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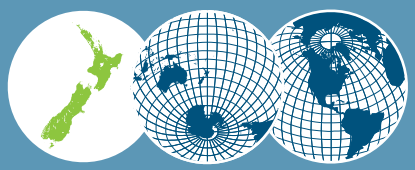
OECD

PISA2012

Series on the Learning Environment, Volume II

Delivery of maths



MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

New Zealand Government

Foreword

The PISA survey measures the abilities of 15-year-olds in mathematics, science and reading. The survey is undertaken every three years by the OECD. In 2012, 65 countries participated.

In 2012 results for New Zealand showed a decline in mathematics, reading and science ability since 2009. The proportion of students at the lowest levels of achievement has increased. New Zealand's results are still above the OECD average in mathematics, reading and science.

The 15 year-olds assessed in this survey started school in 2002. Since that time there have been a number of initiatives put in place to address inequity of achievement among students and to lift the quality of learning and teaching overall.

There have been some successes and there are pockets of excellence in achievement, including in schools in disadvantaged areas. But these successes do not spread easily to other schools. The New Zealand system does not easily support the spread of good practices between schools, and direct interventions in schools that struggle with student achievement have not always been as effective as expected.

Considered together, the information in the Learning Environment series reinforces how important it is for students to get support from their parents, whānau, peers, and those working in their school and the community if they are to reach their potential. The New Zealand PISA data – as well as the data from other countries – clearly establishes a relationship between some of the factors operating in the home and community, in the classroom and school, and student achievement in maths. The data show that support for a student's learning needs to be available in all the contexts in which they acquire their skills and knowledge.

It is unlikely that a student's learning will be better supported or hindered by changing one thing alone – particularly for those students who do not reach the levels of proficiency in the PISA assessment that are associated with supporting a student to participate fully in modern society. But ensuring that students are supported to attend school and classes; are in classrooms where the environment is conducive to learning; are able to enjoy positive relationships with their teachers; are supported by quality teaching – including opportunities to become familiar with all aspects of the curriculum – can make a real difference to what they achieve

An overview of PISA

The Programme for International Student Assessment (PISA) is an international study that assesses and compares how well countries are preparing their 15-year-old students to meet real-life opportunities and challenges after completing around 10 years of compulsory schooling.

PISA is an initiative of the Organisation for Economic Co-operation and Development (OECD) and a collaborative effort of participating countries. In New Zealand, the Ministry of Education is responsible for implementing and analysing PISA results.

PISA provides countries with information on student achievement and how this relates to student and family factors, school-level factors affecting teaching and learning, and system-related factors.

PISA uses a broad approach to "determine the extent to which young people have acquired the wider knowledge and skills in reading, mathematics and science that they will need in adult life".[1] It is not restricted to assessing how well students have mastered the content of a national school curriculum.

PISA has been administered every three years since it began in 2000. Each time PISA is administered, three key areas of knowledge and skills are assessed: reading literacy, mathematical literacy and scientific literacy. Rotating the main focus for each cycle of PISA provides detailed information on one main literacy area, along with an ongoing source of data on two minor areas.

The focus of PISA 2012 was mathematical literacy, as it was in 2003.

In each country, students complete a two-hour test booklet in their language of instruction.[2] Background information was gathered from students and school principal questionnaires.

Approximately half a million 15-year-old students from 65 countries[3] participated in PISA 2012, including the 34 OECD member countries. In New Zealand, over 5,000 students from 177 schools took part.[4] The majority of these students started school in 2001, the rest in 2002.

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

Further details on PISA study design and quality assurance procedures will be provided in the OECD's forthcoming *PISA 2012 Technical Report*.

1 OECD (2013), *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy*, OECD Publishing – p 14.

2 In New Zealand, PISA was administered only in English

3 PISA participants include countries and economies, such as Shanghai-China. For brevity the word 'countries' in this report will refer to both countries and economies

4 This includes nearly 1,000 students who took part in the additional financial literacy component.

Contents

Introduction

The Series on the Learning Environment presents findings from PISA 2012 on the student experience of learning maths in New Zealand classrooms compared with classrooms overseas.[5] The three volumes in this series focus on how opportunities for New Zealand students to learn maths, school resources, the delivery of maths in classrooms and student behaviour are linked to maths achievement.

The analysis draws on information collected from students that reflects their cumulative schooling experience in terms of maths achievement, including their current school and home experience.

In this second volume, *Delivery of Maths* (Volume II), how mathematical content is delivered in classrooms is examined. Information is presented on:

- → maths teaching staff, including teacher qualifications, participation in professional development with a focus on maths, the maths teacher:student ratio, and principals' reports of teacher shortage and how this relates to maths achievement
- → principals' reports of quality of physical infrastructure and educational resources in their schools
- → principals' reports of teacher factors that hinder student learning
- → students' reports of teacher–student relations at school
- → students' reports of four teaching practices in maths lessons (cognitive activation, student orientation, teacher-directed instruction and formative assessment[6])
- → school principals' reports of ability grouping practices within and between maths classes

New Zealand's standing is presented relative to the OECD as a whole and a core group of selected comparison countries. The four comparison countries have been selected for two main reasons: English is a language of instruction in these countries, and they represent a range in average maths achievement, with scores that are lower than, similar to, and greater than New Zealand. Table 1 lists these countries, together with their mean maths score and distribution.

5 The 15-year-old students from around the world who took part in PISA 2012 are enrolled in different grades and will be exposed to different content and classroom environments.

6 These practices are described and explained in the sections in which they occur, and also in Appendix 4.

Table 1: Average maths achievement score and standard deviation for New Zealand and selected countries

	Mean maths score	Standard deviation
New Zealand	500 (2.2)	100 (1.2)
OECD	**494** (0.5)	**92** (0.3)
Australia	504 (1.6)	**96** (1.2)
United Kingdom	494 (3.3)	**95** (1.7)
Canada	**518** (1.8)	**89** (0.8)
Singapore	**573** (1.3)	**105** (0.9)

Note: Average scores and standard deviations of countries significantly different from New Zealand are in bold.
Standard errors are presented in parentheses.

Source: OECD (2013), *PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science (Volume I)*, PISA, OECD Publishing.

New Zealand's average maths achievement (500 points) was higher than the OECD average (494 points). The spread of scores in New Zealand – as shown by the size of the standard deviation – was relatively wide compared with the OECD average.

New Zealand's spread of scores was also relatively wide compared with all the comparison countries apart from Singapore, which had a wide spread of scores, particularly for a high-performing country.

Appendix 1 presents a summary of maths achievement and highlights some of the differences in New Zealand compared with those in the OECD.

Appendix 2 presents the data for the figures in the body of this report.

Appendix 3 looks at the relationship between variables presented in this report and achievement.

Appendix 4 contains the definitions of technical terms and concepts analysed in this report.

When interpreting data presented in this report, it is important to note the following points:

- → 'Maths achievement' refers to the PISA measure of mathematical literacy[7] (see Appendix 4 for a more detailed definition).
- → Information is presented from student and principal questionnaires only. Data relating to teachers, such as teaching practices, were provided by students and principals
- → Any relationship between factors described in this report should not be interpreted as causal.
- → A difference of 35 points in the New Zealand results is regarded by the OCED as equivalent to the difference of one year of formal schooling.

7 The PISA 2012 Assessment and Analytical Framework provides a full description of what mathematical literacy is and how it is measured [OECD (2013), PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy, OECD Publishing].

Key findings

Delivery of maths

Maths teaching staff

- → The proportion of maths teachers in New Zealand with a degree-level qualification in teaching was lower than in the United Kingdom, Singapore and Australia, but on a par with Canada.
- → New Zealand students in urban schools were more likely to be taught by maths teachers with degree-level qualifications than students in rural and town schools.
- → New Zealand students in schools where a larger proportion of students are from low socio-economic backgrounds were less likely to be taught by maths teachers with degree-level qualifications than students in schools where a larger proportion of students have high socio-economic backgrounds.
- → A higher proportion of New Zealand teachers had attended a programme of professional development with a focus on maths than in Australia and the United Kingdom, and noticeably more than in the OECD overall. The proportion in Singapore was higher than in New Zealand.
- → Principals in New Zealand, Australia and Singapore reported that teacher shortages hindered instruction to a much greater extent than did principals in the OECD overall, the United Kingdom and Canada.
- → Students from low socio-economic backgrounds were more likely to be in schools where principals reported that teacher shortage hindered instruction than students from high socio-economic backgrounds.
- → Principals of New Zealand students in socio-economically disadvantaged schools were more likely to report that teacher shortage hindered instruction than did principals of students in advantaged schools. New Zealand stood out among PISA participants in this respect.
- → Principals in rural schools reported that teacher shortage was more of an issue than did principals in urban schools.
- → In schools that reported a greater shortage of teachers, maths achievement tended to be lower.

Physical infrastructure and educational resources at school

- → Although the reported quality of physical infrastructure in New Zealand schools was close to the OECD average, it was lower than that reported in Canada and Singapore. Close to one-third of New Zealand students attend schools whose principals reported that a shortage or inadequacy of physical infrastructure hindered learning. Reported quality of physical infrastructure was not linked with maths achievement in New Zealand.
- → In terms of reported quality of educational resources, shortage or inadequacy of computers and internet was most likely to hinder learning according to New Zealand principals, although New Zealand schools had one of the highest computer:student ratios. Reported quality of educational resources in New Zealand was similar to that in Canada but lower than in Australia, the United Kingdom and Singapore.
- → New Zealand stood out among PISA participants for having one of the largest disparities between public and private schools in reported quality of educational resources.
- → Students in schools whose principals reported a higher quality of educational resources achieved higher maths scores.

Teacher factors

→ New Zealand principals reported that the teacher-related factors and classroom challenges that hindered learning most were: not meeting the needs of individual students and teaching in classes with students of diverse ability levels, and teaching students from diverse backgrounds. Lower maths achievement was found among students in schools where these teacher-related factors were present at least to some extent.

Teacher–student relations at school

→ New Zealand students' reports of teacher–student relations improved noticeably between 2003 and 2012, but teacher–student relations were still viewed more positively overall in Singapore and Canada than in New Zealand.

→ Students with more positive reports about teacher–student relations were more likely to achieve higher maths scores than students who were not as positive.

→ The link between teacher–student relations and maths achievement found in New Zealand classrooms was one of the strongest among the PISA participants.

Teaching practices in maths lessons

→ According to students, formative assessment and cognitive activation were used *most often* in maths classes in New Zealand. *Formative assessment* is about providing feedback to students as part of the teaching and learning process, and *cognitive activation* is about asking questions that encourage students to reflect in different ways on the mathematical problems they are solving. These two practices were used even more frequently in Canada, the United Kingdom and Singapore.

→ In New Zealand, the more teachers encouraged students to reflect on mathematical problems (cognitive activation), the higher their achievement. However, lower achievement was associated with greater use of formative assessment by teachers.

→ According to students, the two practices used *less often* in New Zealand were student orientation and, in particular, teacher-directed instruction. *Student orientation* focuses on assigning different tasks to different students, has students work in small groups, and involves students in planning. *Teacher-directed instruction* focuses on goal setting, checking whether students have understood, and telling students what they have to learn. Student orientation was used more frequently in New Zealand than in Australia, and teacher-directed instruction was used much more regularly in Canada, the United Kingdom and Singapore than in New Zealand, where it was the least used of the four practices.

→ In New Zealand, lower achievement was associated with greater use of student orientation. There was no link between teacher-directed instruction and achievement.

Ability grouping in maths classes

→ New Zealand was notable for its extensive ability grouping practices within maths classes as well as across classes.

→ Across OECD countries, school practices of ability grouping for maths classes were not linked with maths achievement.

Delivery of maths

Volume II of the Series on the Learning Environment focuses on the delivery of mathematical content in classrooms and how it is linked to maths achievement.

First, information on aspects of maths teachers is presented, including teacher qualifications and participation in professional development with a focus on maths, as well as the maths teacher:student ratio within the school[8] and principals' reports of teacher shortage.

Second, principals' reports of the quality of physical infrastructure and educational resources in their schools are examined.

Third, principals' reports of teacher factors that can hinder student learning are presented. Next, students' reports of teacher–student relations at school and of four teaching practices in their maths lessons are explored.

Finally, we examine school principals' reports of ability grouping practices in maths classes.

Maths teachers

A number of aspects of maths teaching are examined in terms of differences across New Zealand schools in the qualifications of maths teachers, professional development in maths, the ratio of maths teachers to students in a school, and reported shortages of maths teachers compared to the OECD average and selected countries.

8 The average number of students per maths teacher in a school does not relate to class size. Rather, it represents the number of students in a school relative to the number of maths teachers in the school.

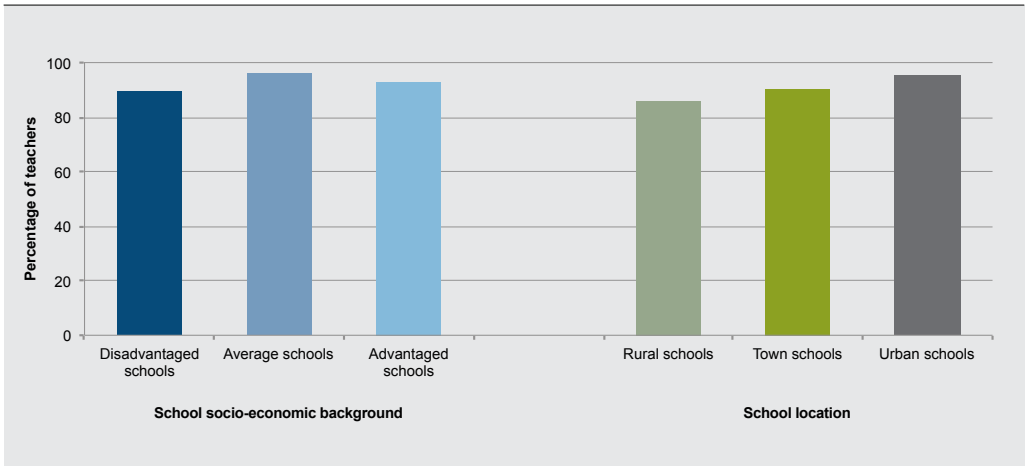
How many maths teachers in New Zealand schools have a degree-level qualification?

Figure 1 illustrates the percentage of maths teachers (including both part time and full time) with degree-level qualifications in New Zealand schools, by school average socio-economic background and school location.

PISA created an index of economic, social and cultural status (ESCS) that is used as a measure of socio-economic status for students,[9] and also compared the average ESCS of students in each school to the average ESCS of students in the system as a whole to distinguish between socio-economically advantaged, average and disadvantaged schools (see Appendix 4 for more information). As well as being able to compare schools within a country, this makes it possible to look at the performance of schools from an international perspective.

There was a noticeable difference of 7 percent in the proportion of maths teachers with degree-level qualifications between socio-economically disadvantaged and average schools, a difference of 5 percent between town and urban schools, and a difference of 10 percent between rural and urban schools.

Figure 1: Percentage of maths teachers in New Zealand schools with degree-level qualifications



9 Low ESCS students are those in the bottom quarter of the PISA ESCS index within a country, and high ESCS students are those in the top quarter of the index.

What qualifications do maths teachers have?

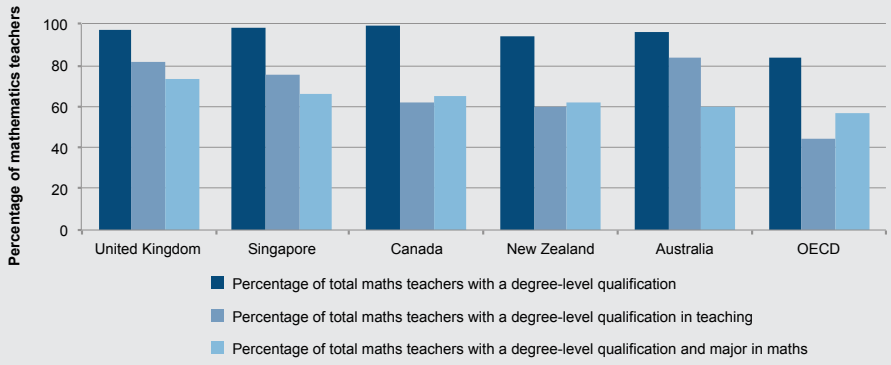
Principals provided data on the percentages of total full-time maths teachers in their school with a degree-level qualification, a degree-level qualification in teaching (eg, BEd or postgraduate diploma), and a degree-level qualification and major in maths, as shown in Figure 2.

More than 90 percent of maths teachers have a tertiary qualification in New Zealand, Australia, the United Kingdom, Canada and Singapore, compared to over 80 percent of maths teachers in the OECD overall.

Close to 60 percent of maths teachers in New Zealand and Canada have a teaching qualification, compared to over 40 percent in the OECD overall, over 70 percent in Singapore, and over 80 percent in the United Kingdom and Australia.

Finally, 60 percent or more maths teachers in New Zealand, Australia, Canada and Singapore have a qualification with specialised knowledge in maths, compared to over 50 percent of maths teachers in the OECD overall, and over 70 percent in the United Kingdom.

Figure 2: Percentage of maths teachers with relevant qualifications

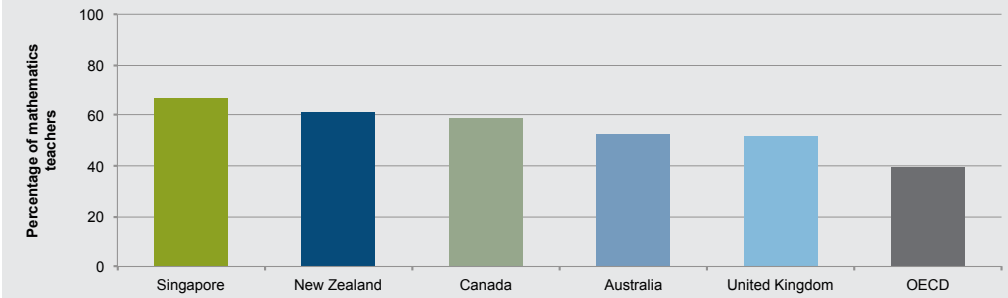


What professional development opportunities do maths teachers have?

Figure 3 shows the percentage of maths teachers who had attended a programme of professional development over the last three months, of at least one day's duration, with a focus on maths. This information was provided by the school principals.

Over sixty percent of maths teachers in New Zealand had attended a professional development programme, similar to the percentage in Canada and Singapore and greater than the percentage of teachers in Australia, the United Kingdom and the OECD overall.

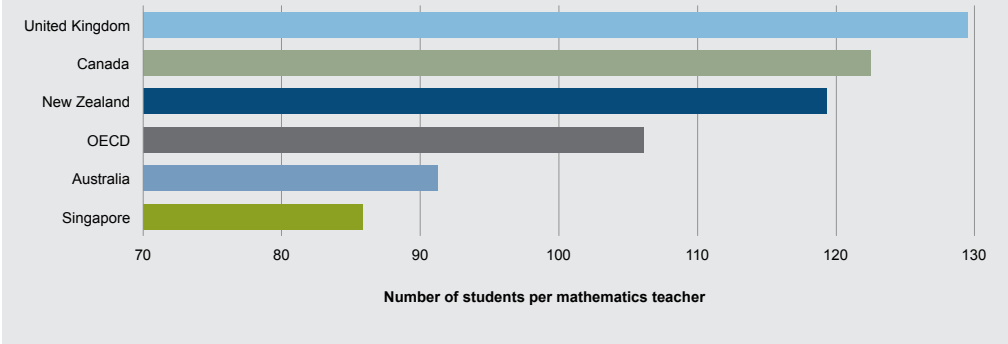
Figure 3: Percentage of maths teachers who had attended a programme of professional development with a focus on maths



How many students per maths teacher are there in schools?

Figure 4 shows that the average number of students per maths teacher in New Zealand (119) is similar to that in Canada, lower than in the United Kingdom, but higher than in the OECD, Australia and Singapore.

Figure 4: Student:maths teacher ratio in schools



Note: The student:maths teacher ratio is not an indicator of class size or contact time.

Do principals report that a shortage of qualified maths teachers hinders instruction?

Seventy-seven percent of New Zealand principals reported that learning is either not at all hindered or is hindered very little by a shortage of qualified maths teachers at their school. However, 16 percent of principals reported that learning is hindered to some extent, and 5 percent reported that learning is hindered a lot, by a shortage of qualified maths teachers.

Is a reported shortage of qualified maths teachers related to achievement?

Students in New Zealand schools where principals reported that instruction is hindered a lot by a shortage of qualified maths teachers scored 26 points lower than students in schools where instruction is not at all hindered by such shortage. This was similar to the 28-point decrease in the OECD overall.

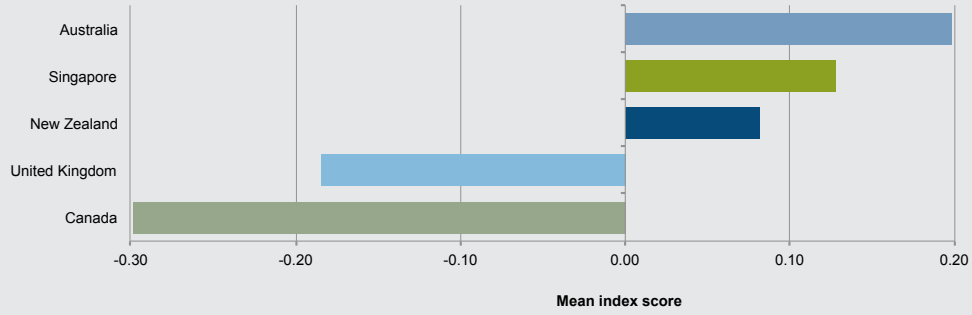
Do principals report that a shortage in qualified teachers hinders instruction?

School principals were asked to report on the extent to which they think that instruction in their school is hindered by a lack of qualified teachers and staff in science, maths, the language of instruction and other subjects, from 'not at all', 'very little', 'to some extent', to 'a lot'. This information was combined to create a composite index of teacher shortage, standardised across OECD countries, such that the index has an average of 0 and a standard deviation of 1.

Unlike most indices in this report, where positive values indicate a more positive learning environment, in the case of teacher shortage, positive values indicate principals' reporting that there are more problems with instruction due to teacher shortages, and negative values indicate principals reporting that teacher shortage hinders learning to a lesser extent than in the OECD overall.

Figure 5 shows that principals in New Zealand, Australia and Singapore reported that teacher shortage hinders instruction to a greater extent than did principals in the OECD overall, while principals in the United Kingdom and Canada reported that teacher shortage hinders instruction to a lesser extent.

Figure 5: Principals' average reports of teacher shortage



Note: The index of teacher shortage is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports that teacher shortage hinders instruction to a greater extent than the OECD, and negative values indicate that teacher shortage hinders instruction less than in the OECD.

Low ESCS students are more likely than high ESCS students to be in schools where principals reported that teacher shortage hinders instruction. The average index value for teacher shortage for low ESCS students is 0.2 compared to –0.9 index points for high ESCS students; that is, teacher shortage is reported to hinder instruction to a lesser extent in schools attended by high ESCS students.

Reported teacher shortage is higher in socio-economically disadvantaged schools (0.6 index points) than in advantaged schools (–0.3 index points), and is higher in schools located in rural areas (0.4 index points) and in towns (0.4 index points) than in city schools (–0.1 index points).

New Zealand and Australia have some of the largest gaps in reported teacher shortage between socio-economically advantaged and disadvantaged schools among PISA participants.

Have reports of teacher shortage changed since 2003?

In New Zealand, principals reported less teacher shortage in 2012 than in 2003, with a decrease of 0.6 index points. The percentage of students in schools whose principal reported that the school's capacity to provide instruction is hindered a lot by a lack of qualified maths teachers had decreased by 26 percent since 2003.

When looking at this decrease by school features, the greatest decrease in shortage of qualified maths teachers is evident among low ESCS students (from 48% to 15%), socio-economically disadvantaged schools (from 63% to 18%), public schools (from 42% to 15%) and rural schools (from 56% to 14%).

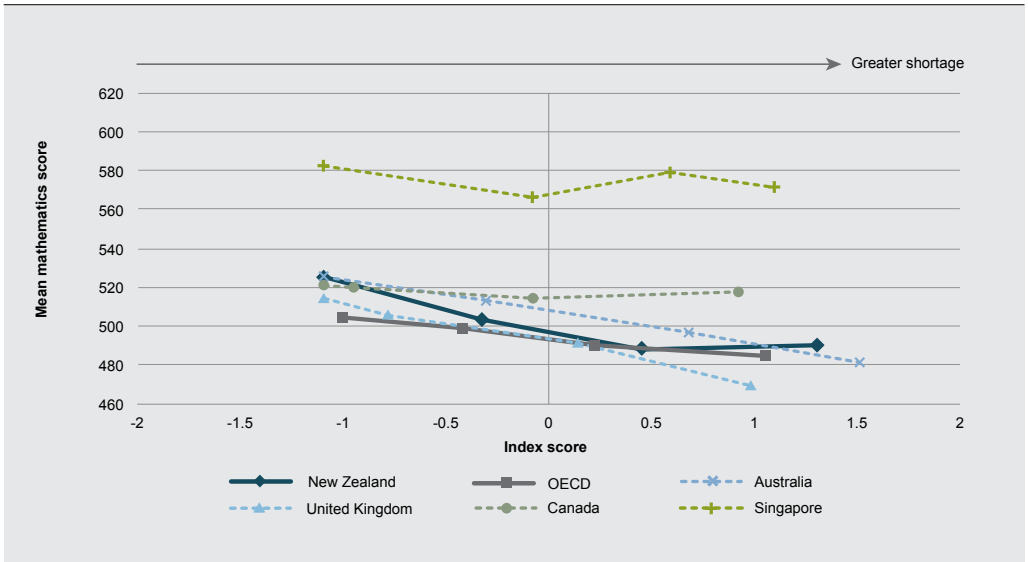
Is teacher shortage linked to maths achievement?

Figure 6 shows the average maths achievement for levels of teacher shortage. This is shown through quarters of the index of teacher shortage, such that a positive number indicates teacher shortages hinder maths learning to a greater degree than in the OECD overall.

New Zealand students in schools with the lowest reports of teacher shortage have an average score of 526 points in maths, and those students in schools with the highest reports of teacher shortages have an average maths score of 490 points.

In New Zealand, the OECD, Australia, the United Kingdom and Singapore, greater reported teacher shortage is linked to lower maths achievement, although this association is not evident in Canada. Reported teacher shortage has a weak relationship to maths achievement in New Zealand and in the OECD as a whole (see Appendix 3).

Figure 6: The link between teacher shortage and maths achievement



Note: The index of teacher shortage is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement of students is plotted against national quarters of this index.

Quality of physical infrastructure and educational resources at school

This section focuses on principals' reports that their schools' capacity to provide instruction is hindered by a shortage or inadequacy of physical infrastructure and educational resources, and the link between such shortages and the maths achievement of students.

Principals indicated the extent to which they think their school's capacity to provide instruction is hindered by a shortage or inadequacy of physical infrastructure and educational resources in their school. Responses to items presented in Figure 7 ranged from 'not at all', 'very little', 'to some extent' to 'a lot'.

Do principals report that the quality of physical infrastructure and educational resources hinders instruction?

Figure 7 illustrates the percentage of New Zealand students attending schools where principals reported that instruction is hindered by a shortage or inadequacy of infrastructure or resources.

In New Zealand, shortages or inadequacy of computers and internet connectivity are most likely to hinder instruction, with approximately 40 percent of students attending schools where principals reported that instruction is impaired because of such shortages. However, New Zealand schools on average have one of the highest computer per student ratios in the OECD, with at least one available per student.

Close to one third of students attend schools whose principals reported that a shortage or inadequacy of physical infrastructure, including school buildings and grounds and instructional space, hinders learning.

Figure 7: Percentage of students in New Zealand schools where principals reported instruction is hindered by a shortage or inadequacy of physical infrastructure and educational resources

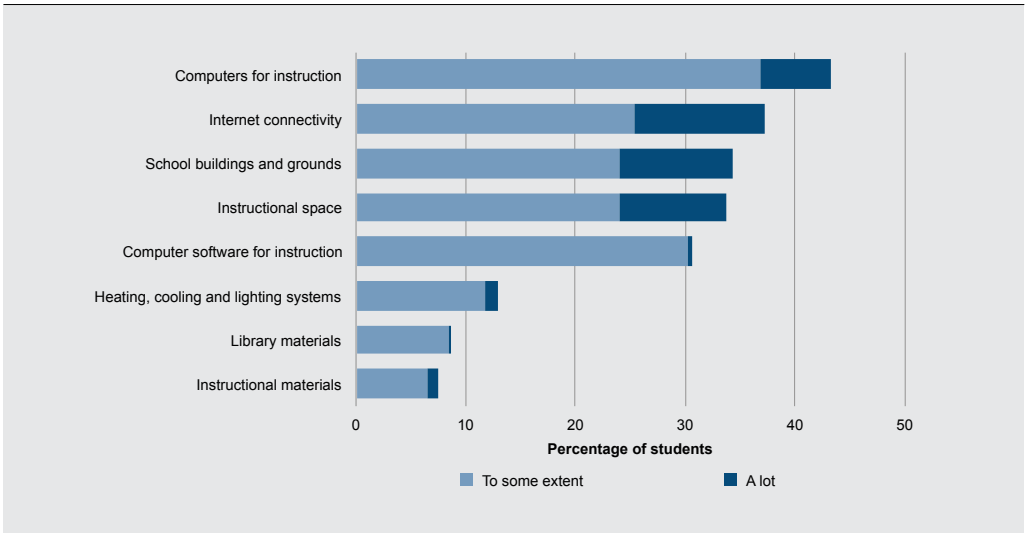
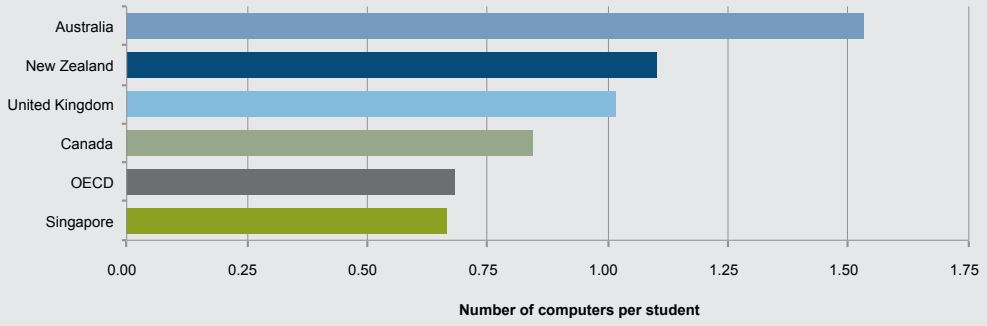


Figure 8 shows that in Australia, New Zealand and the United Kingdom, students have more access to computers in their school on average than students in Canada, Singapore and the OECD overall. However, these differences are not significant (See Appendix 4 for information on how this ratio was calculated).

Figure 8: Availability of computers per student



Item responses were combined to create indices of quality of physical infrastructure and quality of educational resources, standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive index values indicate principals' reports that their school's physical infrastructure and educational resources are of better quality, and negative values indicate that principals report that quality of physical infrastructure and educational resources hinder learning to a greater extent than in the OECD.[10]

Figure 9 shows that reported quality of physical infrastructure in New Zealand is close to the OECD average, and similar to reports from principals in Australia and the United Kingdom, but it is less positive than in Canada and Singapore.

Figure 9 also shows that the reported quality of educational resources in New Zealand is similar to that reported in Canada but lower than that reported in Australia, the United Kingdom and Singapore.

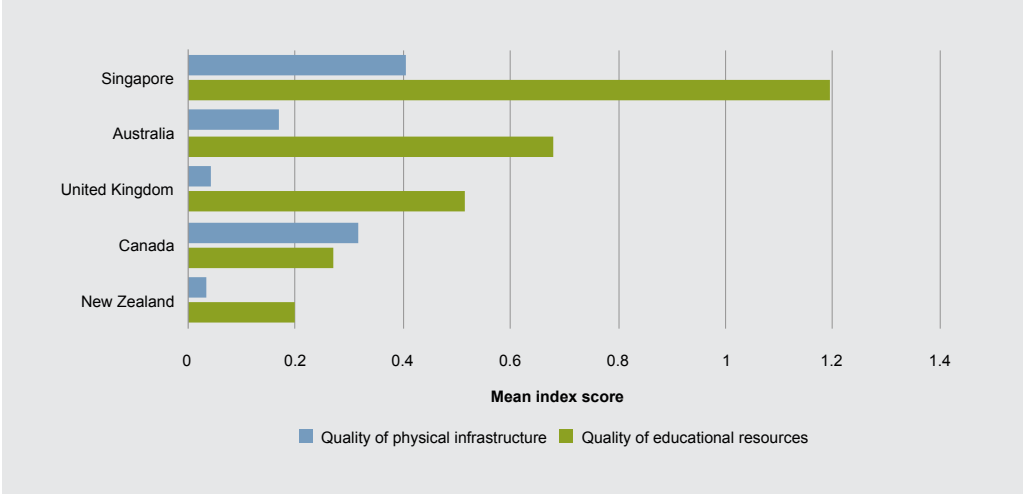
New Zealand principals in private schools reported that school infrastructure is of higher quality (1.1 index points) than did principals in public schools (0.0 index points).

10 Interpretation of these data may be limited because it is likely that principals both within and across countries who participated in PISA have different expectations regarding what constitutes a shortage or inadequacy of infrastructure or resources.

Differences in the reported quality of educational resources were also observed in New Zealand in terms of student economic, social and cultural status (ESCS), school socio-economic background, and whether schools are public or private. Low ESCS students were more likely than high ESCS students to be in schools where principals reported lower quality of educational resources. The average index value for quality of educational resources was 0.1 index points for low ESCS students compared to 0.4 index points for high ESCS students. Similarly, principals from socio-economically disadvantaged schools reported a lower quality of educational resources (0.0 index points) than principals from advantaged schools (0.8 index points).

New Zealand has one of the largest differences among participating countries in reported quality of educational resources between public (0.1 index points) and private (1.5 index points) schools.

Figure 9: Principals' average reports of quality of physical infrastructure and educational resources



Note: The indices of quality of physical infrastructure and of quality of educational resources are standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports of a better quality of infrastructure and resources, such that the shortage or inadequacy of infrastructure and resources hinders instruction to a lesser extent than the OECD overall.

Has the quality of physical infrastructure and of educational resources changed since 2003?

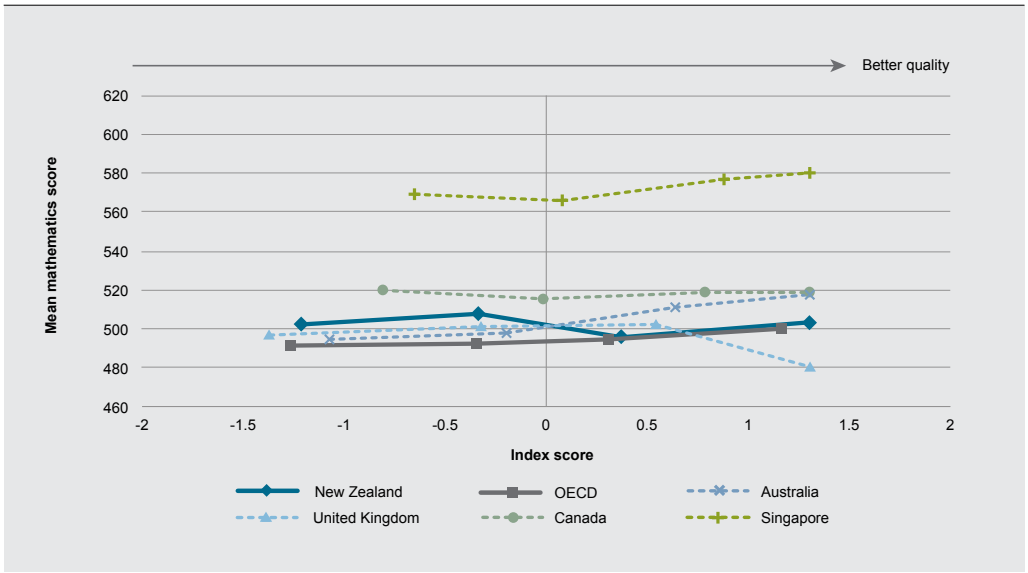
There was no change in New Zealand principals' reports of quality of physical infrastructure and quality of educational resources from 2003 to 2012.

Is quality of physical infrastructure linked to maths achievement?

Figure 10 looks at changes in maths achievement as principals' reports of the quality of the physical infrastructure become more positive. This is shown through quarters of the index of quality of physical infrastructure, where positive numbers indicate better-quality infrastructure than the OECD average.

The quality of physical infrastructure as measured through the reported shortage or inadequacy of physical infrastructure shows no link with maths achievement for students in New Zealand, the United Kingdom and Canada. However, in Australia, Singapore and the OECD, maths achievement increases as principals report better-quality infrastructure.

Figure 10: The link between quality of physical infrastructure and maths achievement



Note: The index of quality of schools' physical infrastructure is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement of students is plotted against national quarters of this index.

Is quality of educational resources linked to maths achievement?

Figure 11 looks at changes in maths achievement as principals' reports about the quality of educational resources become more positive. This is shown through quarters of the index of quality of educational resources, such that positive numbers indicate better-quality educational resources than the OECD overall.

In New Zealand, better reported quality of educational resources is linked to higher maths achievement. A similar effect was found in the OECD overall, Australia and Singapore, but not in the United Kingdom or Canada.

A difference in maths achievement of 40 points and over was found between the top and bottom quarters of the index of quality of educational resources in New Zealand and Australia – more than twice that found in the OECD overall.

Despite the above difference between the top and bottom quarters, each of the quarters of the index of quality of educational resources has a large spread of achievement. This means that reported quality of educational resources has a weak relationship overall to maths achievement in New Zealand and in the OECD overall (see Appendix 3).

Figure 11: The link between quality of educational resources and maths achievement

Note: The index of quality of schools' educational resources is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement of students is plotted against national quarters of this index.

Teacher factors

School principals reported the extent to which student learning is hindered by teacher attitudes and practices that are not constructive. Responses to items illustrated in Figure 12 ranged from 'not at all', 'very little', 'to some extent' to 'a lot'.

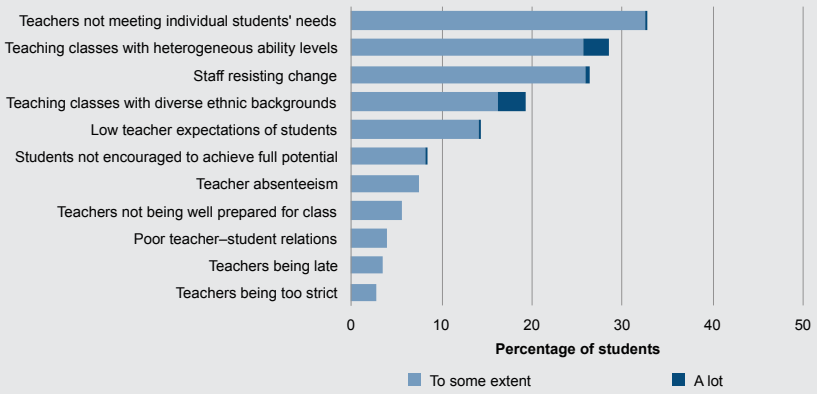
Do principals report that teacher-related factors hinder learning?

Figure 12 illustrates the percentage of New Zealand students attending schools where principals reported that teacher-related factors hinder student learning.

A smaller proportion of students attend schools where principals reported that teachers being too strict, teachers being late, and poor relations with students hinder learning. A larger proportion of students attend schools where principals reported ('to some extent' and 'a lot') that the following factors hinder student learning: teachers not meeting individual students' needs (33%), teaching classes with heterogeneous ability levels (29%), staff resisting change (27%), teaching classes with diverse ethnic backgrounds (19%), and low teacher expectations of students (14%).

In New Zealand, as in the OECD as a whole, teaching students of heterogeneous ability levels was reported as a greater challenge faced in the classroom than teaching students of diverse ethnic backgrounds.

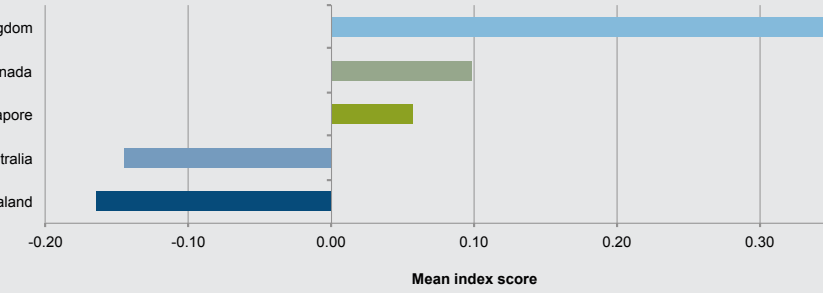
Figure 12: Percentage of students in New Zealand schools where learning is hindered by teacher-related factors



Responses to items were combined to create an index of teacher-related factors, standardised across OECD countries to have an average of 0 and a standard deviation of 1. Responses were reverse-scored, so that positive values reflect principals' reports that teacher-related issues hinder learning to a lesser extent, and negative values indicate that teacher-related issues hinder learning to a greater extent, than the OECD overall.

Figure 13 demonstrates that principals in New Zealand and Australia reported that teacher-related factors hinder student learning to a greater extent than the OECD overall. On the other hand, principals in the United Kingdom, Canada and Singapore reported that teacher-related factors hinder learning less than the OECD overall.

Figure 13: Principals' average reports of teacher-related factors that hinder learning



Note: The index of teacher-related factors that hinder learning is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values indicate that principals believe that factors such as teachers not being well prepared hinder student learning less than the OECD, and negative values indicate that these factors hinder learning more.

Have teacher-related factors changed since 2003?

In New Zealand, principals' reports of teacher-related factors that hinder learning have decreased by 0.3 index points since 2003. This means that teacher-related factors are reported to hinder learning less in 2012. This change stems from a greater number of principals reporting that low teacher expectations of students and teachers not meeting individual students' needs hinder learning 'not at all' or 'very little'.

Are teacher-related factors linked to maths achievement?

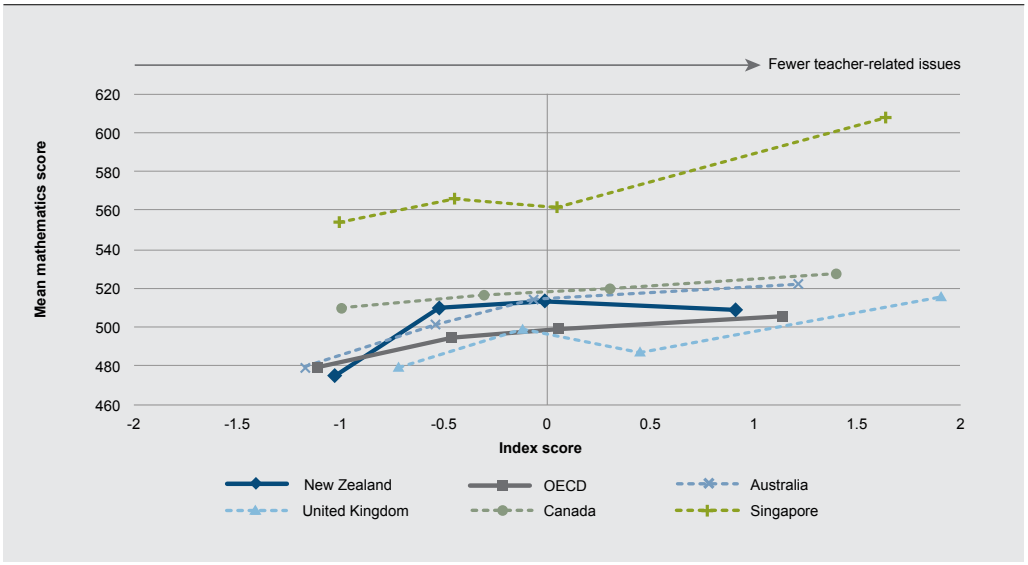
Figure 14 shows changes in maths achievement as teacher-related factors are reported to hinder learning less. This is shown according to quarters of the index of teacher-related factors, such that positive numbers indicate that teacher-related factors hinder student learning less than in the OECD overall.

Generally, student's maths scores increase when principals report that teacher-related factors hinder instruction less.

There was an average increase of 16 points in maths achievement in New Zealand per unit of this index, compared to a 10-point increase in the OECD overall. However, this average increase is not uniform across the spread of index values for New Zealand. In particular, Figure 14 shows that the average maths score of New Zealand students in the lowest quarter is noticeably lower than the other quarters.

Teacher-related factors have a relatively weak relationship to maths achievement in New Zealand and in the OECD overall (see Appendix 3).

Figure 14: The link between teacher-related factors and maths achievement



Note: The index of teacher-related factors that hinder learning, as reported by principals, is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement is plotted against national quarters for this index.

Teacher–student relations at school

As an indicator of the classroom learning environment, students were asked to what extent they agree with statements regarding their relationships with teachers at school (see Appendix 4 for a more detailed definition). Responses were combined to create an index of teacher–student relations, standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values indicate that students report better teacher–student relations than the OECD overall, and negative values indicate poorer relations.

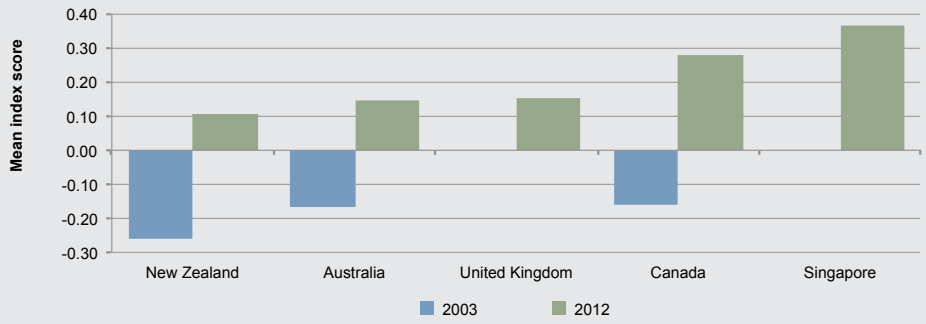
How do students report teacher–student relations?

Figure 15 shows that students' reports of teacher–student relations in New Zealand were less positive than in Canada and Singapore.

Have student reports of teacher–student relations changed since 2003?

Figure 15 illustrates that student reports of teacher–student relations have improved since 2003 in New Zealand, with an increase of 0.4 index points in 2012, and also in Australia and Canada, with index increases of 0.3 and 0.4 points respectively (no comparative data were available for the United Kingdom and Singapore).

Figure 15: Students' average reports of teacher–student relations, and their improvement since 2003



Note: The index of teacher–student relations is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values indicate that students reported better teacher–student relations than in the OECD, and negative values indicate that teacher–student relations are poorer.

Are teacher–student relations linked to maths achievement?

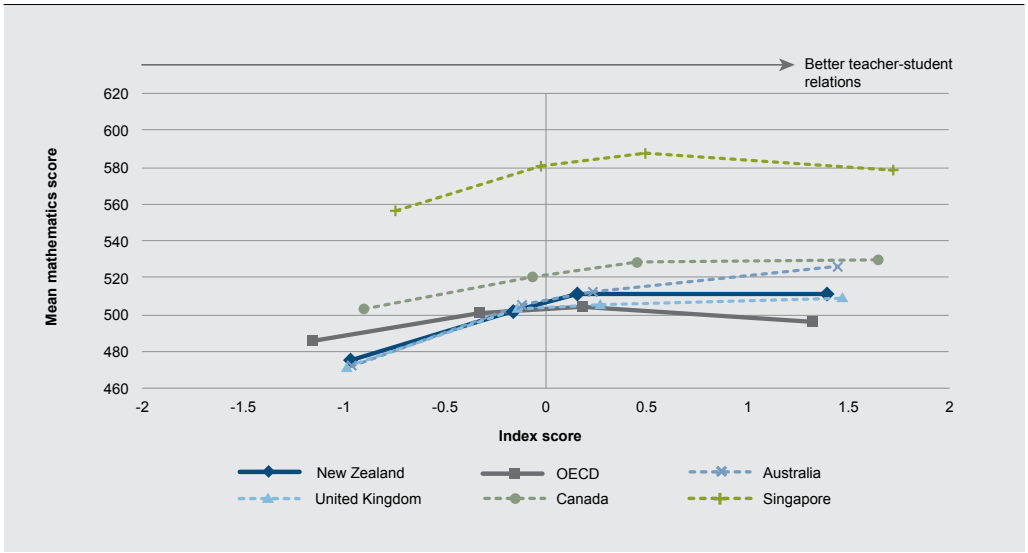
Figure 16 shows the change in maths achievement as student reports of teacher–student relations become increasingly positive. This is shown according to quarters of the index of teacher–student relations, such that positive values indicate that students report better teacher–student relations than in the OECD overall.

Generally, more positive reports of teacher–student relations (not only with maths teachers) are reflected in higher maths achievement.

The link between teacher–student relations and maths achievement in New Zealand classrooms is among the strongest of all participating countries, with a 14-point change in maths achievement per unit of this index. However, this average increase is not uniform across the spread of index values for New Zealand. In particular, Figure 16 shows that in New Zealand, achievement is lower where reports of teacher–student relations are lower than in the OECD overall. Students in the top two quarters have similar maths achievement.

Teacher–student relations have a relatively weak relationship to maths achievement in New Zealand and the OECD overall (see Appendix 3).

Figure 16: The link between teacher–student relations and maths achievement



Note: The index of teacher–student relations is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement is plotted against national quarters for this index.

Teaching practices in maths lessons

PISA 2012 examined the use of different teaching practices for maths instruction. Students answered questions about the practices of their maths teachers, looking at the frequency with which teachers encourage students to reflect on their learning in class, the extent to which student participation is encouraged, whether teachers provide effective structure in the classroom, and if teachers monitor student progress and provide individualised feedback.

Cognitive activation

The index of teachers' use of cognitive activation was constructed from students' responses to questions such as whether their most recent maths teacher asks students to explain how they solved a problem (see Appendix 4 for a more detailed definition). The index was standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently encourages students to reflect on their learning in class.

Student orientation

The index of teachers' student orientation was constructed from students' responses to questions such as whether their most recent maths teacher asks students to help plan classroom activities or topics (see Appendix 4 for a more detailed definition). The index was standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently tailors their classroom learning to maximise student participation.

Teacher-directed instruction

The index of teacher-directed instruction was constructed from students' responses to questions such as whether their most recent maths teacher sets clear goals for student learning (see Appendix 4 for a more detailed definition). The index was standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently provides an effective structure to their learning experience.

Formative assessment

The index of teachers' use of formative assessment was constructed from students' responses to questions such as whether their most recent maths teacher gives students feedback on their strengths and weaknesses in maths (see Appendix 4 for a more detailed definition). The index was standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently monitors student progress and provides individualised feedback.

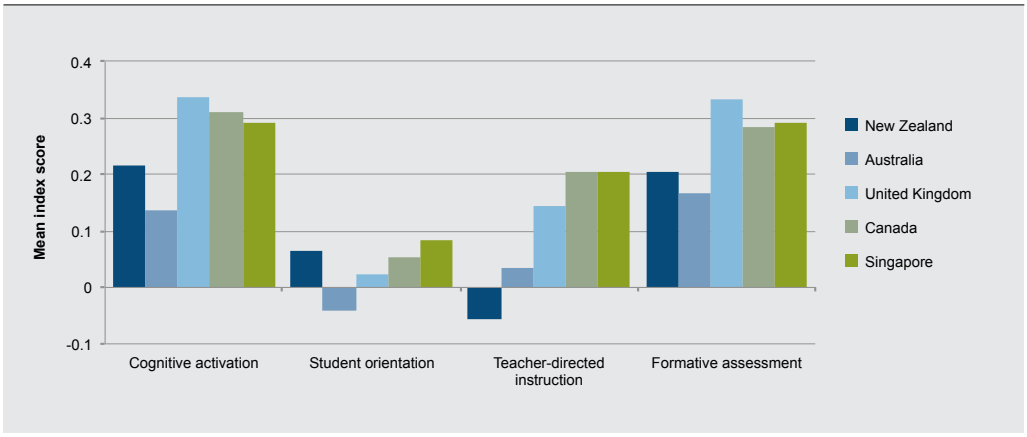
What teaching practices are used in maths lessons?

Figure 17 looks at the four teaching practices described above for New Zealand and key comparison countries. They are each represented in terms of their average value on the respective indices (see above). Based on New Zealand students' reports:

- → teachers use cognitive activation more often than teachers in Australia, but less often than teachers in the United Kingdom, Canada and Singapore
- → teachers engage in student orientation as often as teachers in the United Kingdom, Canada and Singapore and more often than in Australia (reports from New Zealand students and those of key comparison countries were all relatively close to the OECD average)
- → teachers use teacher-directed instruction less than teachers in Australia, the United Kingdom, Canada and Singapore (reports of New Zealand and Australian students were also relatively close to the OECD average)
- → formative assessment practices occur as often as they do in maths lessons in Australia, but less often than they do in the United Kingdom, Canada and Singapore.

In terms of gender differences in New Zealand, boys reported more than girls that teachers use the four teaching practices, with an average difference of 0.2 index points.

Figure 17: Teaching practices in maths lessons

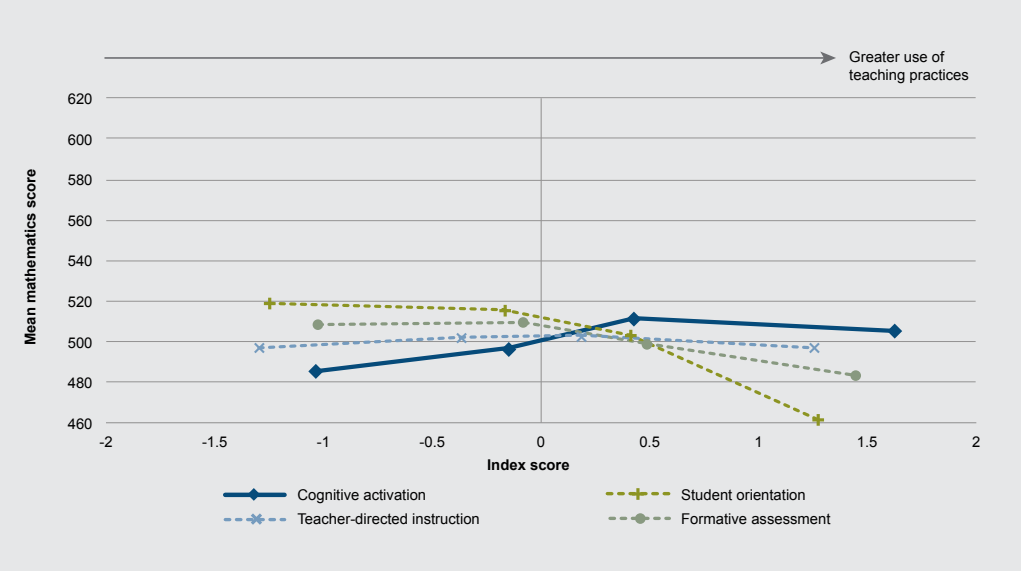


Note: The indices of teachers' use of cognitive activation, student orientation, teacher-directed instruction and formative assessment, as reported by their students, are standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values on the index represent more frequent use of teaching practices than the OECD, and negative values indicate less frequent use.

Are teaching practices linked to maths achievement?

Figure 18 shows how the maths achievement of New Zealand students changes as reported use of these teaching practices increases. This is shown according to quarters of the indices of the four teaching practices, such that positive values indicate the practices are used more often than in the OECD overall. When reviewing the relationships between teaching practices and maths achievement, it is important to keep in mind the nature of the questions that make up each of these practices. (Appendix 4 presents these questions for each practice.)

Figure 18: The link between teaching practices and maths achievement in New Zealand



Note: The indices of teachers' use of teaching practices, as reported by their students, are standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement is plotted against national quarters for each index.

While data is provided on teaching practices and achievement considerable, care needs to be taken in how this information is interpreted, particularly as the achievement differences found in relation to teaching practices are small.

The link between achievement and teaching practices is not straightforward and will be complicated by teachers using all of these practices depending on context. Moreover, the relationship of a particular teaching practice with achievement should not be interpreted as causal. High use of student orientation and formative assessment does not necessarily result in lower achievement. Rather, these results may be reflecting the use and/or the effectiveness of the strategies with particular groups of students. Furthermore, groups of students who share the same maths teacher may also differ in their awareness or sensitivity to the use of these teaching practices.

Overall, maths achievement is higher when students perceive more frequent use of cognitive activation in the classroom (top two quarters of the index). However, maths achievement is not higher when students perceive more frequent use of teacher-directed instruction, formative assessment and student orientation.

An increase of one unit in the index of cognitive activation corresponds to an increase of 6 points in maths achievement in New Zealand, similar to the 5-point increase in the OECD overall. In New Zealand and in the OECD as a whole, an increase of one unit in the index of student orientation corresponds to a decrease of 22 points in maths achievement. For teacher-directed instruction, there is no change in maths achievement among New Zealand students, although a 4-point decrease was found for the OECD overall. An increase of one unit in the index of formative assessment corresponds to a decrease of 11 points in maths achievement in New Zealand, similar to the 10-point decrease in the OECD overall.

To sum up, the four teaching practices examined in PISA do not exhibit a particularly strong relationship to maths achievement in New Zealand (see Appendix 3).

Ability grouping practices in maths classes

School principals were asked which ability grouping options described their school practices for students in all, some, or not any maths classes.[11] One response option was grouping students by ability within maths classes. Two options of between-class ability grouping practices were classes studying similar content at different levels of difficulty, and classes studying different content at different levels of difficulty. A fourth option was also available, whereby teachers use teaching practices suitable for students with different abilities rather than grouping students.[12]

What kinds of ability grouping practices are there in maths classes?

Figure 19 illustrates the percentage of students who attend schools whose principals reported that ability grouping practices occur within maths classes for all classes, some classes, and not any classes.

A greater proportion of New Zealand students attend schools where principals reported that ability grouping practices within maths classes occur in all classes than in Canada, Singapore and the OECD. However, ability grouping within all maths classes occurs more in the United Kingdom than in New Zealand.

More New Zealand students (92%) are in schools whose principals reported that students are grouped by ability within their maths classes in at least some classes than in the OECD (49%). This is similar to the proportions in Australia and the United Kingdom.

However, a greater proportion of students in Canada, Singapore and the OECD are likely to attend schools where ability grouping practices within maths classes do not occur in any class.

11 Note that analysis of ability grouping in this volume looks at practices within schools, and does not examine differences in academic selectivity for school admittance.

12 Although the intent of the question was for principals to report this where there was no ability grouping between or within classes, the data show that many principals reported that the use of teaching practices suitable for students with different abilities occurred even where ability grouping was used in the school.

Figure 19: Ability grouping practices within maths classes

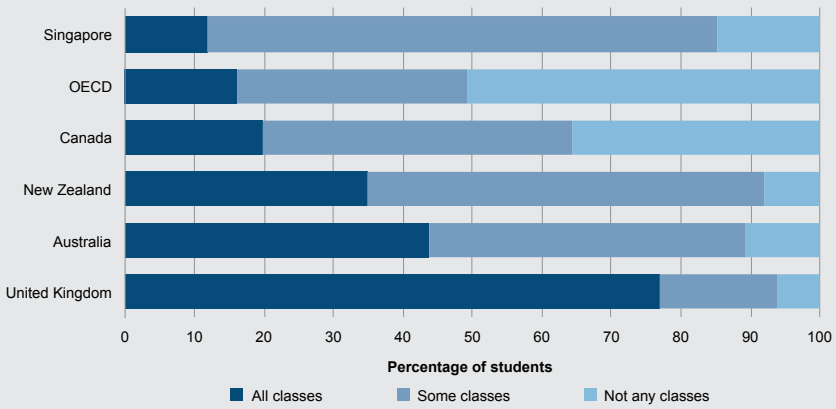
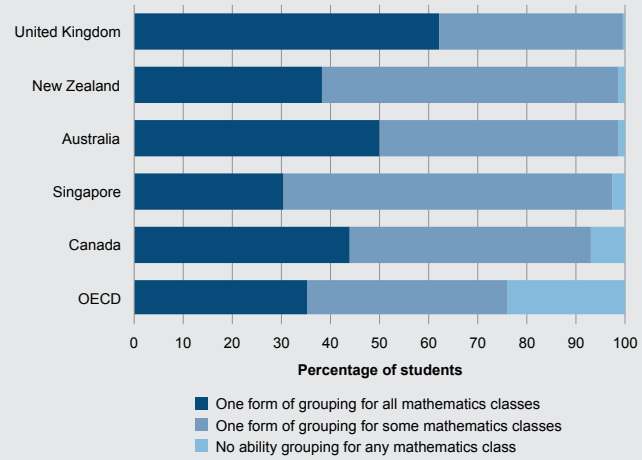


Figure 20 shows the percentage of students who attend schools where principals reported that ability grouping between maths classes occurs for all classes, for some classes, or not any classes. The proportion of New Zealand students attending schools where ability grouping between classes occurs for all maths classes is higher than in Singapore, Canada and the OECD overall but lower than in the United Kingdom and Australia.

Figure 20: Ability grouping practices between maths classes



Over 95 percent of students in New Zealand attend schools where ability grouping between maths classes occurs in at least some classes, compared to 76 percent in the OECD overall. The proportion of New Zealand students attending schools where there is no ability grouping between any classes is lower than in Canada and in the OECD overall.

Based on principals' reports, New Zealand schools do not tend to prefer one kind of between-class ability grouping. Just under one-quarter of students attend schools where all maths classes study different content at different levels of difficulty, and a similar number of students attend schools where all maths classes study similar content at different levels of difficulty.

Have ability grouping practices changed since 2003?

There was no change in reported ability grouping practices in New Zealand schools from 2003 to 2012.

Are ability grouping practices linked to maths achievement?

There is no evidence to support a positive relationship between ability grouping and maths achievement. Overall, across OECD countries only, school practices of ability grouping for all maths classes do not have a significant relationship with maths achievement.

Summary

What can we say about the delivery of maths in New Zealand classrooms?

Maths teaching staff

More than 90 percent of maths teachers have a tertiary qualification in New Zealand. Almost 60 percent of teachers in New Zealand have a degree-level qualification in teaching, and 60 percent have a qualification with specialised knowledge in maths.

Students in socio-economically advantaged schools, average schools and city schools are more likely to be taught by maths teachers with degree-level qualifications than students in disadvantaged schools, rural schools and town schools.

More maths teachers in New Zealand have attended a professional development programme than in the OECD overall.

New Zealand has more students per maths teacher in schools on average than Australia, Singapore and the OECD overall. This is not an indicator of class size: it represents the number of teachers in a school relative to the number of students at that school.

Over 16 percent of principals reported that learning at their school is hindered to some extent, and just over 5 percent reported that learning is hindered a lot, by a shortage of qualified maths teachers.

Principals in New Zealand reported that teacher shortage hinders instruction to a greater extent than the OECD. Higher reported shortage of teachers is related to lower maths achievement

Reports of teacher shortage were higher among New Zealand principals in schools where students have lower economic, social and cultural status (ESCS), in socio-economically disadvantaged schools, and in schools in rural or town settings. Of all countries participating in PISA 2012, New Zealand has one of the largest gaps in reported teacher shortage between socio-economically advantaged and disadvantaged schools.

Physical infrastructure and educational resources at school

In New Zealand, approximately 40% of students attend schools where principals reported that shortages of computers and internet connectivity hinder instruction. However, New Zealand schools on average have one of the highest computer:student ratios in the OECD, with at least one available per student.

Close to one-third of students attend schools whose principals reported that a shortage of physical infrastructure (eg, school buildings and grounds, and instructional space) hinders learning. While reported quality of physical infrastructure in New Zealand is close to the OECD average, it is lower than in Canada and Singapore.

New Zealand principals in private schools reported that school infrastructure is of better quality than did principals in public schools. Although better-reported quality of school physical infrastructure is linked to higher maths achievement in the OECD, this link is not evident among New Zealand students.

Reported quality of educational resources (eg, library materials, computers and software for instruction) in New Zealand is similar to Canada but lower than Australia, the United Kingdom and Singapore. Better reported quality of educational resources is linked to higher average maths achievement in New Zealand, Australia, Singapore and the OECD overall.

Reports of lower-quality educational resources were higher among New Zealand principals in schools where students have lower economic, social and cultural status (ESCS), in socio-economically disadvantaged schools and in public schools. Of all countries participating in PISA 2012, New Zealand has one of the largest differences in reported quality of educational resources between principals from public and private schools.

Teacher factors

School principals reported the extent to which student learning is hindered by teacher attitudes and practices that are not constructive.

Almost one-third of New Zealand students attend schools where principals reported that student learning is hindered by teachers not meeting individual students' needs, and between 14 percent and 26 percent of students attend schools where principals reported that low teacher expectations, staff resisting change, and challenges such as classes with heterogeneous ability levels and classes with diverse ethnic backgrounds hinder learning.

Principals in New Zealand and Australia reported that teacher-related factors hinder student learning to a greater extent than in other selected comparison countries.

Higher reports of teacher-related factors that hinder learning are linked to lower maths achievement in New Zealand.

Teacher–student relations at school

New Zealand reports of teacher–student relations were less positive than in Canada and Singapore in 2012. As occurred in Australia and Canada, teacher–student relations in New Zealand have improved markedly since 2003.

Among all countries participating in PISA 2012, more positive teacher–student relations are linked to higher maths achievement. The association found in New Zealand classrooms was among the highest of the participating countries.

Teaching practices in maths lessons

Students reported how often their maths teacher encourages students to reflect on their learning in class (cognitive activation), tailors their classroom learning to maximise student participation (student orientation), provides an effective structure to their learning experience (teacher-directed instruction), and provides individualised feedback (formative assessment).

Of these four teaching practices, New Zealand stands out in terms of students reporting less teacher-directed instruction than the OECD average: students in all the selected comparison countries reported that teachers use this practice more often. However, use of this practice is not related to a change in maths achievement among New Zealand students, although a small decrease in maths achievement was found for the OECD.

New Zealand students reported less use of cognitive activation by their teachers than in Canada and Singapore, who had maths achievement scores that were higher than the OECD and New Zealand. Greater reported use of cognitive activation as a teaching practice is related to higher maths achievement in New Zealand.

Students in New Zealand reported that their maths teachers use formative assessment less often than in the United Kingdom, Canada and Singapore, and that maths teachers use student orientation more often than Australian students. However, greater use of the latter two teaching practices is linked to lower achievement in New Zealand.

The relationship of a particular teaching practice with achievement should not be interpreted as causal; ie, high use of student orientation and formative assessment does not necessarily result in lower achievement. Rather, these results may be reflecting the use and/or the effectiveness of the strategies with particular groups of students.

Ability grouping in maths classes

Compared to the OECD, New Zealand is notable for its extensive ability grouping practices within maths classes as well as across classes. More New Zealand students (92%) are in schools whose principals reported that students are grouped by ability within their maths classes in at least some classes than in the OECD overall (49%).

Over 95 percent of students in New Zealand attend schools where ability grouping between maths classes occurs in at least some classes, compared to 76 percent in the OECD.

Overall, across the OECD countries, school practices of ability grouping for all maths classes do not have a significant relationship with maths achievement.

Appendix 1: Maths achievement

Table A1.1: Mean maths achievement

	New Zealand		OECD	
Overall mean	500	(2.2)	494	(0.5)
Gender				
Boys	507	(3.2)	493	(1.3)
Girls	492	(2.9)	481	(1.2)
Student economic, social and cultural status				
Bottom quarter of ESCS index	445	(3.2)	452	(0.7)
Second quarter of ESCS index	493	(4.0)	482	(0.6)
Third quarter of ESCS index	514	(4.0)	506	(0.7)
Top quarter of ESCS index	559	(3.6)	542	(0.8)
School average socio-economic background				
Socio-economically disadvantaged schools	443	(4.9)	444	(0.9)
Socio-economically average schools	497	(4.4)	492	(0.7)
Socio-economically advantaged schools	558	(4.1)	548	(0.9)
School authority				
Public schools	496	(2.5)	489	(0.7)
Private schools	584	(6.1)	522	(1.7)
School location				
Rural schools	458	(6.1)	467	(2.5)
Town schools	492	(5.3)	492	(0.9)
City schools	513	(3.2)	502	(1.2)

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

See Appendix 4 for definitions of ESCS, school socio-economic background, school authority and school location.

Table A1.2: Distribution of students

	Percentage	
Gender	**New Zealand**	**OECD**
Boys	51	50
Girls	49	50
School average socio-economic background		
Socio-economically disadvantaged schools	22	26
Socio-economically average schools	55	47
Socio-economically advantaged schools	23	27
School authority		
Public schools	94	81
Private schools	6	19
School location		
Rural schools	6	11
Town schools	38	56
City schools	56	36

The following points summarise some of the differences in maths achievement occurring within New Zealand.

- → New Zealand's maths achievement is significantly higher than the OECD average, but the spread in achievement is wider than the OECD.
- → The variation in maths achievement evident within schools in New Zealand is more than the variation occurring between schools. This means that most New Zealand schools have both low- and high-achieving students. A similar pattern is evident in the OECD overall, but to a lesser extent.
- → In New Zealand, as in the OECD overall, the maths achievement of boys is higher than that of girls.
- → Student economic, social and cultural status (ESCS) has an impact on maths achievement, with students in the bottom, second, third and top quarters of the PISA ESCS index having progressively higher achievement scores. The same pattern is evident among students attending socio-economically disadvantaged, average and advantaged schools and public and private schools.
- → The overall variance in student achievement accounted for by differences in student ESCS in New Zealand is 18%, compared to 15% in the OECD on average.
- → Socio-economic background contributes to explaining much of the difference in maths achievement between schools, but it contributes little in explaining the differences in maths achievement among students in the same school.
- → The achievement of students in town schools and city schools is higher than the achievement of students in rural schools in both New Zealand and the OECD overall, although differences are smaller once socio-economic background is taken into account.

Appendix 2: Tables for figures

Table A2.1: Percentage of maths teachers in New Zealand schools with degree-level qualifications

Type of school	Percentage of teachers
Disadvantaged schools	89 (2.1)
Average schools	96 (0.7)
Advantaged schools	93 (1.6)
Rural schools	86 (3.4)
Town schools	90 (2.1)
Urban schools	96 (1.1)

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: Excellence Through Equity: Giving Every Student the Chance to Succeed (Volume II)*, PISA, OECD Publishing.

Table A2.2a: Mean number of maths teachers per school with relevant qualifications

	Mean number of maths teachers	Maths teachers with a degree-level qualification	Maths teachers with a degree-level qualification in teaching	Maths teachers with a degree-level qualification and major in maths
United Kingdom	7.4 (0.2)	7.2 (0.2)	6.1 (0.3)	5.5 (0.2)
Singapore	16.8 (0.1)	16.6 (0.1)	12.6 (0.1)	11.1 (0.0)
Canada	8.3 (0.3)	8.3 (0.3)	5.1 (0.3)	5.5 (0.2)
New Zealand	8.7 (0.3)	8.2 (0.3)	5.2 (0.4)	5.4 (0.3)
Australia	11.5 (0.4)	11.0 (0.4)	9.6 (0.4)	6.9 (0.3)
OECD	7.9 (0.1)	6.7 (0.1)	3.5 (0.0)	4.5 (0.1)

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: Excellence Through Equity: Giving Every Student the Chance to Succeed (Volume II)*, PISA, OECD Publishing.

Table A2.2b: Percentage of maths teachers with relevant qualifications

	Percentage of maths teachers with a degree-level qualification	Percentage of maths teachers with a degree-level qualification in teaching	Percentage of maths teachers with a degree-level qualification and major in maths
United Kingdom	97	82	74
Singapore	99	75	66
Canada	99	62	65
New Zealand	94	60	62
Australia	96	83	60
OECD	84	44	57

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: Excellence Through Equity: Giving Every Student the Chance to Succeed (Volume II)*, PISA, OECD Publishing.

Table A2.3: Percentage of maths teachers who had attended a programme of professional development with a focus on maths

	Percentage of maths teachers	
Singapore	67	(0.4)
New Zealand	61	(3.0)
Canada	59	(1.8)
Australia	**53**	(1.5)
United Kingdom	**52**	(2.8)
OECD	**39**	(0.4)

Note: Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.4: Student:maths teacher ratio in schools

	Student:maths teacher ratio	
Singapore	**86**	(1.5)
Australia	**91**	(1.7)
OECD	**106**	(0.8)
New Zealand	119	(3.2)
Canada	123	(4.5)
United Kingdom	**130**	(2.2)

Note: The student:teacher ratio is not an indicator of class size. Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.5: Principals' average reports of teacher shortage

	Mean index score	
Canada	**–0.30**	(0.04)
United Kingdom	**–0.18**	(0.06)
New Zealand	0.08	(0.07)
Singapore	0.13	(0.01)
Australia	0.20	(0.04)

Note: The index of teacher shortage is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports that teacher shortage hinders instruction to a greater extent than the OECD. Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.6: The link between teacher shortage and maths achievement

	Mean index scores							
	Bottom quarter		**Second quarter**		**Third quarter**		**Top quarter**	
New Zealand	–1.09	(0.01)	–0.33	(0.17)	0.45	(0.09)	1.30	(0.09)
OECD	–0.99	(0.01)	–0.42	(0.02)	0.23	(0.01)	1.05	(0.02)
Australia	–1.09	(0.00)	–0.31	(0.09)	0.68	(0.04)	1.51	(0.05)
United Kingdom	–1.09	(0.00)	–0.78	(0.11)	0.14	(0.10)	0.99	(0.08)
Canada	–1.09	(0.00)	–0.95	(0.08)	–0.08	(0.06)	0.92	(0.05)
Singapore	–1.09	(0.01)	–0.08	(0.02)	0.59	(0.00)	1.09	(0.00)
	Mean maths scores							
New Zealand	**526**	(7.1)	504	(6.0)	488	(5.9)	**490**	(6.7)
OECD	**504**	(1.1)	499	(1.1)	490	(1.2)	**484**	(1.3)
Australia	**525**	(3.6)	514	(4.2)	497	(3.7)	**481**	(2.8)
United Kingdom	**514**	(5.6)	506	(6.0)	491	(6.1)	**469**	(10.0)
Canada	521	(3.9)	520	(3.8)	514	(3.7)	517	(4.0)
Singapore	**583**	(2.9)	566	(2.4)	579	(3.0)	**571**	(2.9)

Note: The index of teacher shortage is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports that the shortage of teachers hinders instruction to a greater extent than the OECD. Maths achievement is presented for national quarters of this index. Top and bottom quarter values significantly different from each other are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.7: Percentage of students in New Zealand schools where principals reported instruction is hindered by a shortage or inadequacy of physical infrastructure and educational resources

	Percentage of students			
	Not at all	Very little	To some extent	A lot
Instructional materials	52 (3.9)	39 (3.7)	7 (1.8)	1 (0.1)
Library materials	49 (3.8)	41 (4.0)	8 (2.2)	< 0.5 (0.1)
Heating, cooling, and lighting systems	50 (4.1)	35 (3.8)	12 (3.3)	1 (0.7)
Computer software for instruction	32 (3.5)	36 (3.6)	30 (4.1)	< 0.5 (0.4)
Instructional space	41 (4.0)	24 (3.2)	24 (3.8)	10 (3.0)
School buildings and grounds	31 (4.0)	33 (4.0)	24 (3.6)	10 (3.3)
Internet connectivity	38 (3.9)	24 (3.5)	25 (3.2)	12 (3.4)
Computers for instruction	27 (3.5)	29 (3.5)	37 (3.9)	6 (2.1)

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.8: Availability of computers per student

	Ratio of computers per student
Singapore	0.7 (0.01)
OECD	0.7 (0.01)
Canada	0.8 (0.03)
United Kingdom	1.0 (0.04)
New Zealand	1.1 (0.04)
Australia	1.5 (0.05)

Note: No countries are significantly different from New Zealand. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.9: Principals' average reports of quality of physical infrastructure and educational resources

	Mean index scores	
	Shortage of physical infrastructure	Shortage of educational resources
New Zealand	0.0 (0.09)	0.2 (0.08)
Canada	**0.3** (0.04)	0.3 (0.04)
United Kingdom	0.0 (0.07)	**0.5** (0.08)
Australia	0.2 (0.04)	**0.7** (0.03)
Singapore	**0.4** (0.01)	**1.2** (0.01)

Note: The indices of quality of schools' physical infrastructure and educational resources are standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports are of better quality where the shortage and inadequacy of infrastructure and resources hinders instruction to a lesser extent than the OECD. Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.10: The link between quality of physical infrastructure and maths achievement

	Mean index scores			
	Bottom quarter	Second quarter	Third quarter	Top quarter
New Zealand	–1.21 (0.14)	–0.34 (0.10)	0.38 (0.15)	1.31 (0.06)
OECD	–1.26 (0.02)	–0.35 (0.01)	0.31 (0.02)	1.17 (0.01)
Australia	–1.07 (0.06)	–0.19 (0.04)	0.63 (0.08)	1.31 (0.00)
United Kingdom	–1.36 (0.10)	–0.33 (0.11)	0.55 (0.14)	1.31 (0.00)
Canada	–0.81 (0.07)	–0.02 (0.04)	0.78 (0.10)	1.31 (0.00)
Singapore	–0.65 (0.01)	0.08 (0.01)	0.88 (0.02)	1.31 (0.00)
	Mean maths scores			
New Zealand	502 (7.7)	508 (6.0)	495 (8.6)	503 (7.9)
OECD	**491** (1.2)	493 (1.3)	494 (1.3)	**500** (1.3)
Australia	**494** (4.6)	498 (4.7)	511 (3.7)	**517** (3.5)
United Kingdom	497 (5.7)	501 (5.6)	502 (8.0)	481 (10.0)
Canada	520 (4.5)	515 (3.8)	518 (3.5)	519 (3.3)
Singapore	**570** (2.6)	566 (3.0)	577 (3.6)	**581** (4.2)

Note: The index of quality of physical infrastructure is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports that their schools' infrastructure is of better quality and hinders instruction to a lesser extent than the OECD. Maths achievement is presented for national quarters of this index. Top and bottom quarter values significantly different from each other are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.11: The link between quality of educational resources and maths achievement

	Mean index scores							
	Bottom quarter		**Second quarter**		**Third quarter**		**Top quarter**	
New Zealand	–0.85	(0.09)	–0.28	(0.08)	0.29	(0.10)	1.63	(0.13)
OECD	–1.02	(0.01)	–0.30	(0.01)	0.25	(0.02)	1.29	(0.02)
Australia	–0.53	(0.04)	0.22	(0.04)	1.05	(0.08)	1.98	(0.01)
United Kingdom	–0.74	(0.08)	0.01	(0.05)	0.81	(0.21)	1.98	(0.01)
Canada	–0.85	(0.07)	–0.14	(0.04)	0.45	(0.04)	1.62	(0.09)
Singapore	–0.06	(0.01)	0.94	(0.02)	1.93	(0.01)	1.98	(0.00)
	Mean maths scores							
New Zealand	**486**	(7.2)	499	(6.6)	497	(7.8)	**526**	(9.1)
OECD	**486**	(1.3)	491	(1.3)	496	(1.4)	**504**	(1.4)
Australia	**483**	(3.6)	496	(4.7)	514	(4.3)	**525**	(4.3)
United Kingdom	491	(6.8)	500	(6.1)	488	(7.2)	502	(11.6)
Canada	510	(4.2)	520	(3.9)	523	(4.2)	519	(4.0)
Singapore	**565**	(2.3)	563	(3.5)	585	(3.2)	**585**	(3.0)

Note: The index of quality of educational resources is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values reflect principals' reports that their school's educational resources are of better quality and hinder instruction to a lesser extent than the OECD. Maths achievement is presented for national quarters of this index. Top and bottom quarter values significantly different from each other are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.12: Percentage of students in New Zealand schools where learning is hindered by teacher-related factors

	Percentage of students							
	Not at all		Very little		To some extent		A lot	
Teachers being too strict	33	(3.5)	63	(3.8)	3	(1.7)	0	–
Teachers being late	37	(4.1)	58	(4.0)	3	(1.6)	0	–
Poor teacher–student relations	24	(3.2)	71	(3.5)	4	(1.6)	0	–
Teachers not being well prepared for class	25	(3.9)	69	(3.9)	6	(1.9)	0	–
Teacher absenteeism	39	(4.2)	53	(4.6)	7	(2.4)	0	–
Students not encouraged to achieve full potential	37	(4.7)	54	(4.7)	8	(2.5)	< 0.5	(0.3)
Low teacher expectations of students	33	(3.8)	52	(4.1)	14	(2.7)	< 0.5	(0.1)
Teaching classes with diverse ethnic backgrounds	19	(3.1)	62	(4.2)	16	(2.9)	3	(1.6)
Staff resisting change	13	(3.2)	60	(4.0)	26	(3.9)	1	(0.5)
Teaching classes with heterogeneous ability levels	12	(2.5)	59.73	(4.1)	26	(3.9)	3	(1.2)
Teachers not meeting individual students' needs	4	(1.4)	62.36	(4.1)	33	(4.1)	< 0.5	(0.1)

Note: Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.13: Principals' average reports of teacher-related factors that hinder learning

	Mean index score	
New Zealand	–0.16	(0.07)
Australia	–0.15	(0.03)
Singapore	**0.06**	(0.00)
Canada	**0.10**	(0.04)
United Kingdom	**0.38**	(0.07)

Note: The index of teacher-related factors that hinder learning is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values indicate that principals report that factors such as teachers not being well prepared hinder student learning less than the OECD average. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV), PISA, OECD* Publishing.

Table A2.14: The link between teacher-related factors and maths achievement

	Mean index scores							
	Bottom quarter		**Second quarter**		**Third quarter**		**Top quarter**	
New Zealand	–1.03	(0.06)	–0.53	(0.07)	–0.02	(0.11)	0.92	(0.11)
OECD	–1.11	(0.01)	–0.46	(0.01)	0.06	(0.01)	1.13	(0.02)
Australia	–1.18	(0.04)	–0.54	(0.03)	–0.07	(0.03)	1.21	(0.09)
United Kingdom	–0.72	(0.05)	–0.12	(0.06)	0.45	(0.09)	1.90	(0.14)
Canada	–0.99	(0.05)	–0.31	(0.04)	0.30	(0.06)	1.40	(0.08)
Singapore	–1.00	(0.00)	–0.45	(0.00)	0.05	(0.01)	1.64	(0.01)
	Mean maths scores							
New Zealand	**474**	(7.4)	510	(6.8)	513	(8.9)	**509**	(8.5)
OECD	**479**	(1.2)	495	(1.3)	499	(1.4)	**505**	(1.4)
Australia	**479**	(1.2)	495	(1.3)	499	(1.4)	**505**	(1.4)
United Kingdom	**479**	(7.9)	499	(6.3)	487	(9.9)	**515**	(8.9)
Canada	**510**	(5.0)	516	(3.6)	520	(4.6)	**527**	(4.1)
Singapore	**553**	(2.4)	566	(3.1)	562	(3.3)	**607**	(2.9)

Note: The index of teacher-related factors that hinder learning, as reported by principals, is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement is presented for national quarters of this index. Top and bottom quarter values significantly different from each other are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.15: Students' average reports of teacher–student relations and their improvement since 2003

	Mean index scores	
	2003	**2012**
New Zealand	–0.26 (0.02)	0.11 (0.02)
Australia	**–0.17** (0.01)	0.15 (0.01)
United Kingdom	m	0.15 (0.02)
Canada	**–0.16** (0.01)	**0.28** (0.01)
Singapore	m	**0.36** (0.02)

Note: The index of teacher–student relations is standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values indicate that students reported better teacher–student relations than the OECD average. Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

m — data not available.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.16: The link between teacher–student relations and maths achievement

	Mean index scores			
	Bottom quarter	**Second quarter**	**Third quarter**	**Top quarter**
New Zealand	–0.97 (0.03)	–0.16 (0.02)	0.16 (0.03)	1.40 (0.04)
OECD	–1.16 (0.00)	–0.33 (0.00)	0.18 (0.00)	1.31 (0.01)
Australia	–0.96 (0.01)	–0.12 (0.01)	0.23 (0.02)	1.45 (0.02)
United Kingdom	–0.99 (0.03)	–0.15 (0.02)	0.27 (0.02)	1.47 (0.03)
Canada	–0.90 (0.02)	–0.06 (0.01)	0.45 (0.02)	1.64 (0.02)
Singapore	–0.74 (0.03)	–0.02 (0.00)	0.50 (0.03)	1.72 (0.02)
	Mean maths scores			
New Zealand	**475** (4.1)	501 (5.0)	511 (5.4)	**511** (4.3)
OECD	**486** (0.8)	500 (0.8)	504 (0.8)	**497** (0.8)
Australia	**471** (2.6)	506 (2.8)	513 (3.3)	**527** (3.0)
United Kingdom	**472** (4.6)	504 (4.6)	506 (4.6)	**509** (5.2)
Canada	**503** (3.4)	521 (2.8)	528 (2.9)	**530** (2.9)
Singapore	**556** (3.6)	581 (4.3)	587 (4.4)	**579** (3.4)

Note: The index of teacher–student relations is standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement scores are presented for each quarter of this index. Numbers in bold indicate significant differences within each country between the bottom and top quarter of the index of teacher–student relations. Top and bottom quarter values significantly different from each other are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.17: Teaching practices in maths lessons

	Mean index scores			
	Cognitive activation	**Student orientation**	**Teacher-directed instruction**	**Formative assessment**
New Zealand	0.22 (0.03)	0.07 (0.03)	–0.06 (0.03)	0.21 (0.02)
Australia	**0.14** (0.02)	**–0.04** (0.01)	**0.04** (0.01)	0.17 (0.02)
United Kingdom	**0.34** (0.02)	0.02 (0.02)	**0.15** (0.02)	**0.33** (0.02)
Canada	**0.31** (0.02)	0.05 (0.02)	**0.20** (0.02)	**0.28** (0.02)
Singapore	**0.29** (0.02)	0.08 (0.02)	**0.20** (0.02)	**0.29** (0.02)

Note: The indices of teachers' use of cognitive activation, student orientation, teacher-directed instruction and formative assessment, as reported by their students, are standardised across OECD countries with an average of 0 and a standard deviation of 1. Positive values on the index indicate more frequent use of teaching practices than the OECD. Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: Ready to Learn – Students' Engagement, Drive and Self-Beliefs (Volume III)*, PISA, OECD Publishing.

Table A2.18: The link between teaching practices and maths achievement in New Zealand

	Mean index scores			
	Bottom quarter	**Second quarter**	**Third quarter**	**Top quarter**
Cognitive activation	–1.04 (0.02)	–0.15 (0.00)	0.43 (0.01)	1.62 (0.04)
Student orientation	–1.25 (0.02)	–0.18 (0.01)	0.41 (0.01)	1.28 (0.04)
Teacher-directed instruction	–1.30 (0.03)	–0.37 (0.01)	0.19 (0.01)	1.25 (0.03)
Formative assessment	–1.02 (0.02)	–0.08 (0.01)	0.48 (0.01)	1.45 (0.03)
	Mean maths scores			
Cognitive activation	**485** (3.9)	497 (3.8)	512 (3.9)	**506** (4.9)
Student orientation	**519** (4.0)	516 (3.9)	503 (4.2)	**461** (4.4)
Teacher-directed instruction	497 (3.7)	502 (4.1)	503 (4.2)	497 (4.7)
Formative assessment	**508** (3.6)	510 (4.0)	499 (4.2)	**483** (4.6)

Note: The indices of teachers' use of teaching practices, as reported by their students, are standardised across OECD countries with an average of 0 and a standard deviation of 1. Maths achievement scores are presented by national quarters for each index. Numbers in bold indicate significant differences within each country between the bottom and top quarter of the index of each pedagogical practice. Top and bottom quarter values significantly different from each other are indicated in bold.

Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science (Volume I)*, PISA, OECD Publishing.

Table A2.19: Ability grouping practices within maths classes

	Percentage of students		
	All classes	**Some classes**	**Not any class**
United Kingdom	**77** (2.6)	**17** (2.4)	6 (1.5)
Australia	44 (1.7)	**45** (1.8)	11 (1.1)
New Zealand	35 (4.3)	57 (4.5)	8 (2.2)
Canada	**20** (1.9)	**44** (2.3)	**36** (2.4)
OECD	**16** (0.4)	**33** (0.5)	**51** (0.5)
Singapore	**12** (0.5)	**73** (0.5)	**15** (0.1)

Note: Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Table A2.20: Ability grouping practices between maths classes

	Percentage of students		
	One form of grouping for all classes	**One form of grouping for some classes**	**No ability grouping for any class**
OECD	35 (0.6)	**41** (0.6)	**24** (0.5)
Canada	44 (2.7)	**49** (2.5)	**7** (1.2)
Singapore	**31** (0.6)	67 (0.6)	3 (0.0)
Australia	**50** (1.6)	**49** (1.7)	2 (0.5)
New Zealand	38 (3.6)	61 (3.7)	1 (0.9)
United Kingdom	**62** (3.5)	**37** (3.4)	1 (0.5)

Note: Values significantly different from New Zealand are indicated in bold. Standard errors are presented in parentheses. Results may appear inconsistent due to rounding.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, PISA, OECD Publishing.

Appendix 3: Measuring the association between delivery of maths and achievement

Table A3.1 gives measures of the association between learning environment factors that are significantly linked to maths achievement.[13] The first column gives the average difference between two students one unit apart on the index for a learning environment factor (change in achievement per unit of index)[14] is reported.

The second column is the percentage of variance in New Zealand maths scores explained by each learning environment factor.[15] This can be compared with the percentage of variance explained in the OECD (column 3) to provide an indication of whether the strength of the association in New Zealand is stronger or weaker than for other countries.

The percentage of variance explained is obtained from the results of a linear regression where maths achievement is the dependent variable. Another way of looking at the percentage explained is as a measure of how close data points are to the regression line – a high percentage means that data points are close to the line whereas a low percentage means that there is a large spread of achievement around the regression line. The slope of the regression line is given by the change in achievement per unit of index.

13 In this volume, the following factors were not significantly linked to maths achievement: quality of physical infrastructure, teacher-directed instruction, and ability grouping practices.

14 As each PISA index is set to an OECD mean of 0 and standard deviation of 1, the magnitude of the change in achievement can be compared between two or more factors.

15 It is important to note that variance explained in this context is a measure of association only and does not imply that maths achievement is caused by the learning environment factor.

Table A3.1: Relationship between variables in Volume II and maths achievement

Relationship between variables in Volume II and maths achievement[1]	Change in achievement per unit of index	Variance explained in New Zealand (%)	Variance explained in OECD (%)
Higher reported shortage of teachers was related to *lower* maths achievement	Decrease of 16 points	2.2	1.6
Better reported quality of educational resources was related to *higher* maths achievement	Increase of 14 points.	1.8	1.1
The more principals perceive that teacher attitudes and behaviour hinder student learning, the *lower* the maths achievement	Decrease of 16 points	1.6	1.6
Better reported teacher–student relations was associated with *higher* maths achievement	Increase of 14 points	1.7	0.9
Greater reported use of cognitive activation in maths lessons was related to *higher* maths achievement	Increase of 6 points	0.5	0.5
Greater reported use of student orientation in maths lessons was related to *lower* maths achievement	Decrease of 22 points	5.3	5.9
Greater reported use of formative assessment in maths lessons was related to *lower* maths achievement	Decrease of 11 points	1.4	1.5

1 Measures of association from a univariate linear regression with maths achievement as the dependent variable.

Appendix 4: Definitions

Technical definitions

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'. 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.

The OECD average includes only the OECD countries: no non-OECD (partner) countries are included. The OECD average is the average of the means for the OECD countries.

Index points

Index points are values that New Zealand and other participating countries have on a particular index, which, unless otherwise stated, have been standardised to have an average of 0 and a standard deviation of 1 among OECD countries.

Points

The design of PISA allows for a large number of questions to be used in maths, 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 that 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 achieved between 400 and 600 points.

Standard error

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.

Statistical significance

In order to determine whether there is a real difference between two scores, tests of statistical significance are conducted that take into account the error associated with means. In this report, comparisons are tested using the t statistic, with results reported at the 95 percent confidence level.

Variance

Variance is a measure of spread. A small total variance of the average score (calculated as the square of the standard deviation) highlights equity in outcomes, such that most students are achieving at levels close to the average. Large total variance highlights inequity, such that many students achieve at levels far from the average. It is useful to compare the variance in achievement among New Zealand students with the average OECD variance.

Definitions of variables in Volume II

Ability grouping

Ability grouping is a school policy that contributes to horizontal stratification – differences in instruction within a grade or educational level. In this practice, students are grouped according to their performance. The aim is to help schools to cater for students' needs and make it easier for teachers to teach. PISA examines ability grouping that occurs between classes (where students study similar or different content at different levels of difficulty) and also ability grouping within classes.

Availability of computers per student

The ratio of computers available per student was calculated by dividing the number of computers available for educational purposes available to students in the modal grade for 15-year-olds by the number of students in the modal grade for 15-year-olds.

Cognitive activation

Students were asked to think about the maths teacher who taught their most recent maths class and report whether the teacher 'never or rarely' (1), 'sometimes', 'often', or 'always or almost always' (4):

- → asks questions that make students reflect on the problem
- → gives problems that require students to think for an extended time
- → asks students to decide, on their own, procedures for solving complex problems
- → presents problems in different contexts so that students know whether they have understood the concepts
- → helps students to learn from mistakes they have made
- → asks students to explain how they solved a problem
- → presents problems that require students to apply what they have learned in new contexts
- → gives problems that can be solved in different ways.

The index of teachers' use of cognitive activation was constructed from students' responses and standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently encourages students to reflect on their learning in class.

Economic, social and cultural status (ESCS)

The PISA index of economic, social and cultural status (ESCS) was derived from the following three indices: highest occupational status of parents, highest educational level of parents in years of education, and home possessions (including books). In this report, low ESCS students are those in the bottom quarter of the PISA ESCS index within a country, and high ESCS students are those in the top quarter of the index.

Formative assessment

Students were asked to think about their maths lessons and how often, from 'never or hardly ever' (1), 'some lessons', 'most lessons', to 'every lesson' (4) the teacher:

→ tells students how well they are doing in maths class

→ gives students feedback on their strengths and weaknesses in maths

→ tells students what they need to do to become better in maths.

The index of teachers' use of formative assessment was constructed from students' responses and standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently monitors student progress and provides individualised feedback.

Mathematical literacy

Mathematical literacy refers to an individual's capacity to formulate, employ and interpret maths 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 maths plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens.

Quality of educational resources

School principals were asked to report whether their schools' capacity to provide instruction was hindered 'not at all' (1), 'very little', 'to some extent' or 'a lot' (4), by a shortage or inadequacy of:

→ science laboratory equipment

→ instructional materials (eg, textbooks)

→ computers for instruction

→ internet connectivity

→ computer software for instruction

→ library materials.

The responses were combined to create an index of quality of schools' educational resources that has a mean of 0 and a standard deviation of 1 in the OECD countries. Positive values reflect principals' reports that a shortage of educational resources hinders learning to a greater extent than the OECD, and negative values indicate that school principals believe the shortage hinders learning to a lesser extent.

Quality of physical infrastructure

School principals were asked to report on whether their schools' capacity to provide instruction was hindered 'not at all' (1), 'very little', 'to some extent' or 'a lot' (4), by a shortage or inadequacy of:

→ school buildings and grounds

→ heating/cooling and lighting systems

→ instructional space, such as classrooms.

The responses were combined to create an index of quality of physical infrastructure that has an average of 0 and a standard deviation of 1 in OECD countries. Positive values reflect principals' reports that the shortage of physical infrastructure hinders learning to a greater extent than the OECD, and negative values indicate that school principals believe the shortage hinders learning to a lesser extent.

School authority

Schools are classified as either public or private according to whether a private entity or a public agency has the ultimate power to make decisions concerning its affairs. In New Zealand, public schools are also known as state and state-integrated schools. Private schools are also known as independent schools.

School location

- → Rural schools are in areas with less than 3,000 inhabitants.
- → Town schools are in urban areas of 3,000 to 100,000 inhabitants.
- → City schools are in major urban areas with over 100,000 inhabitants.

Shortage of teachers

School principals were asked to report on the extent to which they think instruction in their school is hindered by a lack of qualified teachers in science, maths, English, and 'other subjects', from 'not at all' (1), 'very little', 'to some extent', to 'a lot' (4). This information was combined to create a composite index of teacher shortage, such that the index has an average of 0 and a standard deviation of 1 for OECD countries. Positive values on the index indicate that principals report more problems with instruction because of teacher shortages than the OECD overall, and lower values indicate fewer problems. School principals across countries, and even within countries, may have different expectations and benchmarks to determine whether there is a lack of qualified teachers.

Socio-economically advantaged, average and disadvantaged schools

- → Socio-economically advantaged schools: the average socio-economic status of 15-year-old students is more advantaged than the average socio-economic status of students in the system as a whole.
- → Socio-economically average schools: the average socio-economic status of 15-year-old students is not statistically different from the average socio-economic status of students in the system as a whole.
- → Socio-economically disadvantaged schools: the average socio-economic status of 15-year-old students is more disadvantaged than the average socio-economic status of students in the system as a whole.

Student orientation

Students were asked to think about their maths lessons and how often, from 'never or hardly ever' (1), 'some lessons', 'most lessons', to 'every lesson' (4) the teacher:

- → gives students different work to classmates who have difficulties learning and/or to those who can advance faster
- → assigns projects that require at least one week to complete
- → has students work in small groups to come up with a joint solution to a problem or task
- → asks students to help plan classroom activities or topics.

The index of teachers' student orientation was constructed from students' responses and standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently tailored their classroom learning to maximise student participation.

Student:maths teacher ratio

The ratio was calculated by dividing the school size by the total number of maths teachers, taking into account both part-time and full-time teachers. The student:teacher ratio is not equivalent to maths class size.

Student:teacher ratio

School principals reported the total number of teachers and students in their schools. The ratio was calculated by dividing the school size by the total number of teachers, taking into account both part-time and full-time teachers. The student:teacher ratio is not equivalent to class size. Specialist teachers (eg, of special needs students) and non-contact time will mean that class size is typically larger than the student:teacher ratio.

Teacher quality

PISA measures of teacher quality include the professional development opportunities for maths teachers and measures based on the number of maths teachers with: degree-level qualifications; degree-level qualifications in teaching; and degree-level qualifications with a major in maths.

Teacher-directed instruction

Students were asked to think about their maths lessons and how often, from 'never or hardly ever' (1), 'some lessons', 'most lessons', to 'every lesson' (4) the teacher:

- → sets clear goals for student learning
- → asks students to present their thinking or reasoning at some length
- → asks questions to check whether students understood what was taught
- → tells students what they have to learn.

The index of teacher-directed instruction was constructed from students' responses and standardised across OECD countries to have an average of 0 and a standard deviation of 1. Positive values on the index indicate that, compared to the average student in OECD countries, students reported that their maths teacher more frequently provides an effective structure to their learning experience.

Teacher-related factors that influence learning

School principals were asked to report the extent to which learning in their schools is hindered, from 'not at all' (1), 'very little', 'to some extent', to 'a lot' (4), by such factors as:

- → students not being encouraged to achieve their full potential
- → poor teacher–student relations
- → teachers having to teach students of heterogeneous ability levels within the same class
- → teachers having to teach students of diverse ethnic backgrounds within the same class
- → teachers' low expectations of students
- → teachers not meeting individual students' needs
- → teacher absenteeism
- → school staff resisting change
- → teachers being too strict with students
- → teachers being late for classes
- → teachers not being well prepared for classes.

The responses were combined to create an index of teacher-related factors that hinder learning, with an average of 0 and a standard deviation of 1 in OECD countries. Positive values reflect principals' reports that these teacher-related issues hindered learning to a lesser extent than the OECD overall, and negative values indicate that these teacher-related issues hindered learning to a greater extent.

Teacher–student relations

Students were asked to indicate whether and to what extent they agreed with several statements regarding their relationships with teachers at school, including whether:

- → they get along with their teachers
- → teachers are interested in their personal well-being
- → teachers take the student seriously
- → teachers are a source of support if the student needs extra help
- → teachers treat the student fairly.

These responses were combined to create a composite index of teacher–student relations, such that the index has an average of 0 and a standard deviation of 1 for OECD countries. Positive values indicate better reports of teacher–student relations than the OECD overall, and negative values indicate worse reports.

List of countries and economies participating in **PISA 2012**


Albania*

Austria

Bulgaria*

Chinese Taipei*

Croatia*

Denmark

France

Hong Kong-China*

Indonesia*

Italy

Kazakhstan*

Liechtenstein*

Macao-China*

Montenegro*

Norway

Portugal

Russian Federation*

Singapore*

Spain

Thailand*

United Arab Emirates*

Uruguay*


Argentina*

Belgium

Canada

Colombia*

Cyprus*

Estonia

Germany

Hungary

Ireland

Japan

Korea

Lithuania*

Malaysia*

Netherlands

Peru*

Qatar*

Serbia*

Slovak Republic

Sweden

Tunisia*

United Kingdom

Viet Nam*

Australia

Brazil*

Chile

Costa Rica*

Czech Republic

Finland

Greece

Iceland

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Jordan*

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New Zealand

Poland

Romania*

Shanghai-China*

Slovenia

Switzerland

Turkey

United States

* non-OECD countries and economies

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