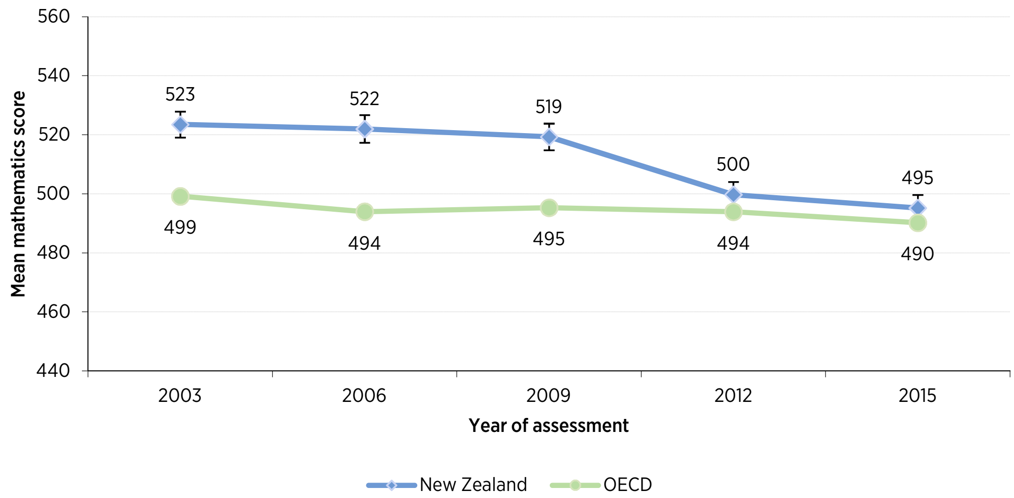
23 The PISA 2000 mathematics assessment only covered two (space and shape, and change and relationships) of the four content areas of the framework.

24 For mathematics ten countries lie within 3 score points of the New Zealand average score. Because the averages are derived from samples, it is not possible to determine a country's/economy's precise ranking. However, it is possible to determine with confidence a range of rankings in which the country's/economy's performance level lies.

25 For OECD countries only, the range of ranks also overlaps considerably from 2012 (12th to 18th) to 2015 (15th to 22nd)

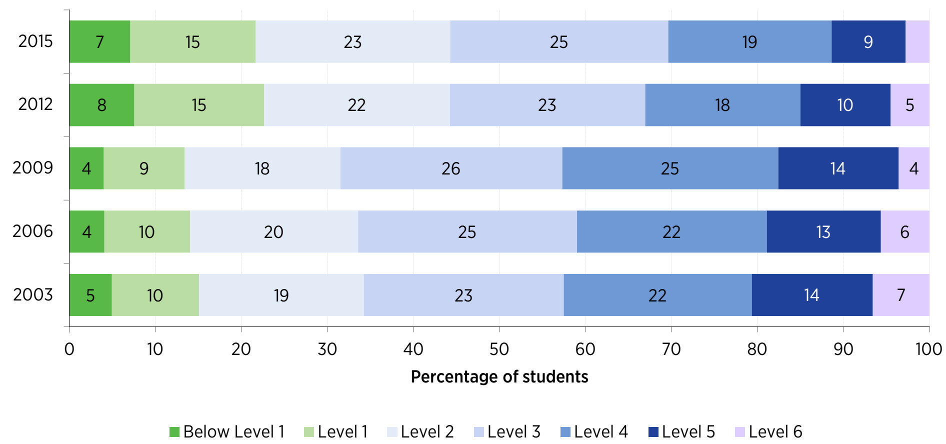
26 The apparent inconsistency is due to rounding of the mean scores reported in the first paragraph above.

Figure 3.2: Trends in New Zealand average mathematics scores



Note: error bars on the graph provide a 95 percent confidence interval for the estimate of the average.

Figure 3.3: Trends in New Zealand mathematics proficiency levels



Note: percentages less than four are not labelled on the graph.

Top performers

How many New Zealand students are top performers in more than one area?

In each of the areas of mathematics, reading and science there are New Zealand students who perform really well.

In PISA, top performers have been defined as the students achieving at Level 5 and above in each area. A student who is a top performer in mathematics may also be a top performer in science but not necessarily a top performer in reading. Figure 4.1 looks at the overlap among those who are top performers in one or more of reading, mathematics and science for the OECD and figure 4.2 displays this overlap for New Zealand.

About one in five students (20%) in New Zealand are among the top performers in at least one subject area, compared to the OECD average of 15 percent.

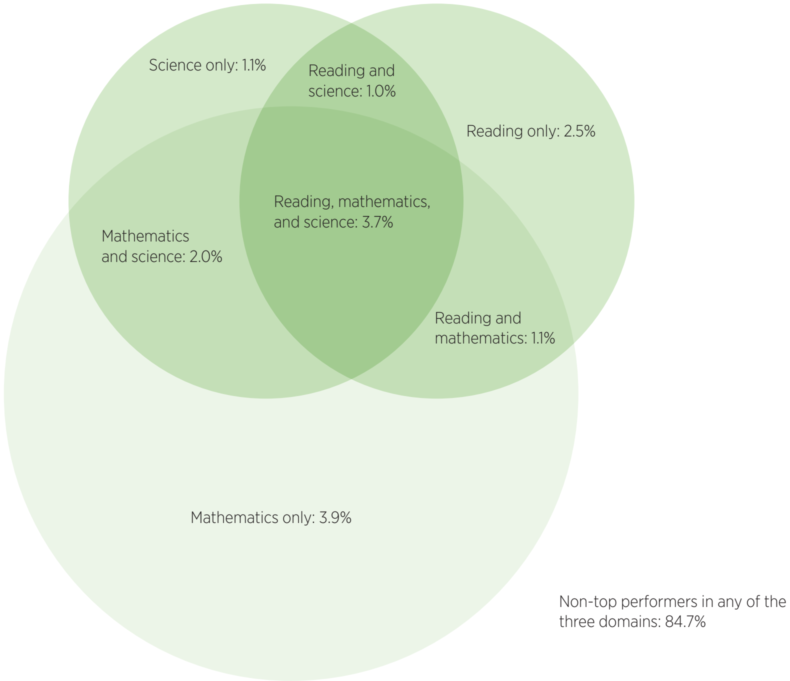
New Zealand has a relatively high proportion of students who are top performers in all three areas (6%) compared to the OECD average (4%).

Australia, Japan and Estonia are among 10 countries with similar proportions of top performers in all three areas. The only country with a significantly larger proportion than New Zealand is Singapore (14%).

While New Zealand has a similar proportion of top performers in all three areas in 2015 (6%) to the proportion in 2012 (8%) many other countries have a lower proportion. For example Japan (11% to 7%) and Hong Kong (China) (11% to 5%) have lower proportions of top performers in all three areas of science, reading and mathematics.

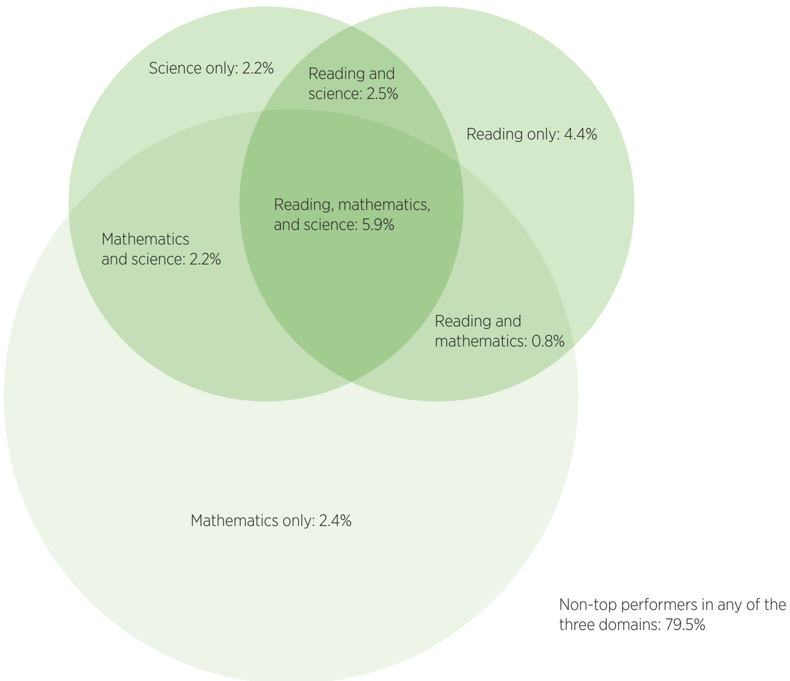
26 Any apparent inconsistencies are due to rounding.

Figure 4.1: **Overlapping of top performers in mathematics, reading and science on average in the OECD**



Source: Adapted from Figure 1.5a, Volume I: What Students know and can do: Student Performance in Mathematics, Reading and Science OECD (2013). Updated with 2015 data

Figure 4.2: **Overlapping of top performers in mathematics, reading and science on average in New Zealand**



Source: Adapted from Figure 1.5a Volume I: What Students know and can do: Student Performance in Mathematics, Reading and Science OECD (2013). Updated with 2015 data

Achievement of different groups

In addition to groups of the population that can be compared internationally, such as boys and girls, data collected specifically for New Zealand provides an understanding of the performance of other groups of the New Zealand population. This section looks at the achievement of different groups of the New Zealand population — boys and girls; Māori, Pasifika, Asian and Pākehā/European; and different socio-economic groups of students — in scientific, reading and mathematical literacy in PISA 2015, and how the achievement of these groups has changed over time.

Gender

Is there a difference between the performance of New Zealand boys and girls?

In 2015 New Zealand boys had a science literacy score (516 points) similar to girls (511 points). In contrast, New Zealand girls demonstrated a higher reading literacy average score (526 points) than boys (493 points). In mathematics boys (499 points) performed higher than girls (491 points).

While this has generally been the pattern for all of the cycles of PISA to date, there are differences between the subject areas in terms of the extent of these gender differences over time. Figures 5.1 to 5.3 illustrate how the performance of boys and girls and the gender differences have changed in each subject area.

While the gender differences in 2015 in all subject areas are similar to those for 2012 the gender differences over the longer term have changed for science and reading. The gender difference for mathematics in 2015 has remained at a similar level to that in 2003.

This has arisen from larger declines in performance for girls in science and reading compared to the declines for boys. In science, the performance of girls has significantly declined (by 21 points) since 2006. The decline for boys (13 points) over the same period was not as great. As a result boys have a marginally higher, but not statistically significant, average science score in 2015 than girls. In reading, the performance of girls has declined by 27 points since 2000, whereas the performance of boys has declined by 14 points. In mathematics, the average for boys declined by 31 points and girls by 25 points between 2003 and 2015.

The changes in average scores over time are also reflected in changes of the proportions of students performing below proficiency Level 2 and at or above Level 5.

In science the proportion of boys performing below Level 2 was 15 percent in 2006 and 18 percent in 2015. The proportion of girls performing below Level 2 was 12 percent in 2006. This increased to 16 percent in 2015. The proportion of boys performing at Level 5 and above was 18 percent in 2006 and 15 percent in 2015. The proportion of girls performing at Level 5 and above declined from 17 percent in 2006 to 11 percent in 2015.

In reading, boys have showed little change in the proportions below Level 2 (19% in 2000 compared with 22% in 2015) and at Level 5 and above (14% in 2000 compared with 11% in 2015). While the proportion of girls below Level 2 was 8 percent in 2000 and 12 percent in 2015, the proportion of girls who were top performers at Level 5 and above has declined noticeably from 24 percent in 2000 to 16 percent in 2015, reflecting the larger change in the average score for girls over this time.

In mathematics the proportion of boys who have poor mathematical skills increased between 2003 (15%) and 2015 (22%). Over the same time period, the proportion of boys who were top performers fell from 24 percent to 14 percent. The proportion of girls with poor mathematical skills also increased between 2003 (16%) and 2015 (22%) and the proportion of girls who were top performers decreased from 17 percent to 9 percent.

In summary, compared to their male counterparts girls have tended to have had larger changes in performance for science and reading where girls had noticeable decreases in the proportions of top performers along with larger decreases in average scores. In mathematics the changes have been similar with both boys and girls with a sizeable increase in the proportion below Level 2 and a decrease in the proportion of top performers for mathematics.[27]

27 The differences reported in this paragraph are statistically significant at a 95 percent level of significance.

Exhibits 5.1 – 5.3: Changes in average science, reading, and mathematics performance of New Zealand boys and girls

Figure 5.1: Science

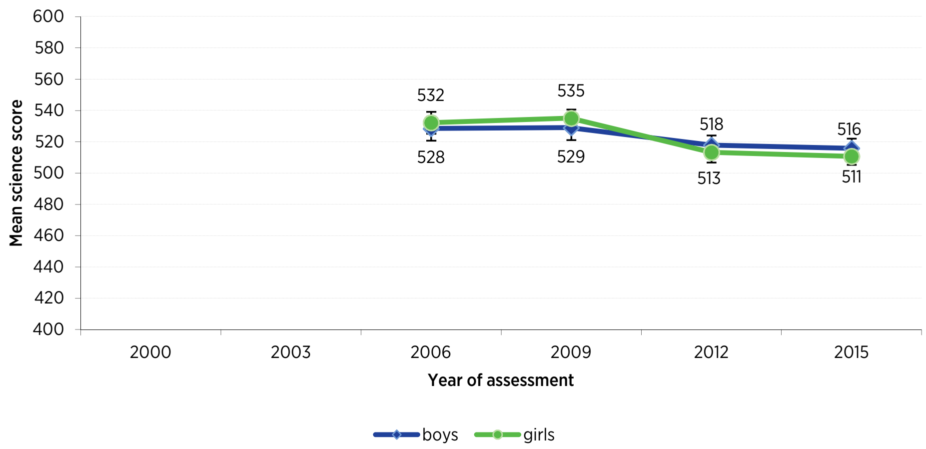


Figure 5.2: Reading

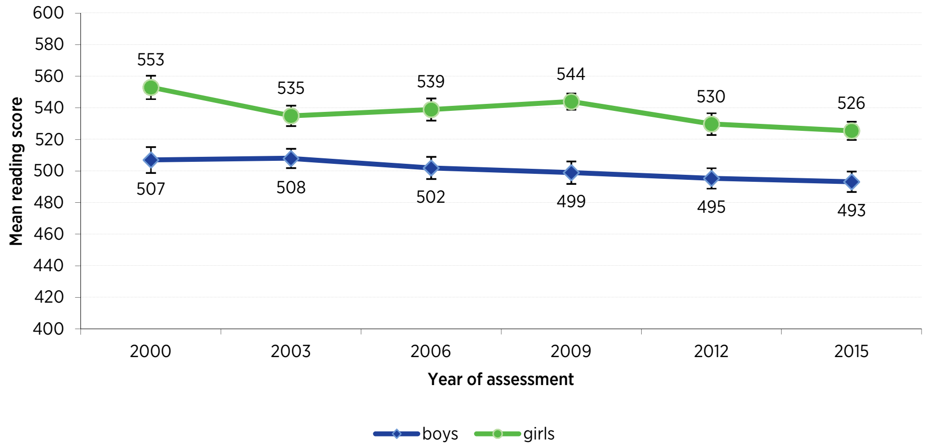
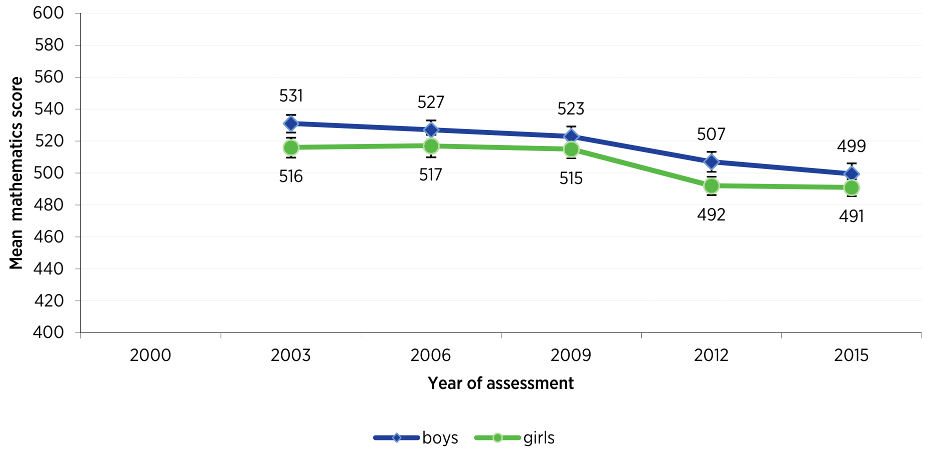


Figure 5.3: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment

Māori

How well are Māori students achieving?

The performance of Māori learners, or of students from any other ethnic background, is not included in the international reports prepared by the OECD. Data on students' ethnic backgrounds is only generated and analysed in country reports. Ensuring Māori enjoy and achieve success in the New Zealand education system is at the heart of the Māori education strategy Ka Hikitia – Accelerating Success 2013–2017. PISA provides a regular way to report on this for Māori students at 15 years of age. In 2015, 19 percent of PISA students identified as Māori.[28]

Figures 6.1 to 6.3 show the average score for Māori students in science (466 points), reading (465 points) and mathematics (452 points). Each subject was below the average score for both New Zealand students and the OECD.

There are very little differences in the average score for each subject between 2012 and 2015. While 2015 scores appear lower than the 2006 levels for science (480 points), and the 2000 levels for reading (482 points) only the decrease for mathematics from the 2003 level (477 points) is statistically significant.

In 2015, a relatively high proportion of Māori students have scores that place them below Level 2 and a relatively low proportion of Māori students have scores which place them at Level 5 and above compared to New Zealand students overall. This is consistent for each of science, reading and mathematics.

Figures 6.4 to 6.6 show that Māori students are represented at all proficiency levels. Over one-third of Māori students were performing below Level 2 in mathematics (36%) and over one quarter in reading (28%) and science (30%). Māori students are represented among the top performers in PISA performing at Level 5 and above with three percent of students in mathematics, five percent in reading and four percent in science.

28 Identification with ethnic groupings was from student self report. Students could identify with one or more ethnic groupings.

Exhibits 6.1 – 6.3: Average science, reading and mathematics performance of Māori students

Figure 6.1: Science

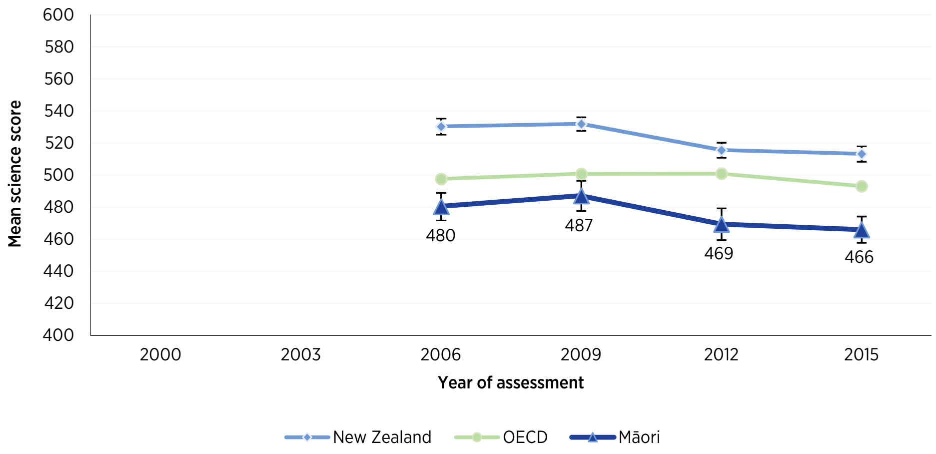


Figure 6.2: Reading

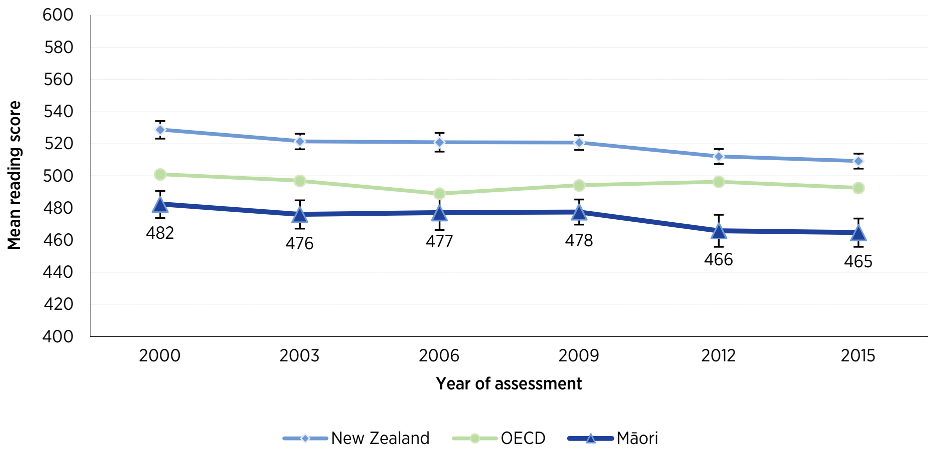
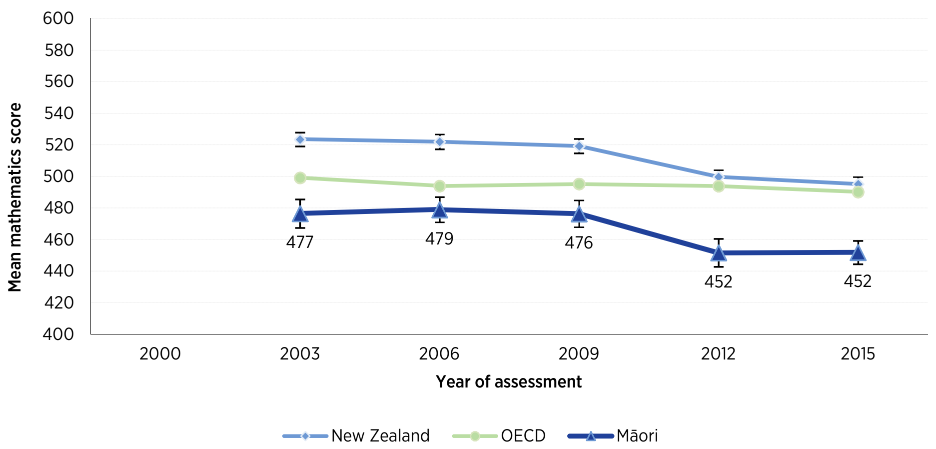


Figure 6.3: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment

Exhibits 6.4 – 6.6: Proficiency levels of Māori students for science, reading and mathematics

Figure 6.4: Science

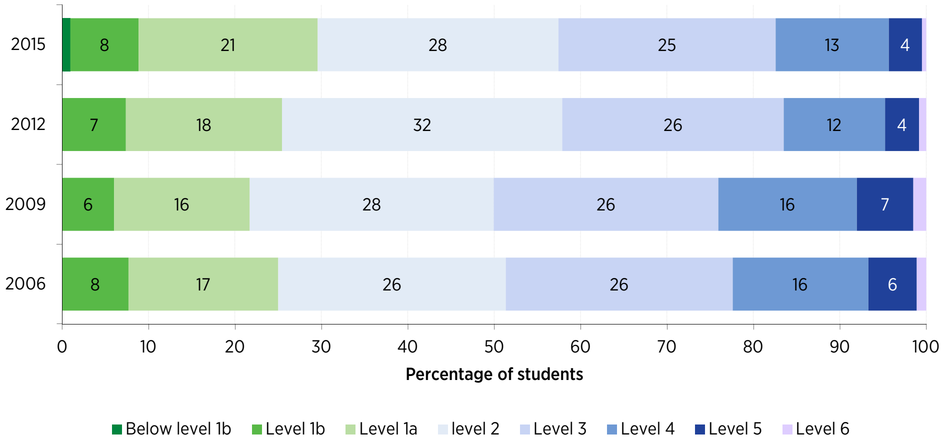


Figure 6.5: Reading

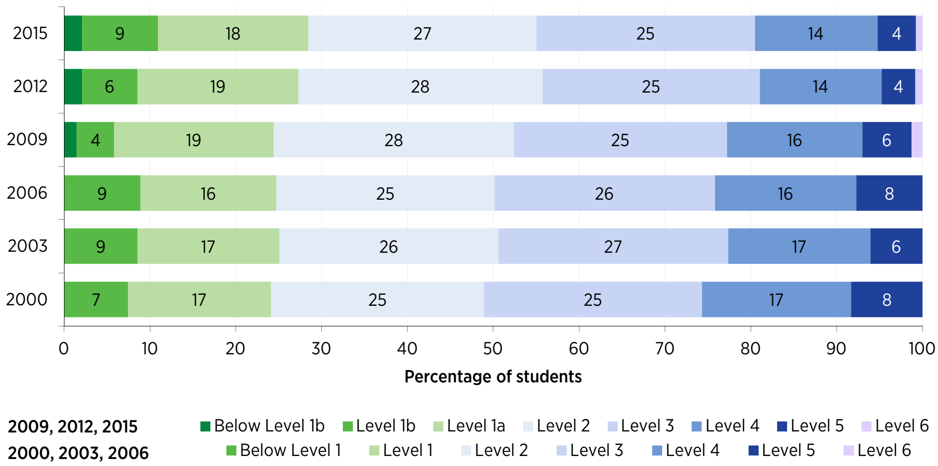
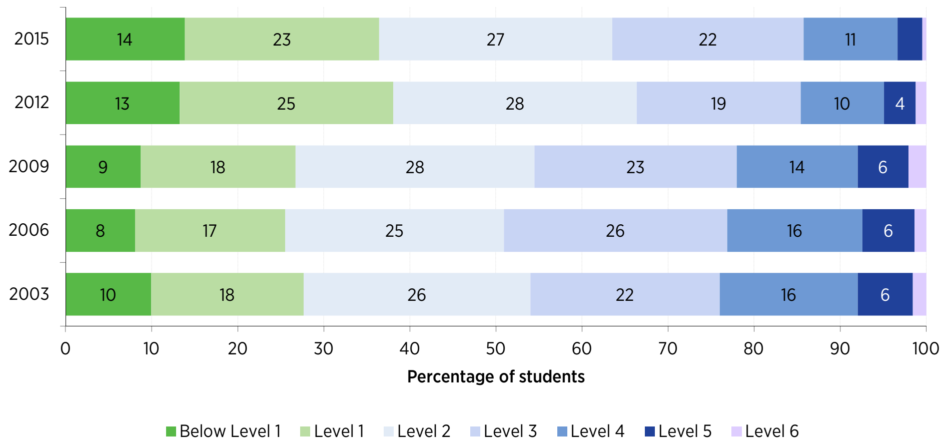


Figure 6.6: Mathematics



Notes: For science, Level 1b was added in 2015 to provide a finer distinction of the proficiency level of students that were previously classified as below Level 1 for earlier assessments.

For reading, Level 1b and Level 6 were added in 2009 to provide a finer distinction of the proficiency levels of students that were previously classified as below Level 1 and at Level 5 and above for the 2000, 2003 and 2006 assessments.

Percentages less than four are not labelled on the graph.

Pasifika

How well are Pasifika students achieving?

Ensuring Pasifika students are participating, engaging and achieving within the New Zealand education system is at the heart of the Pasifika Education Plan 2013–2017. PISA provides a regular way to report on that for Pasifika students at 15 years of age. Twelve percent of PISA students identified as Pasifika.

Figures 7.1 to 7.3 show the average score over time for Pasifika students for each of science, reading and mathematics. These averages are below the average scores for both New Zealand students and the OECD.

While changes since 2012 look encouraging, the differences are not statistically significant. This is mainly because the numbers of Pasifika students are fewer than for other groups.[29] Longer term changes in achievement are also not statistically significant. The longer term changes in average scores for Pasifika students were:

- In science from 453 points in 2006 to 446 points in 2015;
- In reading from 459 points in 2000 to 450 points in 2015; and,
- In mathematics from 455 points in 2003 to 441 points in 2015.

Figures 7.4 to 7.6 show the change in the proportions of Pasifika students at each proficiency level.

In 2015, Over one-third of Pasifika students performed below Level 2 for science (38%), reading (34%) and about two in five Pasifika students performed below Level 2 in mathematics (42%), with relatively few Pasifika students attaining Level 5 and above (3%) and a relatively small proportion attained Level 5 and above in reading (4%) and science (3%).

29 Note that the standard error of the difference between two cycles includes several components. The number of students in the sub-group is a major factor in the overall standard error but it also includes a component related to the number of questions used to provide the link between the two cycles – the more questions used for linking the lower the standard error.

Exhibits 7.1 – 7.3: Average science, reading, and mathematics performance of Pasifika students

Figure 7.1: Science

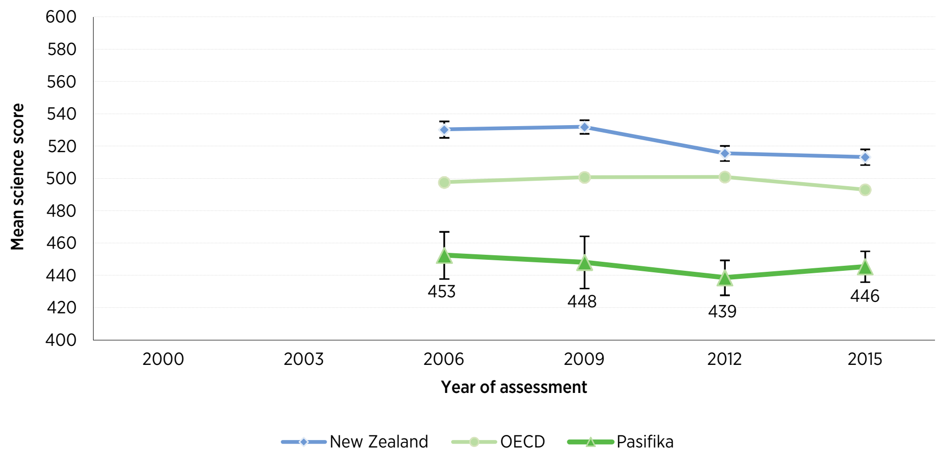


Figure 7.2: Reading

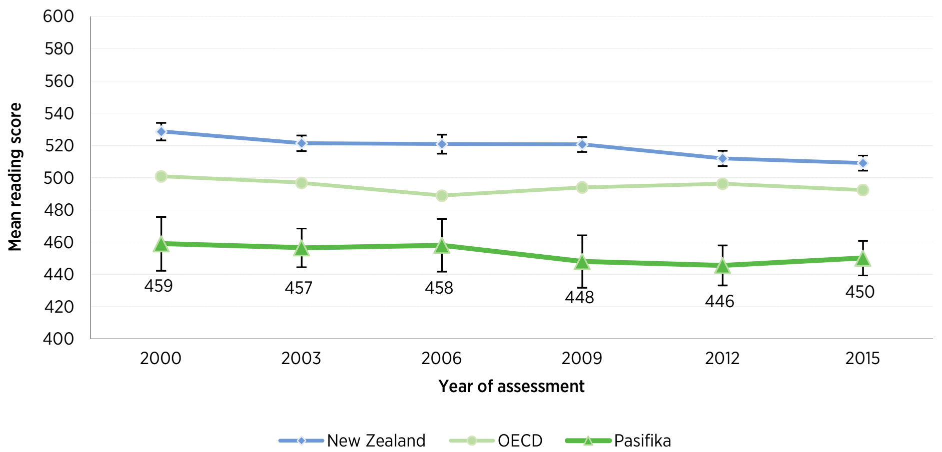
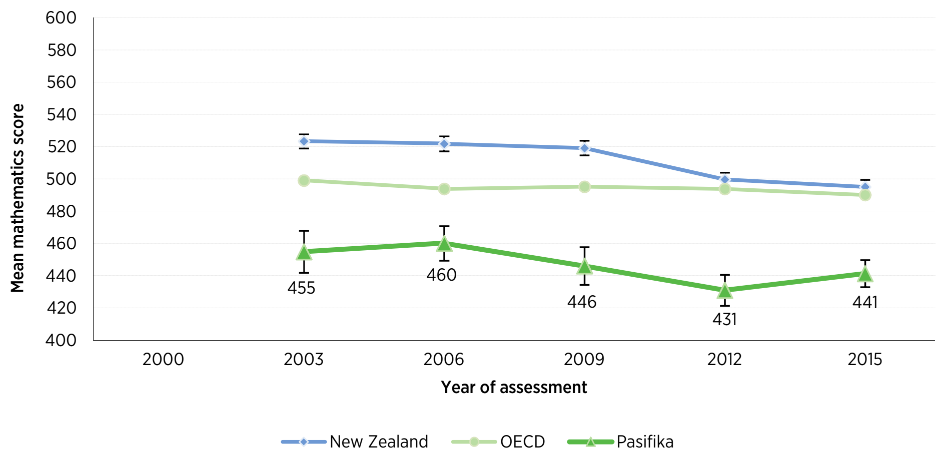


Figure 7.3: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment

Exhibits 7.4 – 7.6: Proficiency levels of Pasifika students for science, reading, and mathematics

Figure 7.4: Science

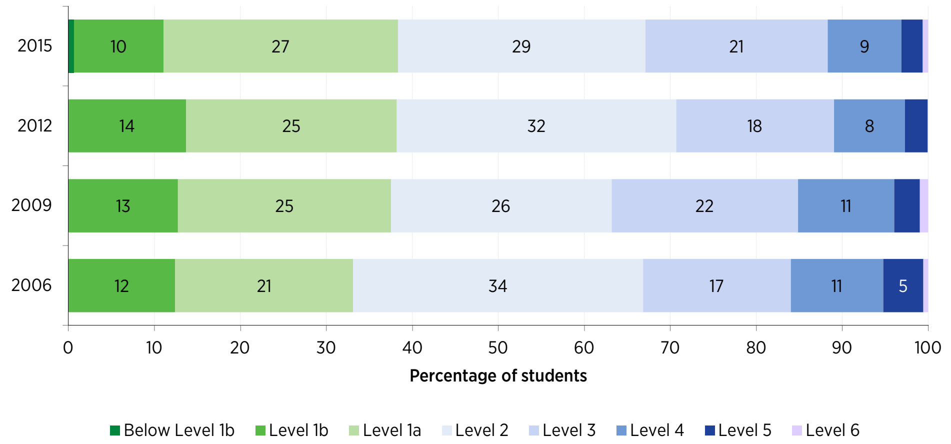


Figure 7.5: Reading

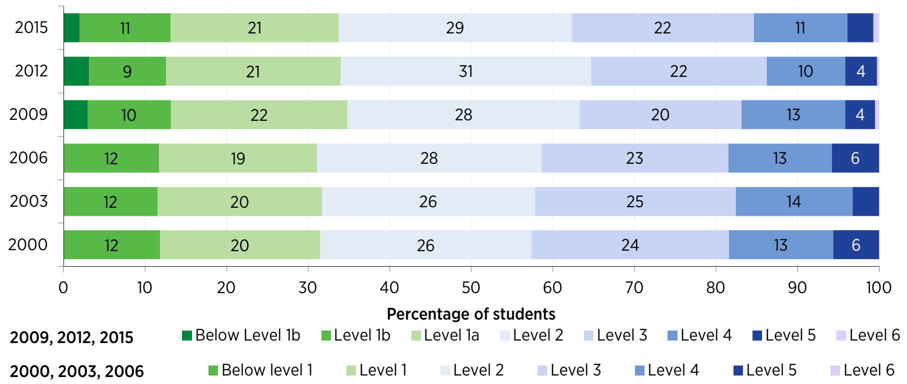
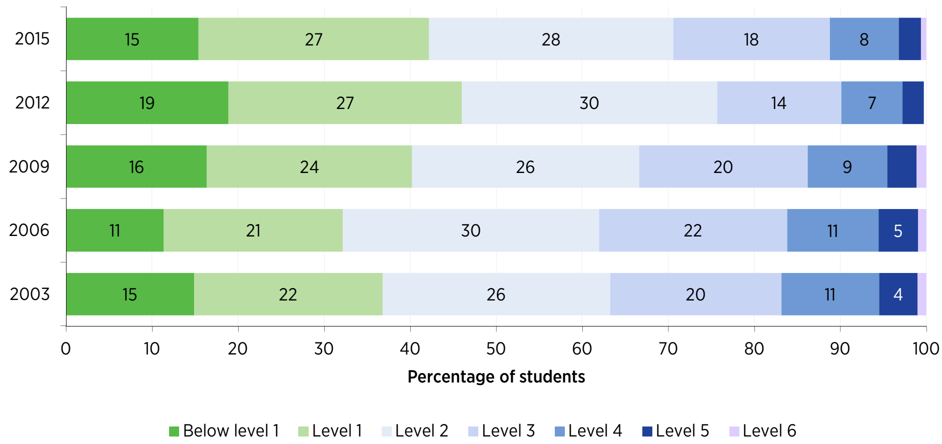


Figure 7.6: Mathematics



Notes: For science, Level 1b was added in 2015 to provide a finer distinction of the proficiency level of students that were previously classified as below Level 1 for earlier assessments.

For reading, Level 1b and Level 6 were added in 2009 to provide a finer distinction of the proficiency levels of students that were previously classified as below Level 1 and at Level 5 and above for the 2000, 2003 and 2006 assessments.

Percentages less than four are not labelled on the graph.

Other groupings

How well are students from other ethnic groupings achieving?

In PISA 2015, 17 percent of students identified with an Asian ethnic group and 67 percent with a Pākehā/European ethnic group.[30]

Figures 8.1 to 8.3 show the average score over time for Asian students for each of science, reading and mathematics. In science the average for Asian students in 2015 (512 points) is not statistically significantly different from 2012 (527 points) but reading (from 525 points in 2012 to 509 points in 2015) and mathematics (from 530 points in 2012 to 503 points in 2015) are significantly lower.

Longer term trends show a decrease in mathematics and in science. However the 2015 average for reading is very similar to the average in 2000.

In 2015, for each of the subject areas about one in five Asian students performed below Level 2. The proportions were 19 percent for science, 18 percent for reading and 21 percent for mathematics. Figures 8.4 to 8.6 show the change in the proportions of Asian students at each proficiency level. While 2015 proportions of low achievers are similar in reading (2000) and science (2006) to the proportions from the start of the trend, the proportion of low achievers in mathematics was 13 percent in 2003.

In science 13 percent of Asian students were high achievers who attained Level 5 and above in 2015. In reading and in mathematics 14 percent of Asian students attained Level 5 and above. These proportions were 22 percent for science in 2006, 18 percent for reading in 2000 and 25 percent for mathematics in 2003.

For Pākehā/European students there has been little change in the average scores from 2012. As Pākehā/European students are the largest ethnic grouping, the pattern for their trend over time mirrors that for the overall New Zealand score. Figures 8.7 to 8.9 show the average score over time for Pākehā/European students.

Figures 8.10 to 8.12 show the change in proportions of Pākehā/European students over time. In each domain the proportion of low achievers below Level 2 has increased while the proportion of high achievers at Level 5 and above has decreased

30 As students could identify with more than one ethnic group these percentages (17% and 67%) along with Maori (19%) and Pasifika (12%) will add to more than 100.

Exhibits 8.1 – 8.3: Average science, reading and mathematics performance of Asian students

Figure 8.1: Science

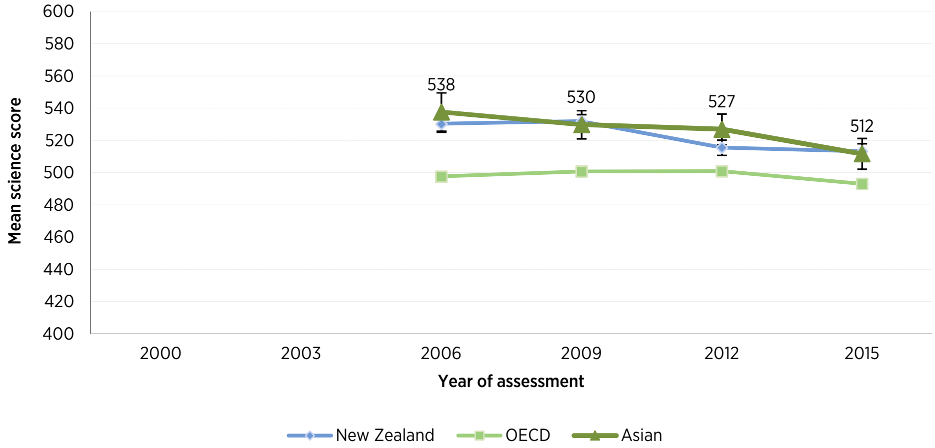


Figure 8.2: Reading

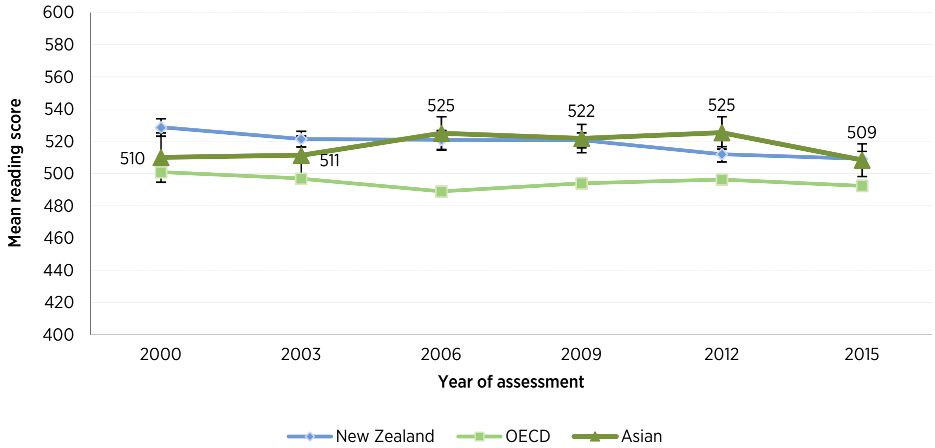
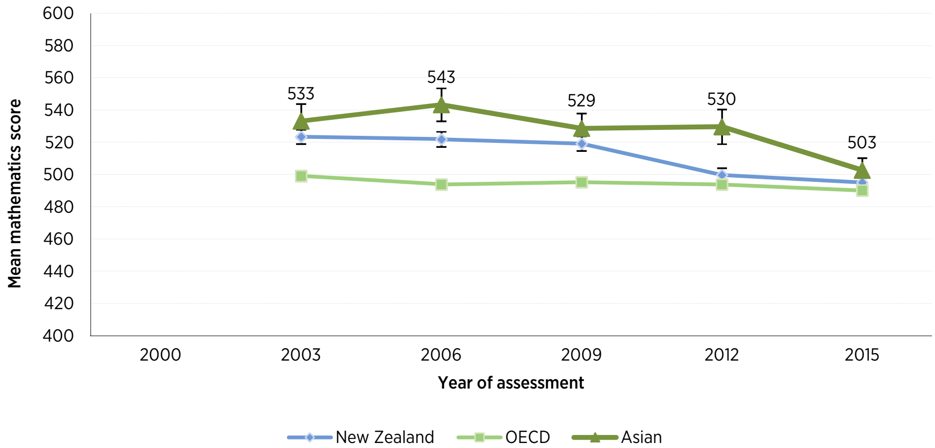


Figure 8.3: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment

Exhibits 8.4 – 8.6: Proficiency levels of Asian students for science, reading and mathematics

Figure 8.4: Science

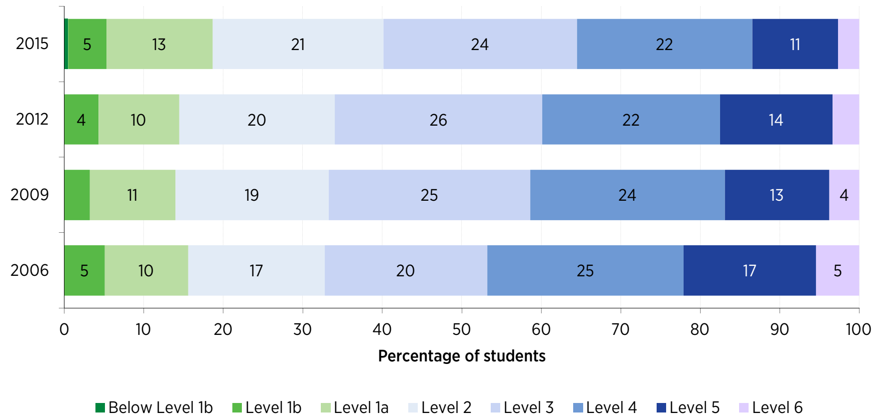


Figure 8.5: Reading

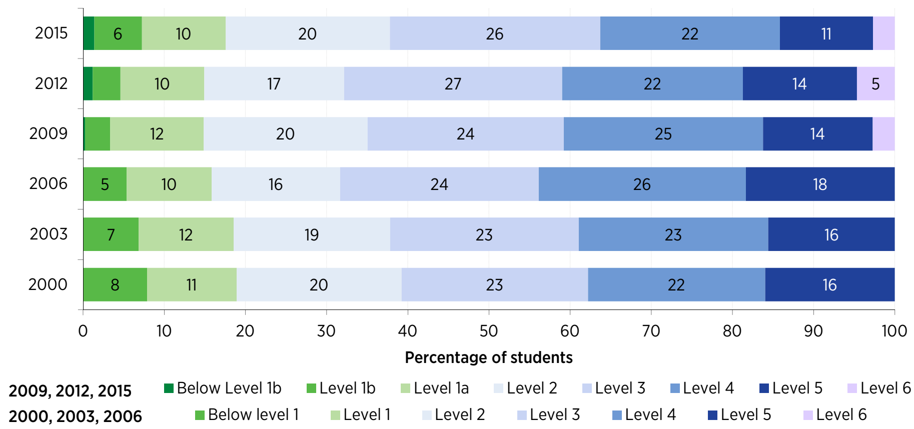
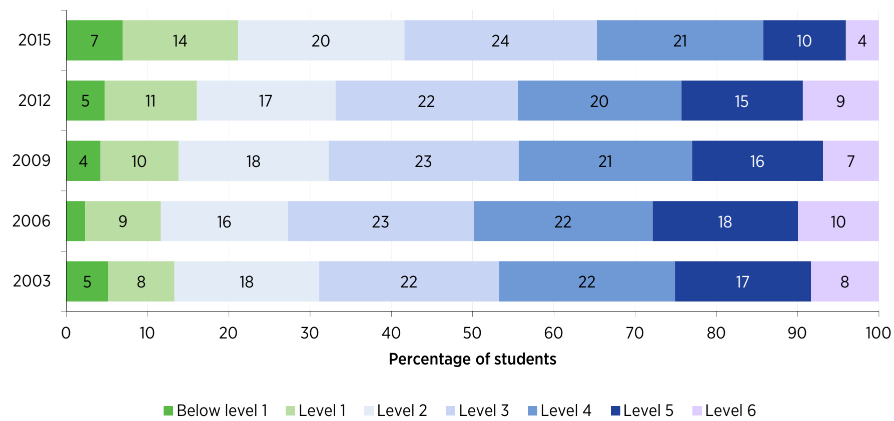


Figure 8.6: Mathematics



Notes: For science, Level 1b was added in 2015 to provide a finer distinction of the proficiency level of students that were previously classified as below Level 1 for earlier assessments.

For reading, Level 1b and Level 6 were added in 2009 to provide a finer distinction of the proficiency levels of students that were previously classified as below Level 1 and at Level 5 and above for the 2000, 2003 and 2006 assessments.

Percentages less than four are not noted on the graph.

Exhibits 8.7 – 8.9: Average science, reading and mathematics performance of Pākehā/European students

Figure 8.7: Science

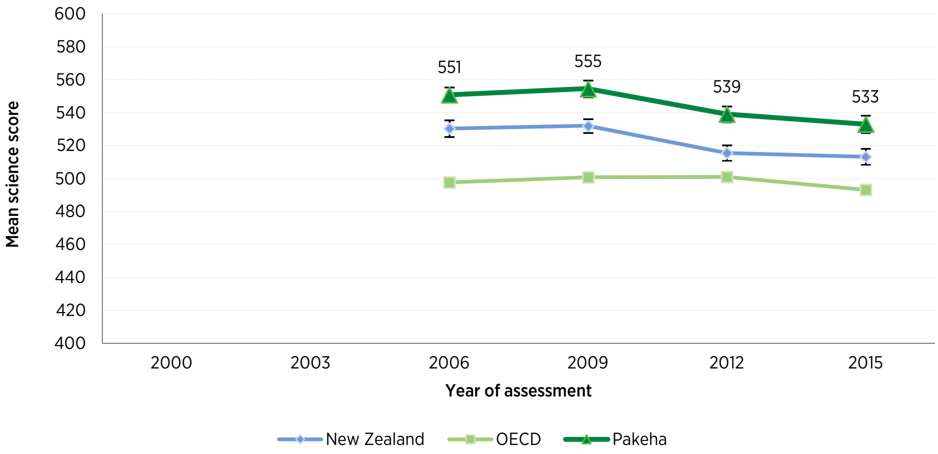


Figure 8.8: Reading

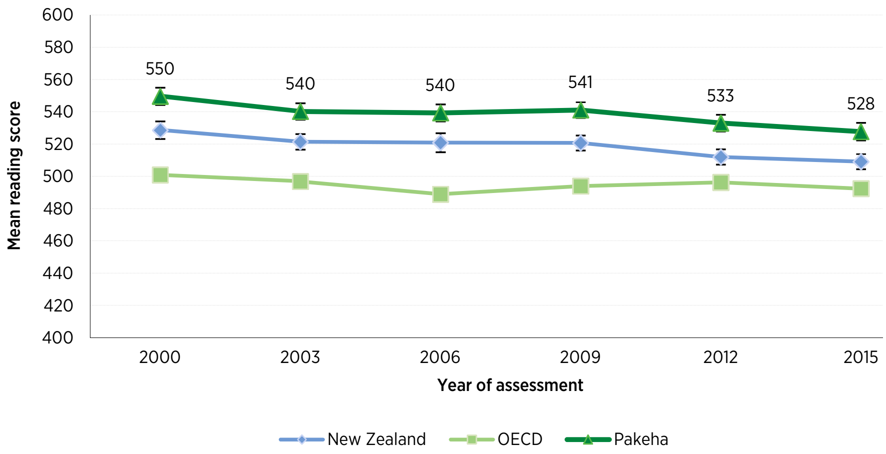
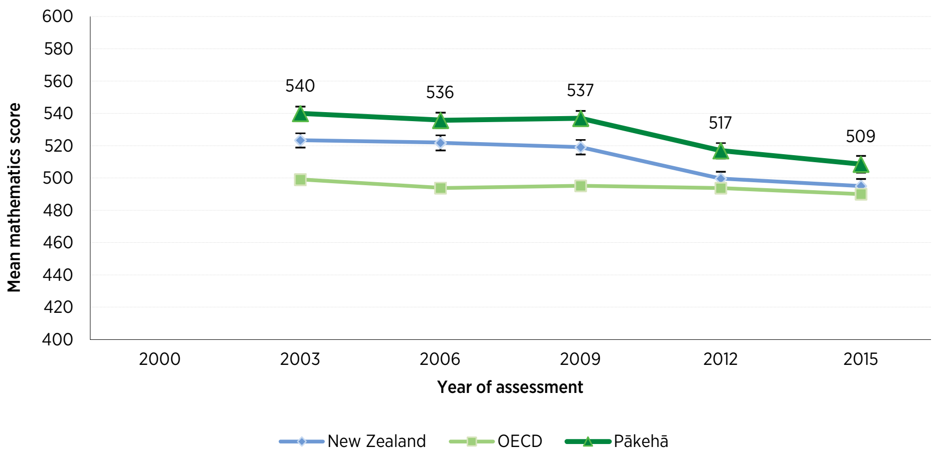


Figure 8.9: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment

Exhibits 8.10 – 8.12: Proficiency levels of Pākehā/European students for science, reading and mathematics

Figure 8.10: Science

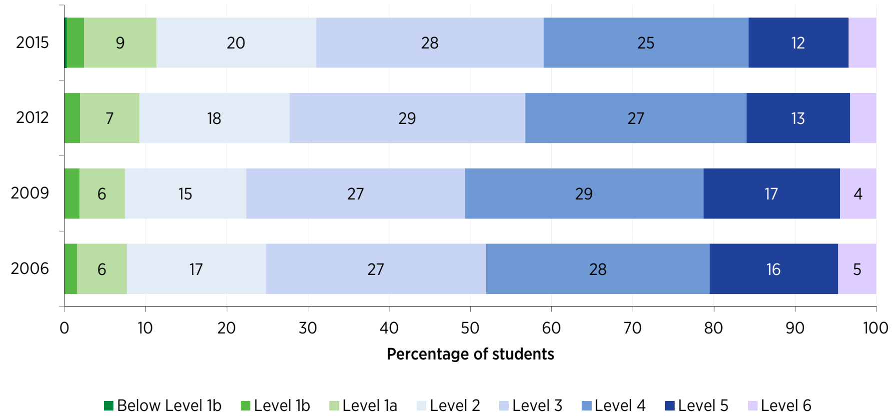


Figure 8.11: Reading

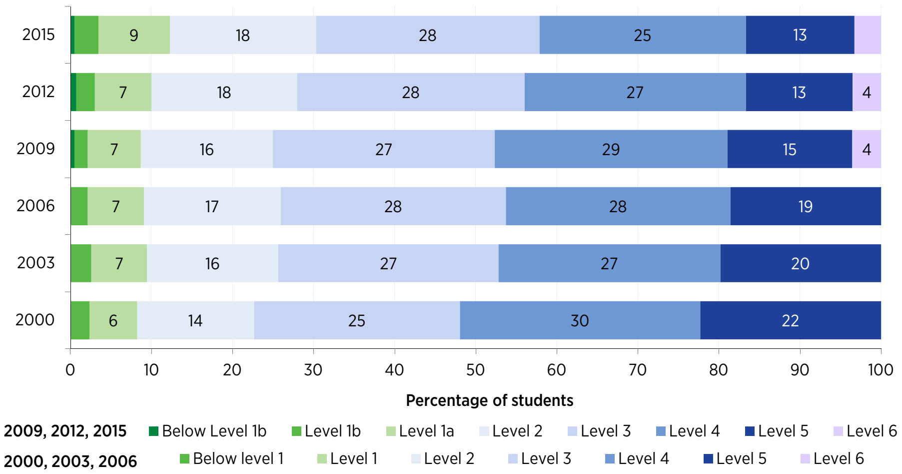
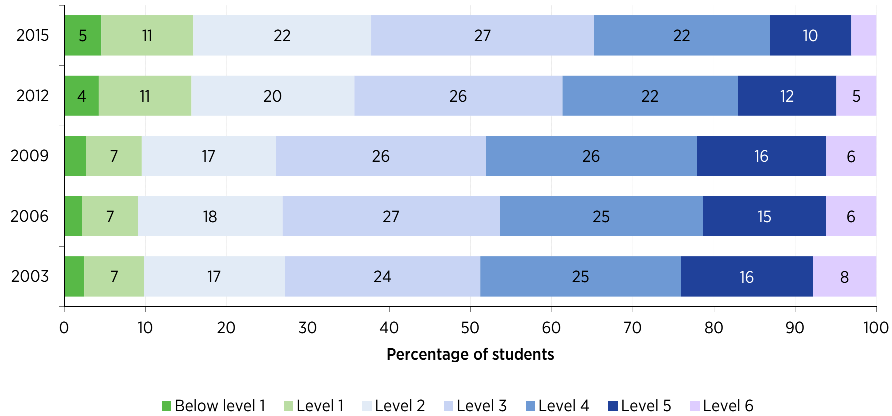


Figure 8.12: Mathematics



Notes: For science, Level 1b was added in 2015 to provide a finer distinction of the proficiency level of students that were previously classified as below Level 1 for earlier assessments.

For reading, Level 1b and Level 6 were added in 2009 to provide a finer distinction of the proficiency levels of students that were previously classified as below Level 1 and at Level 5 and above for the 2000, 2003 and 2006 assessments.

Percentages less than four are not labelled on the graph.

Socio-economic status

How well are New Zealand students from different socio-economic backgrounds achieving?

In PISA socio-economic status is measured through the PISA index of economic, social and cultural status (ESCS). This index is taken from information reported by the student about their parents' occupations, the highest education level of their parents and possessions in the home. The latter included things such as whether the student had access to educational resources like desks, computers and books, as well as possessions that would likely be related to parental income, such as a dishwasher, pay television, and the number of mobile phones, televisions, computers and cars in the household.

The ESCS index for a student, or the average for a country, provides a value relative to the average level of socio-economic status across the OECD. Most scores fall between -1 and + 1.[31] If a student has a value on the ESCS index of -1 it means their socio-economic status is less than 84 percent of OECD students. A score of +1 means their socio-economic status is greater than 84 percent of OECD students.

The overall ESCS index value for New Zealand is 0.17, which is higher than the OECD average.

To enable comparison between students from different socio-economic backgrounds within New Zealand they have been divided into four quarters according to their score on the ESCS index. For example, the 25 percent of students with the lowest ESCS index value in New Zealand are identified as low socio-economic students.[32] The same classification is used each year PISA is assessed to ensure we are always comparing the lowest 25 percent of students on the ESCS index. The average science score for New Zealand's low socio-economic students in PISA 2015 (463 points) was well below the New Zealand and OECD averages for all students. See figure 9.1. The score is similar to the 2012 value (458 points) but lower than the 2006 value (480 points). For the other quarters of ESCS the 2015 value is significantly lower than the 2006 value but similar to the 2012 value.

There has been little change in the average score for low socio-economic students in reading between 2003 (468 points) and 2015 (463 points).[33] Only the students in the high socio-economic quarter have had a decline in average score in this period (see Figure 9.2).

While the overall average mathematics score for low socio-economic students in 2015 (452 points) is similar to the 2012 value (445 points) it is lower than the 2003 average score (473 points). Figure 9.3 shows a similar pattern in the scores of low/medium and medium/high socio-economic quarters from 2003 to 2015. However, the decrease is more pronounced for high socio-economic students from 2003 (579 points) to 2015 (540 points).

In summary, changes in average achievement appear more pronounced for high socio-economic students than for low socio-economic students both in the short term (since 2012) and over the longer term.

31 Approximately 68 percent of students in the OECD will have values that range between -1 and +1, and 95 percent of students will have values that range between -2 and +2.

32 The 25 percent of students with the next highest ESCS index values are referred to as low/medium, with medium/high the next group and high being the quarter of students with the highest ESCS index values.

33 The socio-economic index is not available for analysis of reading data from PISA 2000.

Exhibits 9.1 – 9.3: Average science, reading and mathematics performance by quarters of socio-economic status

Figure 9.1: Science

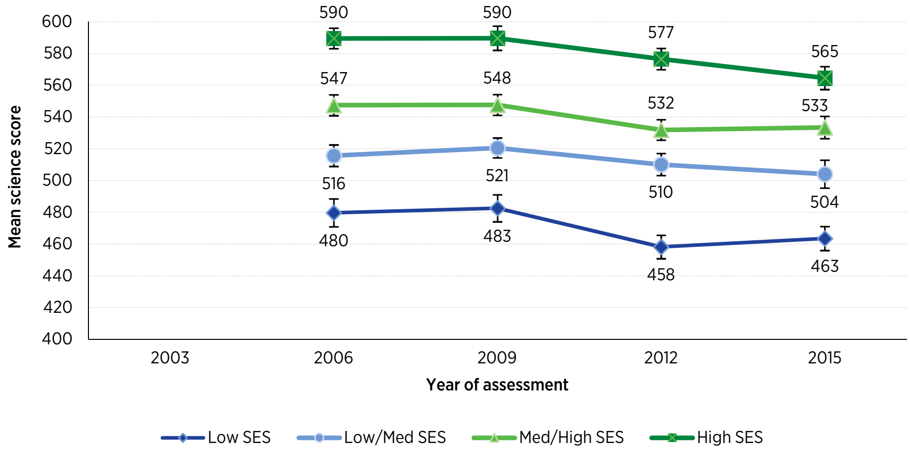


Figure 9.2: Reading

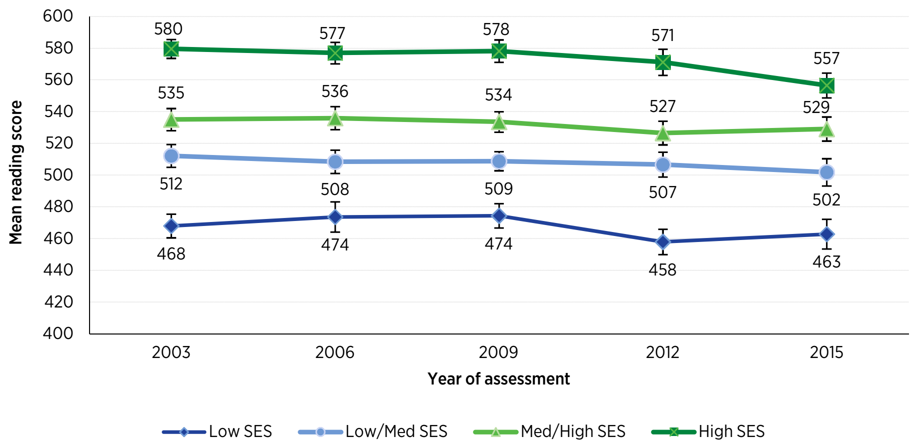
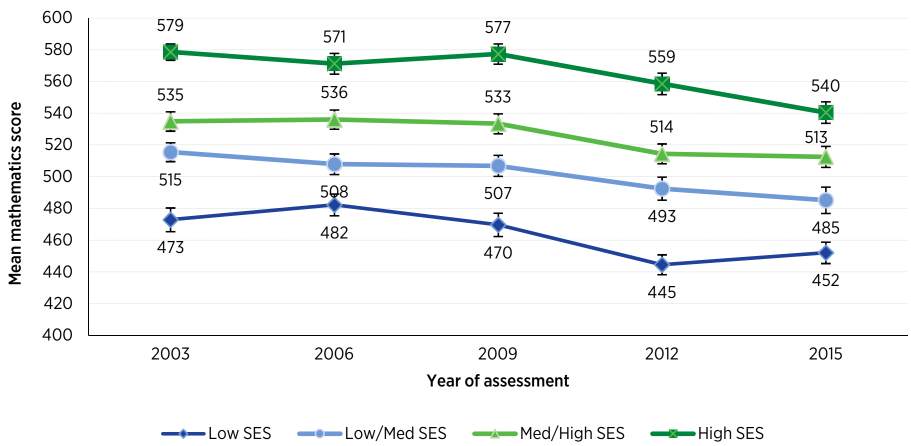


Figure 9.3: Mathematics



Notes: error bars on the graphs provide a 95 percent confidence interval for the estimate of the average.
Graphs begin at the year the subject was first the major focus of the year of assessment, except reading where ESCS is not available for PISA 2000.

Equity in achievement

An aim of high performing education systems is to provide high quality education to all students. These systems would not only have large proportions of students at the highest levels of reading, mathematical and scientific proficiency, but also relatively few students at the lower levels. These would be education systems characterised by a relatively small spread in scores and a relatively high average performance.

Importantly these systems would provide equitable outcomes for students with different background characteristics such as gender or socio-economic status.

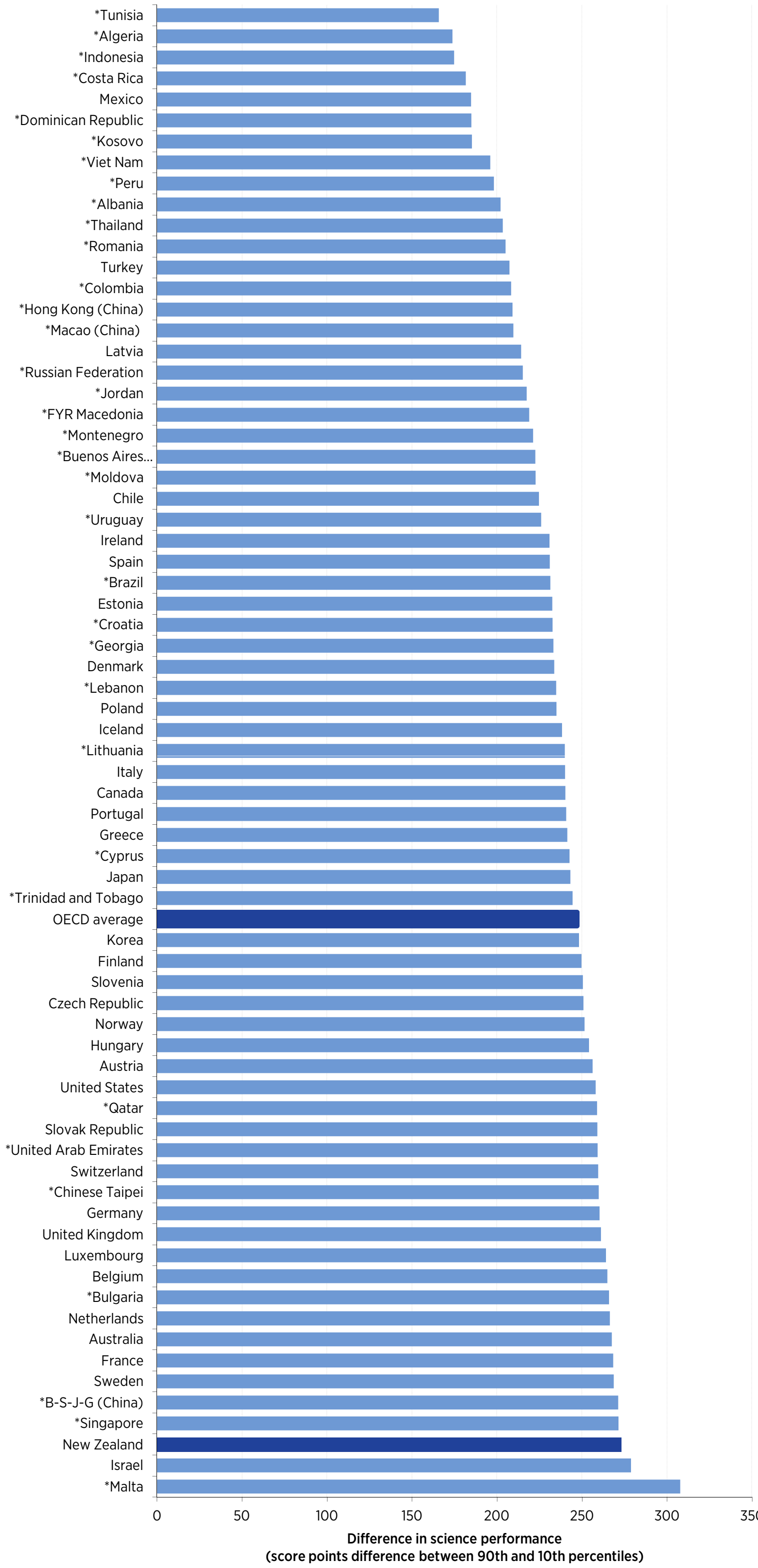
Equity in achievement

PISA provides a number of measures and indicators of equity in education. Both the average performance and the proportion of low achievers provide indicators of equity for sub-groups of the New Zealand population. For example, in New Zealand both boys and girls have average scores above the overall OECD average in science and scores that are not statistically different from each other. However, in reading the average score of New Zealand girls is much greater the average score for New Zealand boys. The average score of New Zealand girls in reading is also much greater than the overall OECD average whereas the average score for New Zealand boys is very similar to the overall OECD average.

The spread of scores in a country also helps to identify whether it is achieving equity in its education system. One measure of a country's spread of scores (variation in science performance) is the difference between students' scores at the upper end of the achievement distribution (the 90th percentile) and the lower end (the 10th percentile). On this measure, New Zealand has one of the widest spreads of science scores in the OECD. This means that the New Zealand education system has relatively large differences among 15-year-olds in scientific literacy.

Figure 10.1 shows the difference in score points between the top ten percent of students in a country and the bottom ten percent. The top performing OECD countries such as Japan, Estonia, Finland and Canada all have differences around the OECD mean or lower. Singapore is unusual in that it is one of the highest performing countries on average, but it has relatively low equity. Some countries with similar average performance to New Zealand such as Sweden and Australia also have similar differences to us between their top ten percent and bottom ten percent.

Figure 10.1: Score point difference between top ten percent and bottom ten percent of students



Notes: * before country name denotes a non-OECD country/economy

B-S-J-G (China) refers to the four participating China provinces: Beijing, Shanghai, Jiangsu, Guangdong.

FYR Macedonia refers to the Former Yugoslav Republic of Macedonia.

How much of the difference in science performance is associated with differences between schools?

The previous section looked at the spread of scores across New Zealand and found, particularly relative to some other countries, New Zealand has a wide spread of achievement. Going further, we can look at the differences in achievement that occur within and between schools and how New Zealand compares with other countries.

To some extent, how much difference there is between and within schools is related to the type of education system. For example, in countries like Germany where the students are placed in different types of schools early on, the differences within schools are relatively small and the differences between schools are relatively large. In other countries such as Finland where there is a comprehensive system the differences within schools are likely to be bigger when compared to the differences between schools. This needs to be taken into account when making comparisons with other countries.

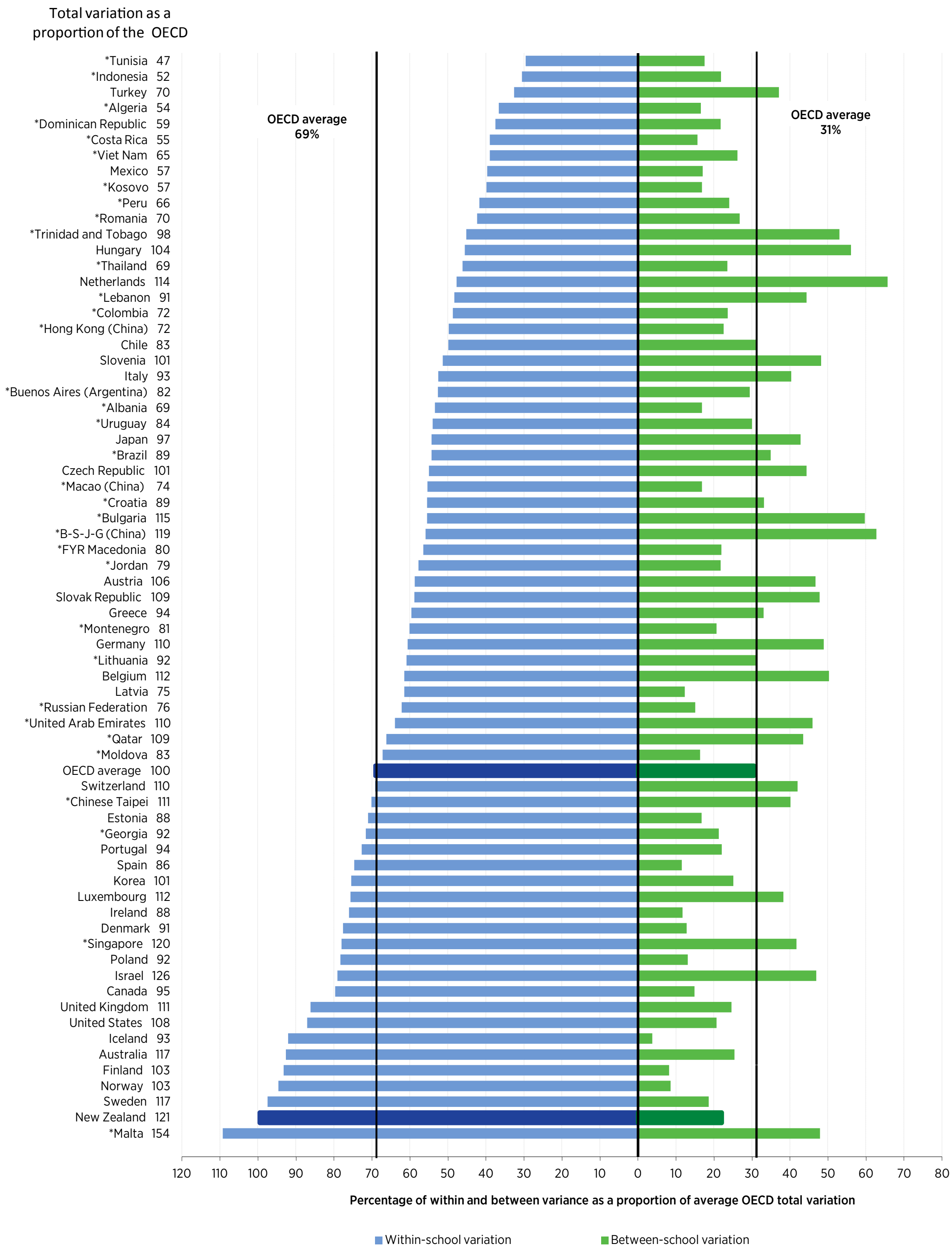
Figure 10.2 shows the differences between and within schools in science achievement for countries that participated in PISA 2015. Countries with large between-school differences have large differences between the average science performances of schools. As above, these can often be countries where schools have different educational programmes (or tracks) for their 15-year-olds. Other countries may have little differences in the average performance of different schools and the differences in student performance are mainly attributable to differences in achievement within schools.

Figure 10.2 shows that New Zealand particularly stands out because of larger differences within schools. While other countries such as Finland and Norway also have large within-school differences, a larger difference between schools is evident in New Zealand. This means that there are larger differences in the average performance of New Zealand schools compared to schools in either Finland or Norway.

However other countries such as Sweden, Australia, the United Kingdom and the United States where the spread of scores within their schools is well above the OECD average also have similar differences between schools to New Zealand.

For New Zealand and these countries there are noticeable differences between the average performances of schools. This means that some schools will have higher average achievement than other schools within the same country. The relatively large differences within schools means that these countries will also tend to have students with a wide range of abilities in many of their schools.

Figure 10.2: Between and within school variation in science achievement



Notes: * before country name denotes a non-OECD country/economy

B-S-J-G (China) refers to the four participating China provinces: Beijing, Shanghai, Jiangsu, Guangdong.

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How is New Zealand student performance in science associated with socio-economic status?

On average socio-economically advantaged students usually perform better than disadvantaged students[34]. However the relationship between student socio-economic status and performance is far from deterministic. In fact, for any group of students with similar socio-economic backgrounds, the range in performance is considerable. Likewise any group of students with a given score has a wide range of students from different socio-economic levels. Figure 10.3 illustrates this as well as other features of the relationship between socio-economic status and achievement. Each dot in Figure 10.3 represents a student randomly selected from across the OECD. The socio-economic gradients provide a summary of the relationship for the OECD and for New Zealand.

The socio-economic gradient lines on the graph describe the typical performance of a student given their socio-economic status. The strength of the relationship or how well this gradient line predicts the expected achievement of a student is related to the variation of scores around each point on the gradient line (ie. how closely points are clustered around the gradient). This is measured by the percentage of variation in performance explained by students' socio-economic status - the higher the percentage the stronger the relationship.

The slope of the socio-economic gradient measures the impact that socio-economic status has on achievement ie. how much scores would change, on average, for different levels of socio-economic status. It is defined as the average difference in performance between two students whose socio-economic status differs by one unit on the PISA index of economic, social and cultural status. As can be seen in the diagram the slope of the socio-economic gradient for New Zealand was much steeper than the gradient line for OECD countries.

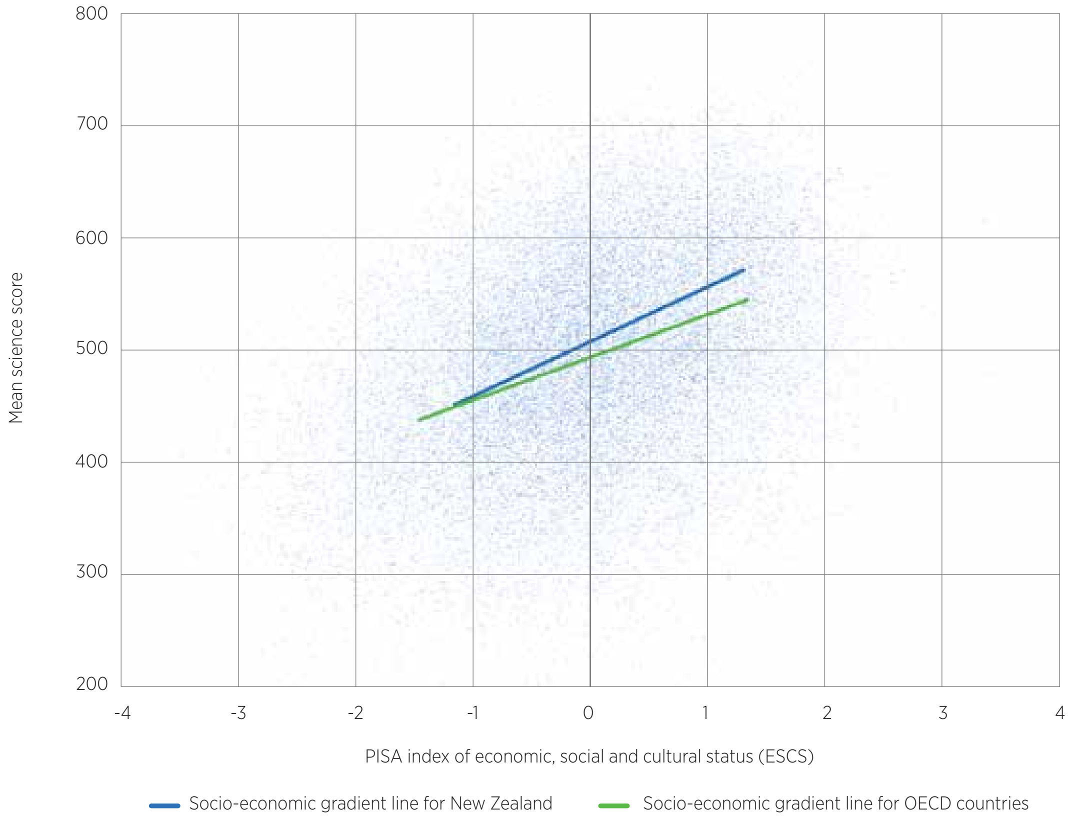
The above characteristics of the socio-economic gradients provide two further measures of equity. One relates to how strong socio-economic status is a predictor of achievement (the percentage of variation in performance explained by students' socio-economic status). Countries where socio-economic status is a weak predictor of achievement are considered more equitable, ie. *knowing a students' socio-economic status is not a good indicator of a students' science ability*. The other is an indicator of the impact of different levels of socio-economic status on achievement (the score point difference associated with a one-unit increase in the PISA index of economic, social and cultural status (ESCS)). Countries with small score point differences are considered more equitable.

For New Zealand students in 2015, 13 percent of the variation in science scores is explained by students' socio-economic background. This is the same as the OECD average. However the strength of the relationship has lessened since 2012 when 18 percent of the variation in science scores was explained by students' socio-economic background. This means that New Zealand is more likely to have low socio-economic students with good achievement and high socio-economic students with low achievement compared to PISA 2012. This is also reflected in Figure 9.1 earlier in this report where the mean scores for high socio-economic students and low socio-economic students are not as far apart in 2015 as they were in 2012. Socio-economic status is not as strong a predictor of achievement as it was and New Zealand now has a *level of equity on this indicator that is not different from the OECD average*.

On average across OECD countries, a one-unit increase on the PISA index of economic, social and cultural status (ESCS) is associated with an increase of 39 score points in the science assessment. In New Zealand, a one-unit increase is associated with a 49 score point difference in science achievement. This score-point difference is not statistically different to the 54 score point difference in PISA 2012 for science. New Zealand continues to *have a level of equity on this indicator that is lower than the OECD average*.

34 See also figures 9.1- 9.3 earlier in this report

Figure 10.3: **The relationship between socio-economic status and achievement**



In summary, New Zealand is a country where performance differences across socio-economic levels are large (ie. slope is steep and equity is comparatively low) and students often perform better (or worse) than expected given their socio-economic status (ie. strength of the relationship and equity is comparatively average). The OECD notes, that for countries with steep slope and weak strength targeting socio-economically disadvantaged students only would provide extra support to some students who are already performing relatively well, while it would leave out some students who are not necessarily disadvantaged but who perform poorly.

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Further information from PISA 2015

This report and further information from PISA 2015 are available from the Ministry of Education, Education Counts website at:

www.educationcounts.govt.nz/goto/pisa

Another national report, *PISA 2015: New Zealand summary report*, is also available, and this and any future national publications for PISA 2015 will be added to the website above.

As part of the global release of PISA 2015, the OECD has produced two international volumes:

» *PISA 2015 results (volume I): Excellence and equity in education.* (OECD, 2016)

» *PISA 2015 results (volume II): Policies and practices for successful schools*. (OECD, 2016)

The OECD international reports and further information on PISA in an international context can be found on the OECD PISA webpage **www.oecd.org/pisa/**. Future international reports, including the PISA 2015 technical report, will also be available from this website.

Data in this report are sourced either from the OECD volumes I and II or the PISA 2015 database.

Definitions and technical notes

PISA 2015 literacy definitions

Scientific literacy: The ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to:

» *Explain phenomena scientifically* – recognise, offer and evaluate explanations for a range of natural and technological phenomena.

» *Evaluate and design scientific enquiry* – describe and appraise scientific investigations and propose ways of addressing questions scientifically.

» *Interpret data and evidence scientifically* – analyse and evaluate data, claims and arguments in a variety of representations and draw appropriate scientific conclusions.

Mathematical Literacy: An individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens.

Reading Literacy: An individual's ability to understand, use, reflect on and engage with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society.

Technical Notes

Average

Student performances in PISA are reported using means (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 it is referred to in this report as 'the average'. Note that for PISA, as with other large-scale studies, the means for a country are adjusted slightly (in technical terms 'weighted') to reflect the total population of 15-year-olds rather than just the sample.

OECD average

The OECD average includes only the OECD countries: no non-OECD (partner) countries are included in this average. The OECD average is the average of the means for all the OECD countries that have data available. Achievement data were not available for: Chile, Estonia, Israel, Slovenia and the United Kingdom in 2000 (reading) and in 2003 (reading and maths); plus Netherlands in 2000 (reading); United States in 2006 (reading); and Austria in 2009 (all subjects).

Points – or scale score points

The design of PISA allows for a large number of questions to be used in reading, mathematics and science, but each student answers only a proportion of these questions. PISA employs techniques to enable population estimates of achievement to be produced for each country even though a sample of students responded to differing selections of questions. These techniques result in scores which are on a scale with an average value of 500. Scores on this scale are referred to in this report as points. About two-thirds of students across OECD countries score between 400 and 600 points.

Standard error, confidence intervals and error bars

Because of the technical nature of PISA, the calculation of statistics such as averages and proportions has 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 (usually given in brackets) provide a measure of this uncertainty. In general, we can be 95 percent confident that the true population value lies within an interval 1.96 standard errors either side of the given statistic. This has been displayed on graphs in this report as error bars. The error bars provide a measure of the precision of the estimate of the average.

Proficiency levels

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. Note that students were considered to be proficient at a particular level if, on the basis of their overall performance, they could be expected to answer 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.

Summary descriptions of the proficiency levels for science, reading and mathematics are on the following pages:

Summary description of the seven levels of proficiency in science in PISA 2015

Level	Lower score limit	Characteristics of tasks
6	708	At Level 6, students can draw on a range of interrelated scientific ideas and concepts from the physical, life and earth and space sciences and use content, procedural and epistemic knowledge in order to offer explanatory hypotheses of novel scientific phenomena, events and processes or to make predictions. In interpreting data and evidence, they are able to discriminate between relevant and irrelevant information and can draw on knowledge external to the normal school curriculum. They can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations. Level 6 students can evaluate competing designs of complex experiments, field studies or simulations and justify their choices.
5	633	At Level 5, students can use abstract scientific ideas or concepts to explain unfamiliar and more complex phenomena, events and processes involving multiple causal links. They are able to apply more sophisticated epistemic knowledge to evaluate alternative experimental designs and justify their choices and use theoretical knowledge to interpret information or make predictions. Level 5 students can evaluate ways of exploring a given question scientifically and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data.
4	559	At Level 4, students can use more complex or more abstract content knowledge, which is either provided or recalled, to construct explanations of more complex or less familiar events and processes. They can conduct experiments involving two or more independent variables in a constrained context. They are able to justify an experimental design, drawing on elements of procedural and epistemic knowledge. Level 4 students can interpret data drawn from a moderately complex data set or less familiar context, draw appropriate conclusions that go beyond the data and provide justifications for their choices.
3	484	At Level 3, students can draw upon moderately complex content knowledge to identify or construct explanations of familiar phenomena. In less familiar or more complex situations, they can construct explanations with relevant cueing or support. They can draw on elements of procedural or epistemic knowledge to carry out a simple experiment in a constrained context. Level 3 students are able to distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim.
2	410	At Level 2, students are able to draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation, interpret data, and identify the question being addressed in a simple experimental design. They can use basic or everyday scientific knowledge to identify a valid conclusion from a simple data set. Level 2 students demonstrate basic epistemic knowledge by being able to identify questions that can be investigated scientifically.
1a	335	At Level 1a, students are able to use basic or everyday content and procedural knowledge to recognise or identify explanations of simple scientific phenomenon. With support, they can undertake structured scientific enquiries with no more than two variables. They are able to identify simple causal or correlational relationships and interpret graphical and visual data that require a low level of cognitive demand. Level 1a students can select the best scientific explanation for given data in familiar personal, local and global contexts.
1b	261	At Level 1b, students can use basic or everyday scientific knowledge to recognise aspects of familiar or simple phenomenon. They are able to identify simple patterns in data, recognise basic scientific terms and follow explicit instructions to carry out a scientific procedure.

Summary description of the seven levels of reading proficiency in PISA 2015

Level	Lower score limit	Characteristics of tasks
6	698	Tasks at this level typically require the reader to make multiple inferences, comparisons and contrasts that are both detailed and precise. They require demonstration of a full and detailed understanding of one or more texts and may involve integrating information from more than one text. Tasks may require the reader to deal with unfamiliar ideas in the presence of prominent competing information, and to generate abstract categories for interpretations. Reflect and evaluate tasks may require the reader to hypothesise about or critically evaluate a complex text on an unfamiliar topic, taking into account multiple criteria or perspectives, and applying sophisticated understanding from beyond the text. A salient condition for access and retrieve tasks at this level is precision of analysis and fine attention to detail that is inconspicuous in the texts.
5	626	Tasks at this level that involve retrieving information require the reader to locate and organise several pieces of deeply embedded information, inferring which information in the text is relevant. Reflective tasks require critical evaluation or hypothesis formulation, drawing on specialised knowledge. Both interpretative and reflective tasks require a full and detailed understanding of a text whose content or form is unfamiliar. For all aspects of reading, tasks at this level typically involve dealing with concepts that are contrary to expectations.
4	553	Tasks at this level that involve retrieving information require the reader to locate and organise several pieces of embedded information. Some tasks at this level require interpreting the meaning of nuances of language in a section of text by taking into account the text as a whole. Other interpretative tasks require understanding and applying categories in an unfamiliar context. Reflective tasks at this level require readers to use formal or public knowledge to hypothesise about or critically evaluate a text. Readers must demonstrate an accurate understanding of long or complex texts whose content or form may be unfamiliar.
3	480	Tasks at this level require the reader to locate, and in some cases recognise the relationship between, several pieces of information that must meet multiple conditions. Interpretative tasks at this level require the reader to 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. They need to take into account many features in comparing, contrasting or categorising. Often the required information is not prominent or there is much competing information; or there are other text obstacles, such as ideas that are contrary to expectations or negatively worded. Reflective tasks at this level may require connections, comparisons and explanations, or they may require the reader to evaluate a feature of the text. Some reflective tasks require readers to demonstrate a fine understanding of the text in relation to familiar, everyday knowledge. Other tasks do not require detailed text comprehension but require the reader to draw on less common knowledge.
2	407	Some tasks at this level require the reader to locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. Others require recognising the main idea in a text, understanding relationships, or construing meaning within a limited part of the text when the information is not prominent and the reader must make low level inferences. Tasks at this level may involve comparisons or contrasts based on a single feature in the text. Typical reflective tasks at this level require readers to make a comparison or several connections between the text and outside knowledge, by drawing on personal experience and attitudes.
1a	335	Tasks at this level require the reader to locate one or more independent pieces of explicitly stated information; to recognise the main theme or author's purpose in a text about a familiar topic, or to make a simple connection between information in the text and common, everyday knowledge. Typically the required information in the text is prominent and there is little, if any, competing information. The reader is explicitly directed to consider relevant factors in the task and in the text.
1b	262	Tasks at this level require the reader to locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text with a familiar context and text type, such as a narrative or a simple list. The text typically provides support to the reader, such as repetition of information, pictures or familiar symbols. There is minimal competing information. In tasks requiring interpretation the reader may need to make simple connections between adjacent pieces of information.

Summary description of the six levels of mathematics proficiency in PISA 2015

Level	Lower score limit	Characteristics of tasks
6	669	At Level 6, students can conceptualise, generalise and utilise information based on their investigations and modelling of complex problem situations, and can use their knowledge in relatively non-standard contexts. 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 understanding, 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 reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situation.
5	607	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 begin to reflect on their work and can formulate and communicate their interpretations and reasoning.
4	545	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, linking them directly to aspects of real-world situations. Students at this level can utilise their limited range of skills and can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	482	At Level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
2	420	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 to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
1	358	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 almost always obvious and follow immediately from the given stimuli.

Participants in PISA 2015

- Albania*
- Algeria*
- Argentina*
- Australia
- Austria
- Belguim
- Brazil*
- B-S-J-G (China)*
- Bulgaria*
- Canada
- Chile
- Chinese Taipei*
- Colombia*
- Costa Rica*
- Croatia*
- Cyprus*
- Czech Republic
- Denmark
- Dominican Republic*
- Estonia
- Finland
- France
- Germany
- Georgia*
- Greece
- Hong Kong (China)*
- Hungary
- Iceland
- Indonesia*
- Ireland
- Israel
- Italy
- Japan
- Jordan
- Kazakhstan*
- Korea
- Kosovo*
- Latvia
- Lebanon*
- Lithuania*
- Luxembourg
- Macao (China)*
- FYR Macedonia*
- Malaysia*
- Malta*
- Mexico
- Moldova*
- Montenegro*
- Netherlands
- New Zealand
- Norway
- Peru*
- Poland
- Portugal
- Qatar*
- Romania*
- Russian Federation*
- Singapore*
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- Thailand*
- Trinidad & Tobago*
- Tunisia*
- Turkey
- United Arab Emirates*
- United Kingdom
- United States
- Uruguay*
- Vietnam*

* non-OECD countries and economies
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