



The achievement of Australia's Indigenous students in PISA 2000 — 2006

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First published 2009
by ACER Press, an imprint of
Australian Council for Educational Research Ltd
19 Prospect Hill Road, Camberwell
Victoria, 3124, Australia

www.acerpress.com.au

sales@acer.edu.au

Text © Lisa De Bortoli and Sue Thomson, 2009

Design and typography © ACER Press 2009

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Cover and text design by ACER, Project Publishing Department

Printed in Australia by BPA Print Group Pty Ltd

National Library of Australia Cataloguing-in-Publication data:

Author:	De Bortoli, Lisa Jean, 1968-
Title:	The achievement of Australia's Indigenous Students in PISA 2000 - 2006 / Lisa De Bortoli, Sue Thomson.
ISBN:	9780864319012 (pbk.)
Subjects:	Programme for International Student Assessment. Educational evaluation--Australia. Aboriginal Australians--Education.
Other Authors:	Thomson, S. (Susan), 1958- Australian Council for Educational Research.
Dewey Number:	371.26

This publication is the result of research that formed part of a program supported by a grant to the Australian Council for Educational Research by Commonwealth, State and Territory governments. The support provided by these governments is gratefully acknowledged.

The views expressed in this report are those of the authors and not necessarily those of the Commonwealth, State and Territory governments.

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Executive Summary

The three-yearly PISA assessments provide an opportunity to monitor the performance of Australian students in reading, mathematical and scientific literacy. In particular, the assessments allow us to examine the performance of particular equity groups; to look at how well particular groups of 15-year-old students, approaching the end of their compulsory schooling are prepared for meeting the challenges they will face in their lives beyond school.

A special focus for Australia has been to ensure that there is a sufficiently large sample of Australia's Indigenous students so that valid and reliable analysis can be conducted. This has been achieved in each cycle of PISA and this report presents analyses of the achievement of Indigenous students in reading, mathematical and scientific literacy in each of the cycles.

Achievement is presented in two ways in this report: in terms of mean scores and in terms of proficiency levels. Mean scores allow comparisons with other students and with other countries, and while proficiency levels also allow comparisons, additionally they provide information about what students can and cannot do.

Across the three PISA cycles, Indigenous students have performed at a substantially and statistically lower average level in reading, mathematical and scientific literacy than their non-Indigenous peers. In each domain, Indigenous students performed more than 80 score points (or more than one proficiency level) lower than non-Indigenous students and more than 50 score points lower than the OECD average. In terms of proficiency levels, Indigenous students are overrepresented at the lower levels and underrepresented at the upper levels in reading, mathematical and scientific literacy.

The OECD has determined that for mathematical and scientific literacy Proficiency Level 2 is the base level at which students are considered able to demonstrate competencies that will enable them to actively participate in life situations. For the purposes of this report, Level 2 will be treated in a similar manner for reading literacy.

More than one third of Indigenous students did not achieve Level 2 in reading, mathematical or scientific literacy. Only 12 per cent of Indigenous students were able to achieve the highest levels of reading literacy, and no more than five per cent achieved the highest level in mathematical and scientific literacy.

Significant gender differences were found between Indigenous males and females in reading literacy, favouring Indigenous females by 34 score points. No significant gender differences in mathematical and scientific literacy were found for Indigenous students.

The performance of Australian Indigenous students in PISA continues to raise concerns about the educational disadvantage faced by these students. From an international perspective, they are performing well below the OECD average and from a national perspective, they are achieving well below the performance of non-Indigenous students.

The results from the three PISA assessments have shown that the performance of Indigenous students has not improved over time. These results suggest that initiatives to improve the education of Indigenous students through educational policy have to date had little effect. In terms of real-life functioning and future opportunities, Indigenous students remain at a substantial disadvantage.

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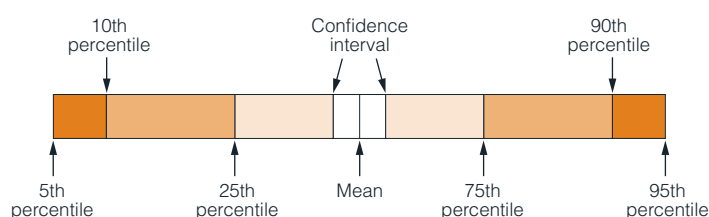
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Reader's Guide

How to read the mean and distribution graphs

Each country's or student group's results are represented in horizontal bars with various colours. On the left end of the bar is the 5th percentile – this is the score below which 5 per cent of the students have scored. The next two lines indicate the 10th percentile and the 25th percentile. The next line at the left of the white band is the lower limit of the confidence interval for the mean – i.e. we are confident that the mean will lie in this white band. The line in the centre of the white band is the mean. The lines to the right of the white band indicate the 75th, 90th and 95th percentile.



Definitions of background characteristics

A number of different background characteristics are referred to in this report. The definitions of some of these are particular to the Australian context, while others are standard across different countries or within an international context. This section provides an explanation for those that are not self-evident.

Indigenous status:	Indigenous status is based on students' self-identification as being of Australian Aboriginal or Torres Strait Islander descent. For the purposes of this report, data for the two groups are presented together with the descriptor, Indigenous Australian students.
Socioeconomic background:	Two measures are used by the OECD to represent elements of socioeconomic background. One is the highest level of the father's and mother's occupation (known as HISEI), which is coded in accordance with the International Standard Classification of Occupations. The other measure is the index of economic, social and cultural status (ESCS), which was created to capture the wider aspects of a student's family and home background. The ESCS index is based on students' reports of their parents' occupations; the highest level of education of the father and mother converted into years of schooling; the number of books in the home; and access to home educational and cultural resources.

- Geographic location: In Australia, the participating schools were coded according to the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) Schools Geographic Location Classification. For the analysis in this report, only the broadest categories are used:
- ▶ Metropolitan – including mainland state capital cities or major urban districts with a population of 100,000 or more (e.g. Queanbeyan, Cairns, Geelong, Hobart)
 - ▶ Provincial – including provincial cities and other non-remote provincial areas (e.g. Darwin, Ballarat, Bundaberg, Geraldton, Tamworth)
 - ▶ Remote – Remote areas and Very remote areas. Remote: very restricted accessibility of goods, services and opportunities for social interaction (e.g. Coolabah, Mallacoota, Capella, Mt Isa, Port Lincoln, Port Hedland, Swansea and Alice Springs). Very remote: very little accessibility of goods, services and opportunities for social interaction (e.g. Bourke, Thursday Island, Yalata, Condungup, Nhulunbuy).

Reporting of student data

Age of students

The report uses “15-year-olds” as shorthand for the PISA target population. In practice, the target population is students who were aged between 15 years and 3 (complete) months and 16 years and 2 (complete) months at the beginning of the assessment period and who were enrolled in an educational institution that they were attending full-time or part-time.

PISA scores

To facilitate the interpretation of the scores assigned to students, scales were constructed to have an average score among the OECD countries of 500 points, with about two-thirds of students across OECD countries scoring between 400 and 600 points (i.e. the scale has a mean of 500 and a standard deviation of 100).

OECD average

An OECD average was calculated for most indicators in this report and is presented for comparative purposes. The OECD average takes the OECD countries as a single entity, to which each country contributes with equal weight. The OECD average is equivalent to the arithmetic mean of the respective country means

Confidence intervals and standard errors

In this and other reports, student achievement is often summarised by a mean score. For PISA, each mean score is calculated from the sample of students who undertook the PISA assessment, and is referred to as the sample mean. These sample means are an approximation of the actual mean score, known as the population mean, which would have been derived had all students in Australia actually taken part in the PISA assessment. Since the sample mean is just one point along the range of student achievement scores, more information is needed to gauge whether the sample mean is an underestimation or overestimation of the population mean. The calculation of confidence intervals can assist our assessment of a sample mean’s precision as an estimation of the population mean. Confidence intervals provide a range of scores within which we are

‘confident’ that the population mean actually lies. In this report, sample means are presented with an associated standard error. The confidence interval, which can be calculated using the standard error, indicates that there is a 95 per cent chance that the actual population mean lies within plus or minus 1.96 standard errors of the sample mean.

Spread of scores

The spread of scores between the 5th and 95th percentile summarises the range of student performance. The goal for education systems is to have a narrow spread (that is, where students are achieving at similar levels, rather than achieving wide-ranging mean scores and for those mean scores to be high).

Proficiency levels

Responses to the PISA tests can be summarised numerically, as a scale score on each of the assessment domains, or as a proficiency level, which provides a description of the types of tasks that students should be able to perform. For each assessment domain, a number of proficiency levels are described and aligned with a range of scale scores. Students who score with a range for a particular proficiency level are then expected to be able to complete those sorts of tasks. For example, in scientific literacy, at the lowest proficiency level in science, students are able to recall simple factual scientific knowledge (e.g. names, facts, terminology, simple rules); and to use common scientific knowledge in drawing or evaluating conclusions.

Around the OECD average score (500 points) students are typically able to use scientific knowledge to make predictions or provide explanations; to recognise questions that can be answered by scientific investigation and/or identify details of what is involved in a scientific investigation; and to select relevant information from competing data or chains of reasoning in drawing or evaluating conclusions.

Towards the high end of the science proficiency levels, students are generally able to create or use conceptual models to make predictions or give explanations; to analyse scientific investigations in order to grasp, for example, the design of an experiment or to identify an idea being tested; to compare data in order to evaluate alternative viewpoints or differing perspectives; and to communicate scientific arguments and/or descriptions in detail and with precision.

Rounding of figures

Some figures in tables may not exactly add to the totals due to the practice of rounding. Totals, differences and averages are always calculated on the basis of exact numbers and are rounded only after calculation. When standard errors have been rounded to one or two decimal places and the value 0.0 or 0.00 is shown, this does not imply that the standard error is zero, but that it is smaller than 0.05 or 0.005, respectively. In general, achievement scores are rounded to a whole number, and standard errors to one decimal place.

Introduction

In 1997, the Organisation for Economic, Cooperation and Development (OECD) launched the Programme for International Student Assessment (PISA). The aim of PISA is to monitor the outcomes of education systems by measuring how well students who are approaching the end of their compulsory schooling are prepared for meeting the challenges they will face in their lives beyond school. The first PISA assessment was carried out in 2000, and has been conducted every three years since then.

The educational indicators that are obtained from each PISA cycle are used to assess differences and similarities both at a point in time and over a period of time. Comparisons can be made between countries or in Australia between states. Key demographic, social and educational influences on student and school performance are also measured in PISA. Due to the collection of this background information, the data also allow detailed analysis and comparison of the performance of Australian Indigenous¹ and non-Indigenous students.

In Australia, the disparity between the educational outcomes of Indigenous and non-Indigenous students are well documented and of great concern. The National Declaration on Educational Goals for Young Australians reports that the educational outcomes for Indigenous students are substantially lower than compared to other students and advised:

Meeting the needs of young Indigenous Australians and promoting high expectations for their educational performance requires strategic investment. Australian schooling needs to engage Indigenous students, their families and communities in all aspects of schooling; increase Indigenous participation in the education workforce at all levels; and support coordinated community services for students and their families that can increase productive participation in schooling.

(MCEETYA, 2008, p. 15)

Hunter and Schwab (2003) investigated the educational disadvantage faced by older Indigenous students. Their research found that the gap in higher education participation rates between Indigenous and non-Indigenous students had widened over time, while the degree of inequality in educational attainment between these two groups increased with the level of qualification. The higher the level of qualification, the fewer Indigenous graduates compared to non-Indigenous graduates.

The *National Report on Indigenous Education and Training* detailed the serious gaps between Indigenous and non-Indigenous outcomes in education (Commonwealth of Australia, 2002). Results from the Information and Communications Technology (ICT) Literacy and Civics and Citizenship sample assessments, other national assessments which test the same age group of

¹ The term 'Indigenous' refers to students who identify as either Australian Aboriginal or Torres Strait Islanders. Please refer to the Reader's Guide.

students, have continued to show Indigenous students do not perform as well as non-Indigenous students, with differences being both statistically significant and of a substantial nature (MCEETYA, 2006; 2007).

The educational disadvantage faced by Indigenous students has also been illustrated in PISA. Some of these results were included in the Australian PISA reports. This report, the first of two volumes, presents a summary of results from PISA 2000, PISA 2003 and PISA 2006, as well as providing additional details and analysis on the performance of Indigenous students. The second volume will focus on family background and contextual factors, such as socioeconomic background, and psychological factors, including beliefs and attitudes, learning strategies and interests.

Why PISA?

PISA was designed to help governments not only understand but also to enhance the effectiveness of their educational systems. PISA findings are being used internationally to:

- ▶ compare literacy skills of students in one country to those of students in other participating countries;
- ▶ establish benchmarks for educational improvement, in terms of the mean scores achieved by other countries or in terms of a country's capacity to provide high levels of equity in educational outcomes and opportunities; and
- ▶ understand the relative strengths and weaknesses of individual education systems.

PISA's orientation towards the future of these students is reflected in its literacy approach, which is concerned with the capacity of students to apply their skills and knowledge in a particular subject area, and to analyse, reason and communicate effectively as they do so.

PISA in Australia

PISA is an element of the National Assessment Program in Australia. Together with the International Association for the Evaluation of Educational Achievement (IEA)'s Trends in International Mathematics and Science Study (TIMSS), PISA provides data from internationally standardised tests that enables Australia to compare its performance to that of other countries. The international measures complement national literacy and numeracy assessments for students in Years 3, 5, 7 and 9 and national sample assessments of Science at Year 6, Civics and Citizenship at Years 6 and 10, and Information and Communications Technology at Years 6 and 10.

Reporting on the assessments is undertaken through the annual National Reports on Schooling as well as through monographs and reports on particular assessments.

An indicative progress measure based on PISA results has been agreed by the Council of Australian Governments (COAG) and is included in the new National Education Agreement as one mechanism to measure progress towards the achievement of outcomes and aspirations for schooling. This elevates the relevance and importance of PISA as a measure of educational attainment in Australia.

The main goals of PISA

Overall, PISA seeks to measure how well young adults, at age 15 and therefore near the end of compulsory schooling, are prepared to use knowledge and skills in particular areas to meet real-life challenges. This is in contrast to assessments that seek to measure the extent to which students have mastered a specific curriculum. PISA's orientation reflects a change in the goals and objectives of curricula themselves, which increasingly address how well students are able to apply what they learn at school.

As part of the PISA process, students complete an extensive background questionnaire and school principals complete a survey describing the context of education at their school, including the level of resources in the school, qualifications of staff and teacher morale. The reporting of the findings from PISA is then able to focus on issues such as:

- ▶ How well are young adults prepared to meet the challenges of the future? What skills do they possess that will facilitate their capacity to adapt to rapid societal change?
- ▶ Are some ways of organising schools or school learning more effective than others?
- ▶ What influence does the quality of school resources have on student outcomes?
- ▶ What educational structures and practices maximise the opportunities of students from disadvantaged backgrounds? How equitable is the provision of education within a country or across countries?

What skills does PISA assess?

As PISA's goal is measuring competencies that will equip students to participate productively and adaptively in their life beyond school education, the PISA assessment focuses on young people's ability to apply their knowledge and skills to real-life problems and situations. Are students able to analyse, reason and communicate their ideas effectively in a range of situations? How well do they make use of technological advances? Do they have the capacity to continue learning throughout their lives and are they equipped with strategies to do so?

PISA uses the term 'literacy' to encompass this broad range of competencies relevant to coping with adult life in today's rapidly changing societies. In such a context, adults need to be literate in many domains, as well as in the traditional literacy areas of being able to read and write. The OECD considers that mathematics, science and technology are sufficiently pervasive in modern life that personal fulfilment, employment, and full participation in society increasingly require an adult population which is not only able to read and write, but is also mathematically, scientifically and technologically literate.

(OECD, 2000, p. 9)

Major and minor domains

PISA assesses competencies in each of three core domains – reading literacy, mathematical literacy and scientific literacy. During each PISA cycle one domain is tested in detail and is referred to as the 'major' domain. The remaining time is allocated to assessing the other (minor) domains. In 2000, the major domain was reading literacy, with mathematical literacy and scientific literacy making up the minor domains. In 2003, the emphasis moved from reading literacy to mathematical literacy as the major domain. In 2006, the major focus of the assessment was scientific literacy, with reading literacy and mathematical literacy forming the minor domains.

The domains covered by PISA are defined in terms of the content that students need to acquire, the processes that need to be performed, and the contexts in which knowledge and skills are applied. The assessments are based on frameworks that provide a common language and a vehicle for discussing the purpose of the assessment and what it is trying to measure. Working groups consisting of subject matter experts were formed to develop the assessment frameworks, which are subsequently considered and approved by the PISA Governing Board (PGB) established by the OECD. These frameworks are revised for the major domain in each cycle. Each of the three domains is described briefly in the relevant chapter of this report.

Skills for life

Without further follow-up of future educational and occupational outcomes of the students assessed in PISA, it is not possible to say how relevant their skills at age 15 will be in later life. However, there is evidence from both the International Adult Literacy Survey (IALS) and the Longitudinal Surveys of Australian Youth (LSAY) of differential future educational success and labour market experiences of people with higher and lower achievement in literacy.

More specifically, there is evidence from LSAY that school completion is strongly correlated with PISA achievement outcomes (Hillman & Thomson, 2006). Further evidence from the longitudinal follow-up of students in Canada who had participated in the PISA 2000 reading assessment also showed that the PISA performance of students at age 15 was a very strong predictor for a successful transition to higher education at age 19.

How results are reported

International comparative studies have provided an arena to observe the similarities and differences that stem from different educational policies and practices, and have enabled researchers and others to observe what is possible for students to achieve, and which environments are most likely to facilitate their learning. PISA provides regular information on educational outcomes within and across countries by providing insight about the range of skills and competencies, in different assessment domains, that are considered to be essential to an individual's ability to participate and contribute to society.

As is the practice in other international studies, PISA results are reported as means, which indicate average performance, and various statistics that reflect the distribution of performance. PISA also attaches meaning to the performance scale by providing a profile of what students have achieved in terms of skills and knowledge. The performance scale is divided into levels of difficulty, referred to as 'described proficiency levels'. Students at a particular level not only typically demonstrate the knowledge and skills associated with that level but also the proficiencies required at lower levels.

In PISA 2000, five proficiency levels were defined for the major domain of reading literacy. In 2003 and 2006, six levels of proficiency were defined for the respective major domains of mathematical literacy and scientific literacy.

Conducting PISA

What do PISA participants do?

Students who participate in PISA complete an assessment booklet that contains questions about one or more of the literacy domains being tested and a Student Questionnaire.

Testing occurs during the morning and students are given two hours to complete the assessment booklet and 30 to 40 minutes to complete the Student Questionnaire. In PISA 2000, there were 10 assessment booklets, and in PISA 2003 and PISA 2006 there were 13 assessment booklets. The booklets are assembled according to a complex design so that each booklet is linked through common items to other booklets in a balanced way.

In each PISA cycle, all booklets contain items from the major domain, and a rotation system is used to distribute items from the minor domains evenly across the booklets. This distribution of the different items across the booklets means that a broader range of tasks can be assessed in the same amount of time, as well as enhancing the validity of the administration as students are unlikely to be doing the same booklet as students around them. Item Response Theory is used to link common items from the different booklets.

The Student Questionnaire, which is the same across all participating countries, collects information on students and their family background, aspects of learning and instruction in the major domain of assessment for that cycle, and the context of instruction, including instructional time and class size.

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

In Australia, a National Advisory Committee guides all aspects of the project. The National Project Manager is responsible for the implementation of PISA at the national level. Prior to the beginning of the first round of PISA, the National Advisory Committee recommended a process of oversampling Indigenous students to reliably report results for this minority group. ACER (the National Project Manager in Australia) liaises with schools to gain their participation and help with the logistics of arranging assessment sessions.

Who participates in PISA?

Countries

PISA was originally an OECD assessment, created by the governments of OECD countries. The first PISA assessment of 15-year-old students in 2000 took place in 28 OECD countries (including Australia) and four non-OECD (or partner) countries. Since then, it has become a major assessment tool in many regions and countries around the world. In 2001, 11 partner countries repeated PISA 2000. In 2003, more than one-quarter of a million students from 41 countries (all 30 OECD member countries and 11 non-OECD countries) participated in PISA, and in 2006, almost 400,000 students from 57 countries (all OECD countries and 27 partner countries) took part in the assessment.

Schools

In most countries 150 schools and 35 students in each school are randomly selected to participate in PISA. In some countries, including Australia, a larger sample of schools and students participate. This allows countries to carry out specific national options at the same time as the PISA assessment, or for meaningful comparisons to be made between different sectors of the population.

In Australia, a larger sample of schools and students are gathered for three main reasons:

- ▶ To allow comparison between the States and Territories. It is necessary to 'oversample' the smaller states because a random sample proportionate to state populations would not yield sufficient students in the smaller states to give a result that would be sufficiently precise;
- ▶ To allow examination of Indigenous student performance. A special focus in PISA in Australia has been to ensure that there is a sufficiently large sample of Australia's Indigenous students, so that valid and reliable separate analysis can be conducted; and
- ▶ To allow for longitudinal follow-up of participating students. The PISA 2003 and 2006 samples became a cohort of the Longitudinal Surveys of Australian Youth (LSAY). These students are tracked, and contacted in future years to trace their progress through school and entry into further education and the work force. A large sample is needed to allow for attrition: over time a proportion of the original sample is not able to be traced or chooses to leave the study.

In PISA 2000 there were 231 schools in the achieved Australian sample. In PISA 2003 and PISA 2006 the sample of schools increased to 321 and 356, respectively. The Australian school sample is designed so that schools are selected with a probability proportional to the enrolment of

15-year-olds in each school. Stratification ensures the correct ratios of government, Catholic and independent sectors.

The PISA participating schools were also stratified with respect to the MCEEETYA Schools Geographic Location Classification². In PISA 2000, 69 per cent of the schools were located in the metropolitan zone, 30 per cent were from provincial zones and one per cent of schools were in remote areas. Similar proportions of schools were selected for PISA 2003, with 72 per cent of schools located in metropolitan zones, 27 per cent from provincial zones and one per cent in remote locations. In PISA 2006, 65 per cent of schools were located in the metropolitan zone, 30 per cent from provincial zones and around five per cent of schools were in remote areas.

Students

The target population for PISA is students who are 15-years-old and enrolled at an educational institution, either full- or part-time, at the time of testing³.

From each country, a random sample of 35 students is selected with equal probability from each school using a list of all 15-year-old students that is submitted by the school. Schools were requested to provide information such as date of birth, sex and year level as well as Indigenous status for their 15-year-old students.

In PISA 2000, 35 students were randomly selected from each Australian school and in PISA 2003 and PISA 2006 the Australian student sample was increased to 50 students per school (for the reasons described earlier). In addition to the general increase in sample size, to ensure the Indigenous sample was as large as possible, all age eligible Indigenous students from all participating schools were sampled and asked to participate in PISA.

The Australian student sample was drawn from all states and sectors and Table 1.1 shows the number of participating students in PISA 2000, PISA 2003 and PISA 2006, along with the size of the underlying population.

Table 1.1: Number of Australian PISA Students

PISA	Sample N	Population N ⁴
2000	5 477	228 331
2003	12 551	235 593
2006	14 170	234 938

Table 1.2 shows the number of Indigenous and non-Indigenous students who participated in PISA. The Australian Bureau of Statistics (2007) reported the estimated resident Indigenous population of Australia for 2006 at 2.5 per cent of the total population.

Table 1.2: Number of Indigenous and non-Indigenous students in PISA 2000, PISA 2003 and PISA 2006

PISA	Indigenous students			Non-Indigenous students	
	Sample N	Population N	Weighted %	Sample N	Population N
2000	493	5 440	2.4	4 984	222 892
2003	815	5 193	2.2	11 736	230 398
2006	1080	6 891	2.9	13 090	228 049

² Refer to the Reader's Guide for a definition of geographic location.

³ Refer to the Reader's Guide.

⁴ This is the weighted number of students.

In PISA 2000, there was a slight gender imbalance across the entire sample of students, with 53 per cent of the sample being male. In PISA 2003 and again in PISA 2006, the magnitude of the gender imbalance was almost negligible, with 51 per cent of the sample male students.

Among participating Indigenous students, there were similar numbers of male and female students in each cycle. Table 1.3 provides a breakdown of Indigenous and non-Indigenous students by gender for each PISA cycle.

Table 1.3: Number of Indigenous and non-Indigenous students by gender in PISA 2000, PISA 2003 and PISA 2006

PISA	Indig. Females %	Indigenous students				Non-Indig Females %	Non-Indigenous students			
		Females		Males			Females		Males	
		Sample N	Population N	Sample N	Population N		Sample N	Population N	Sample N	Population N
2000	51	256	2 772	237	2 667	47	2 393	105 462	2 591	117 430
2003	47	400	2 462	415	2 730	49	5 816	113 366	5 920	117 032
2006	49	537	3 405	543	3 486	49	6 441	111 387	6 649	116 662

As the sample is age-based, the students may be enrolled in different year levels, although the majority are from Year 9, 10 and 11. There are some variations to the year-level composition of the sample because of differing school starting ages in the different states. Table 1.4 shows the percentage of Indigenous and non-Indigenous students at each year level.

Table 1.4: Distribution of Indigenous and non-Indigenous students by year level in PISA 2000, PISA 2003 and PISA 2006

PISA	Indigenous students					non-Indigenous students				
	Year level #, € (%)					Year level #, € (%)				
	8	9	10	11	12	8	9	10	11	12
2000	€	7	74	19	0	€	7	76	17	0
2003	€	10	74	16	€	€	8	72	19	€
2006	€	9	59	32	0	€	9	71	20	€

Totals may not add up to 100 because of rounding.
 € Percentage ≤ 0.2

In PISA 2006, there were a higher percentage of Indigenous students who were in Year 11 and fewer Indigenous students in Year 10 than compared to PISA 2000 and PISA 2003. Further investigation showed that there were 23 per cent of Indigenous students aged between 15 years and 9 months and 16 years and 2 months who were in Year 11 in PISA 2006 compared to 12 per cent in PISA 2003.

In PISA 2000 and PISA 2003, almost all of the Indigenous students sampled were from schools in metropolitan and provincial locations with very few from schools in remote areas. In PISA 2006, however, a higher proportion of Indigenous students in the sample were from schools in remote areas (Table 1.5).

Table 1.5: Distribution of Indigenous students by geographic location in PISA 2000, PISA 2003 and PISA 2006

PISA	Geographic location (%)		
	Metropolitan	Provincial	Remote
2000	44	54	2
2003	50	49	2
2006	37	44	19

Table 1.6 shows the distribution of Indigenous students by socioeconomic background⁵ in PISA. Socioeconomic quartiles are defined on the whole population, so the distribution of Indigenous students' scores should be approximately the same across quartiles; however the table shows that Indigenous students are overrepresented in the lowest quartile of socioeconomic background and underrepresented in the highest quartile.

Table 1.6: Distribution of Indigenous students by socioeconomic background in PISA 2000, PISA 2003 and PISA 2006

PISA	Socioeconomic status			
	Lowest quartile	Second quartile	Third quartile	Highest quartile
2000	37	29	20	13
2003	41	22	22	14
2006	44	24	23	10

PISA so far

Table 1.7 provides a summary of Australian results from PISA 2000, 2003 and 2006. Results are reported for Australia and for the highest and lowest performing countries in each domain of assessment. Figures refer to mean scores points on the relevant PISA literacy scales and the figures within the brackets refer to standard errors for the associated mean scores.

Table 1.7: A summary of results from PISA

	PISA		
	2000	2003	2006
MAJOR DOMAIN	Reading literacy	Mathematical literacy	Scientific literacy
MINOR DOMAINS	Mathematical literacy	Reading literacy	Mathematical literacy
	Scientific literacy	Scientific literacy	Reading literacy
AUSTRALIA'S PERFORMANCE			
Reading Literacy	528 (3.5)	525 (2.1)	513 (2.1)
Mathematical Literacy	533 (3.5)	524 (2.1)	520 (2.2)
Scientific Literacy	528 (3.5)	525 (2.1)	527 (2.3)
HIGHEST PERFORMING COUNTRY			
Reading Literacy	Finland 546 (2.6)	Finland 543 (1.6)	Korea 556 (3.8)
Mathematical Literacy	Japan 557 (5.5)	Hong Kong-China 550 (4.5)	Chinese Taipei 549 (4.1)
Scientific Literacy	Korea 552 (2.7)	Finland 548 (1.9)	Finland 563 (2.0)
LOWEST PERFORMING COUNTRY			
Reading Literacy	Brazil 396 (3.1)	Tunisia 375 (2.8)	Kyrgyzstan 285 (3.5)
Mathematical Literacy	Brazil 334 (3.7)	Tunisia 385 (2.6)	Kyrgyzstan 311 (3.4)
Scientific Literacy	Brazil 375 (3.3)	Brazil 356 (4.8)	Kyrgyzstan 332 (2.9)

Organisation of the report

This report focuses on Indigenous and non-Indigenous students' results from PISA 2000, PISA 2003 and PISA 2006 in the areas of reading literacy, mathematical literacy and scientific literacy. Chapters 2, 3 and 4 focus on each of these assessment domains in turn. Chapter 5 presents a summary of the findings and policy implications.

⁵ Socioeconomic measure is HISEI. See Reader's Guide for a further description of the socioeconomic variable.

Reading literacy

The assessments conducted as part of PISA provide information about how well young adults use their knowledge and skills to participate in today's changing world. The first PISA assessment in 2000 provided a detailed insight into reading literacy performance and skills of 15-year-old students.

In 2000, when reading literacy was the major domain of assessment in PISA, three reading literacy subscales were created and used for reporting reading proficiency: retrieving information; interpreting texts; and reflection and evaluation. In PISA 2003 and PISA 2006 reading literacy was a minor domain and so only the results of the overall reading literacy scale were reported.

The first part of this chapter provides a summary of reading literacy and how it is measured⁶. The remaining parts of the chapter examine Indigenous students' performance in reading literacy.

Definition of Reading Literacy

The PISA concept of reading literacy emphasises skills in using written information in situations that students may encounter in their life both at and beyond school. The PISA framework (OECD, 2006) defines reading literacy as:

... understanding, using and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential and to participate in society.

(p. 46)

This definition goes beyond the traditional notion of reading literacy as decoding information and literal comprehension. It includes understanding texts at a general level, interpreting them, reflecting on their content and form in relation to the reader's own knowledge of the world, and arguing a point of view in relation to what has been read. The definition incorporates the PISA emphasis on acquiring skills that will be relevant throughout life.

How reading literacy is measured

The concept of reading literacy in PISA is defined by three dimensions: the format of the reading material, the type of reading task or reading processes, and the situation or the use for which the text was constructed.

As reading literacy was the major domain of assessment in PISA 2000, most of the testing time was devoted to this domain. In 2003 and 2006, with reading literacy being a minor domain,

⁶ Information about the reading literacy assessment framework has been taken from the PISA 2006 National Report, *Exploring Scientific Literacy: How Australia measures up*.

less overall testing time was devoted to reading literacy. However, in each of the PISA cycles the distribution of reading literacy items across the processes has remained the same. Half of the assessed reading literacy items measure students' reading skills in retrieving information, 20 per cent measure interpreting texts, and the remaining 30 per cent of items assess reflection and evaluation.

Text format

The text format or the structure of the reading material makes a distinction between continuous and non-continuous texts. Continuous texts are typically composed of sentences that are, in turn, organised into paragraphs. These may fit into even larger structures such as sections, chapters and books. Examples of continuous texts are narration, exposition, argumentation, instruction and hypertext. Non-continuous texts are organised differently from continuous texts and so require different kinds of reading approaches. Non-continuous texts are classified by their formats; for example, charts and graphs, diagrams, maps, and information sheets.

Processes

The PISA reading assessment measures the following five processes associated with achieving a full understanding of a text: retrieving information; forming a broad general understanding; developing an interpretation; reflecting on and evaluating the context of a text; and reflecting on and evaluating the form of a text. It is expected that all readers, irrespective of their overall proficiency, will be able to demonstrate some level of competency in each of these areas.

For reporting purposes in PISA 2000, the five processes were collapsed into three larger categories (forming the reading literacy subscales): retrieving information, interpreting texts (combining the two processes that require students to focus on relationships within a text), and reflecting and evaluating (combining the two processes that require students to reflect on and evaluate content or form of text - forming a broad understanding and developing an interpretation). In 2003 and 2006, results for reading are reported on a single reading literacy scale that combines elements of the three different categories of processes.

Situations

The reading situation refers to the use for which the text was constructed and can be understood as a general categorisation of texts based on the author's intended use, on the relationship with other persons implicitly or explicitly associated with the text, and on the general content of the text. The texts used in the assessment were drawn from a variety of situations to maximise the diversity of content included in PISA. Four different situations were included in the assessments: reading for private use (personal), reading for public use, reading for work (occupational) and reading for education.

A more detailed description of the conceptual framework underlying the PISA reading literacy assessment is provided in the publication, *Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006* (OECD, 2006).

Reading literacy performance: scale scores

On average, Indigenous students performed at a significantly lower level in reading literacy compared to non-Indigenous students in each of the three PISA cycles conducted thus far. In PISA 2000, Indigenous students achieved a mean score of 448 points for reading literacy, while non-Indigenous students achieved a mean score of 531 points. Similar levels in reading literacy performance were also found in PISA 2003 and PISA 2006. Indigenous and non-Indigenous students' PISA results for reading literacy are shown in Table 2.1, along with the results for Australia and the OECD average for comparison.

Table 2.1: Means and standard errors for Indigenous and non-Indigenous students on the overall reading literacy scale

Student group	PISA 2000		PISA 2003		PISA 2006	
	Mean	SE	Mean	SE	Mean	SE
Indigenous	448	5.8	444	8.6	434	6.9
Non-Indigenous	531	3.4	527	2.0	515	2.1
Australia	528	3.5	525	2.1	513	2.1
OECD average	500	0.6	494	0.6	492	0.6

Relatively large differences between the mean performance of the Indigenous and non-Indigenous students are evident across the PISA cycles, with an average difference of 82 score points, equivalent to about 0.8 of a standard deviation.

Across the three PISA cycles, Indigenous students also performed significantly below the OECD average, by 53 score points on average. In reading literacy, one proficiency level equates to 73 score points. Thus, the average reading literacy performance of Indigenous students was almost three-quarters of a proficiency level lower than the average performance of all students across OECD countries in PISA 2000 and PISA 2003, and more than three-quarters of a proficiency level lower in PISA 2006. Non-Indigenous students, in comparison, performed more than one-third of a proficiency level higher than the OECD average across the three PISA cycles.

Figure 2.1⁷ shows the distribution of performance scores for PISA 2000 on the reading literacy scale, including the range of performance for students between the 5th percentile (the point below which the lowest performing 5 per cent of the students score) and the 95th percentile (the point above which the highest performing 5 per cent of students score). The spread of the scores indicates that while there are some Indigenous students performing at lower levels, there are also some Indigenous students performing at higher levels. However, the figure also shows that the top five per cent of Indigenous students are performing at a level similar to that of the top 25 per cent of non-Indigenous students.

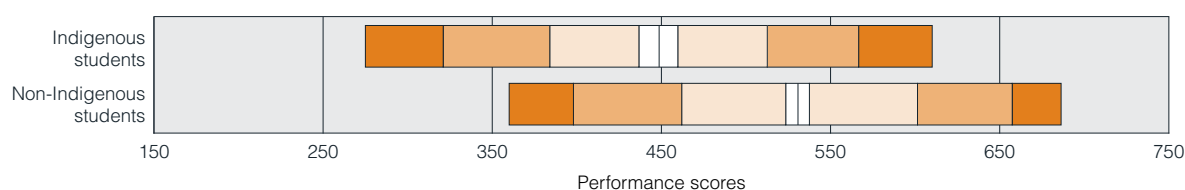


Figure 2.1: Distribution of Indigenous and non-Indigenous students on the reading literacy scale for PISA 2000

In PISA 2000, the spread of scores for Indigenous students between the 5th and 95th percentile was 335 score points, which was similar to the spread of scores for the non-Indigenous students, which was 326 score points. In PISA 2003, the spread of scores for Indigenous students remained similar to the previous cycle, at 327 score points, as did the spread for non-Indigenous students (318 score points). In PISA 2006, however, the range of scores for Indigenous students had increased to 347 points (from 255 points at the 5th percentile to 602 score points at the 95th percentile), while the score range for non-Indigenous students had narrowed to 303 score points. The mean score for Indigenous students at the 5th percentile in 2006 was slightly lower (by 20 score points) than the mean score at the 5th percentile for 2000. This was not the case for non-Indigenous students, where the mean score at the 5th percentile between 2000 and 2006 remained almost the same.

7 Refer to the Reader's Guide for instructions on how to read the figures on means and distribution of scores.

Reading literacy performance: proficiency levels

Five levels of proficiency were developed and defined in PISA 2000 for the overall reading literacy scale, and for the three subscales of retrieving information, interpreting texts, and reflection and evaluation. Describing performance in terms of proficiency levels adds further information about student competencies to the means and standard errors reported in the previous section.

Reading proficiency Level 5

Students at this level are able to deal with difficult texts and complete sophisticated reading tasks. They can deal with information that is difficult to find in unfamiliar texts, especially in the presence of closely competing information, show detailed understanding of these texts and identify which information is relevant to the task. They are able to evaluate texts critically, draw on specialised knowledge to build hypotheses, and cope with concepts that may be contrary to expectations.

Although the average score for Indigenous students was significantly lower than that of non-Indigenous students, representing both a statistical and educational disparity, there were some Indigenous students who performed exceptionally well in reading literacy. In PISA 2000, four per cent of Indigenous students achieved the highest proficiency level. Eighteen per cent of non-Indigenous students achieved at Level 5, while 19 per cent of students in Finland, the highest performing country in reading literacy in 2000, achieved at this level. On average across the OECD countries, about 10 per cent of students assessed in PISA were at Level 5 on the overall reading literacy scale.

Reading proficiency Level 4

Students at Level 4 are able to cope with difficult tasks, such as locating embedded information, construing meaning of parts of a text through considering the texts as a whole, and dealing with ambiguities and negatively worded ideas. They show accurate understanding of complex texts and are able to evaluate texts critically.

Eight per cent of Indigenous students were placed at Level 4, compared to 26 per cent of non-Indigenous students and 32 per cent of Finnish students. On average, 22 per cent of students across OECD countries were at Level 4.

Reading proficiency Level 3

Students classified at Level 3 can deal with moderately complex reading tasks, such as finding several pieces of relevant information and sorting out detailed competing information requiring consideration of many criteria to compare, contrast or categorise. They are able to make links between different parts of a text and to understand text in a detailed way in relation to everyday knowledge. Equivalent proportions of Indigenous and non-Indigenous students performed at reading proficiency Level 3, with just over one quarter of students from both groups at this level. In Finland, and across the OECD as a whole, slightly less than one third (29%) of students achieved at reading proficiency Level 3.

Reading proficiency Level 2

At Level 2 students can cope with basic reading tasks, such as locating straightforward information, making low-level inferences, using some outside knowledge to help understand a well-defined part of a text, and applying their own experience and attitudes to help explain a feature of a text.

Twenty-nine per cent of Indigenous students achieved this level in PISA 2000, compared to 19 per cent of non-Indigenous students, 14 per cent of Finnish students and 22 per cent of students in participating OECD countries.

Reading proficiency Level 1

At reading proficiency Level 1, students are able to deal with only the least complex reading tasks developed for PISA, such as finding explicitly stated pieces of information and recognising the main theme or author's purpose in a text in a familiar topic when the required information is readily accessible in the text. They are also able to make a connection between common, everyday knowledge and information in the text.

Twenty per cent of Indigenous students, or one in every five students, were placed at this level. Nine per cent of non-Indigenous students and five per cent of students from Finland performed at Level 1, while across the OECD countries, 12 per cent of students on average performed at this level.

Not yet reached reading proficiency Level 1

Reading tasks easier than the Level 1 tasks in PISA no longer fit PISA's concept of reading literacy. Students who scored below this level have not demonstrated understanding of even the most basic type of information and the OECD have argued that this points to serious deficiencies in their ability to meet the challenges of the future and adapt to societal change.

Thirteen per cent of Indigenous students were unable to demonstrate Level 1 reading skills in PISA 2000, compared to three per cent of non-Indigenous students, two per cent of Finnish students and six per cent of students across participating OECD countries.

The percentages of Indigenous and non-Indigenous students at each reading literacy proficiency level, from below Level 1 to Level 5, are summarised in Figure 2.2. The proficiency levels for the OECD on average and for Finland, the highest performing country in reading literacy in PISA 2000, have been included for comparison.

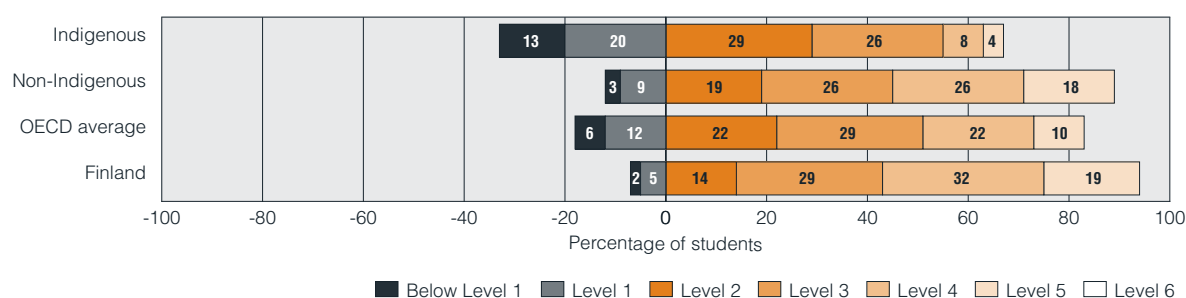


Figure 2.2: Reading literacy proficiency levels for Indigenous and non-Indigenous students, the OECD average and Finland for PISA 2000

At the higher end of the reading literacy proficiency scale, the proportion of non-Indigenous students achieving at Level 5 is more than four times the proportion of Indigenous students achieving at a similar level. At the lower end of the proficiency scale, almost three times as many Indigenous as non-Indigenous students were not able to achieve proficiency level 2. While not officially defined as such for reading, Level 2 is the base level or minimum standard for mathematics and science at which the OECD has argued that students are able to demonstrate reading competencies that will enable them to actively participate in life situations. For this report, Level 2 will be considered as a baseline for reading as well.

Table 2.2 shows the percentage of Indigenous and non-Indigenous students who performed at each level on the reading literacy proficiency scale in PISA 2003 and PISA 2006. A pattern of Indigenous students being over-represented in the lower proficiency levels and under-represented

in the high proficiency levels was apparent across all three PISA cycles. More than one third of Indigenous students failed to attain proficiency Level 2 in either PISA 2003 or 2006. At the higher levels, up to 15 per cent of Indigenous students attained proficiency Level 4 or 5 in PISA 2003 and 2006, compared to 42 per cent and 36 per cent of non-Indigenous students in those years, respectively.

Table 2.2: Reading literacy proficiency levels for Indigenous and non-Indigenous students for PISA 2003 and PISA 2006

	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
PISA 2003						
Indigenous	15	23	24	23	11	4
Non-Indigenous	3	8	18	28	27	15
PISA 2006						
Indigenous	16	22	28	21	9	3
Non-Indigenous	3	9	21	30	25	11

Indigenous students' performance from an international perspective

One of the benefits of participating in an international assessment such as PISA is that it allows policymakers, researchers, teachers and other interested people to compare students' relative standing to that of students in other participating countries. As previously reported, Australia's students have performed very well overall in the reading literacy assessments of PISA.

Figure 2.3 shows the international student performance in reading literacy for PISA 2000 as well as the mean scores and distribution of performance for Indigenous and non-Indigenous Australian students. Results on the reading literacy scale showed Finland scored significantly higher than any other country (547 score points). This level of performance was around one and one third proficiency levels higher than the average performance of Indigenous students. The majority of countries, from Finland to Portugal in Figure 2.3 achieved significantly higher results than Australian Indigenous students. Indigenous students' performance was equivalent to that of students in the Russian Federation, Latvia, Israel and Luxembourg. Indigenous students scored significantly higher than students in Thailand, Bulgaria, Romania, Mexico, Argentina, Chile, Brazil and Indonesia.

As mentioned in Chapter 1, lower average performance and attainment among Indigenous students in Australia in comparison to their non-Indigenous peers is not a new finding. Viewing the average performance of our Indigenous students in an international context, however, highlights this issue and underscores the need for this disparity to be addressed.

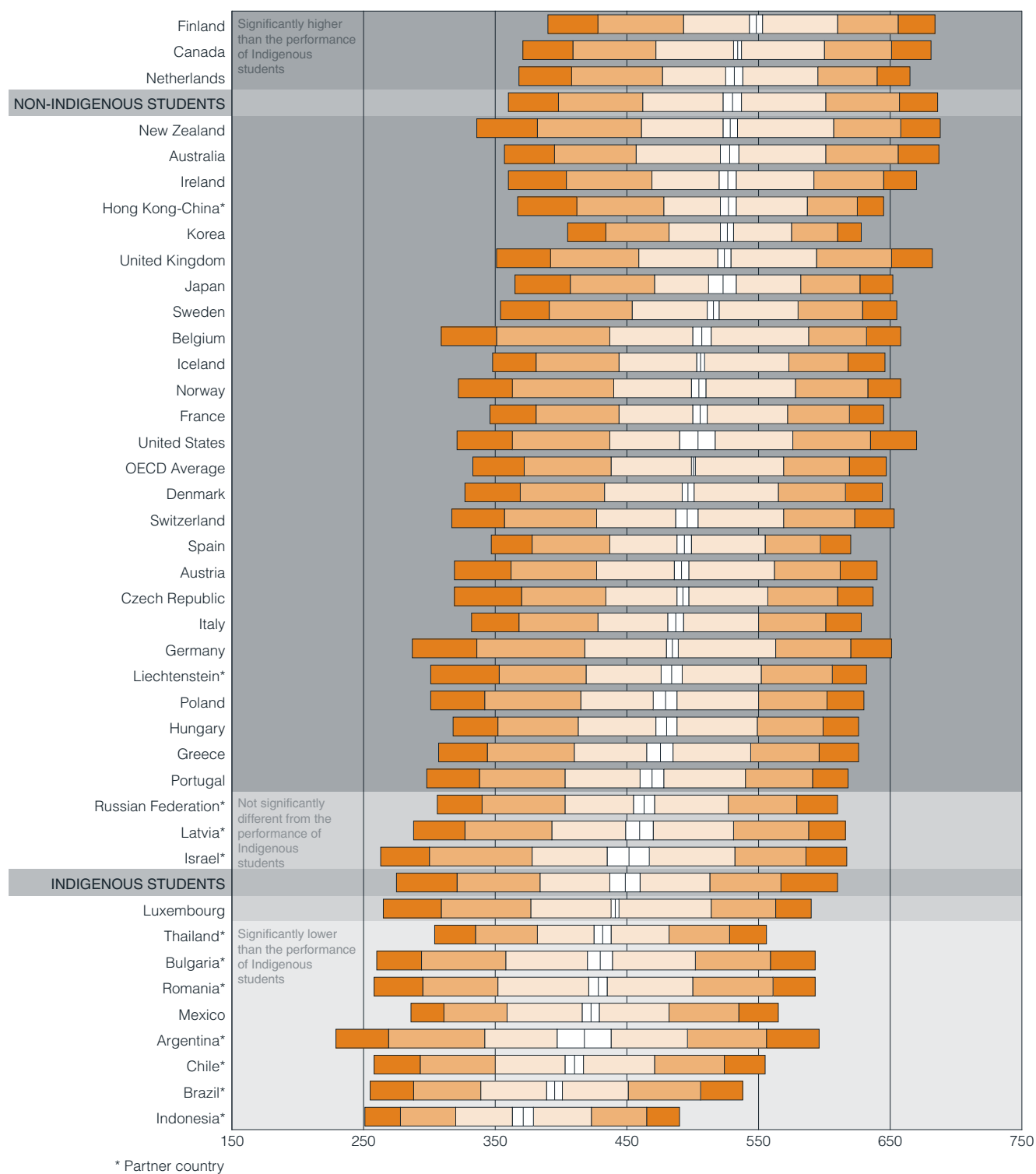


Figure 2.3: International student performance in reading literacy for PISA 2000 including Indigenous and non-Indigenous performance

Reading literacy performance by gender

Female students outperformed male students in reading literacy in almost all countries across the three PISA cycles to date (the sole exception being Liechtenstein in PISA 2003 in which the difference did not reach statistical significance). This pattern is also evident among Indigenous students, with Indigenous female students scoring 46 points higher on average than Indigenous male students, a difference significant and equivalent to more than half of a proficiency level. Both Indigenous females and males performed significantly lower than their OECD average counterparts (Table 2.3).

Table 2.3: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall reading literacy scale

Student group		PISA 2000		PISA 2003		PISA 2006	
		Mean	SE	Mean	SE	Mean	SE
Indigenous	Females	467	8.7	478	6.4	451	11.6
	Males	429	9.5	413	10.9	417	9.4
Non-Indigenous	Females	549	4.5	547	2.6	534	2.1
	Males	515	4.0	508	2.7	497	3.1
OECD average	Females	517	0.7	511	0.7	511	0.7
	Males	485	0.8	477	0.7	473	0.7

Figure 2.4 shows the mean and distribution of scores for Indigenous and non-Indigenous females and males on the reading literacy scale for PISA 2000. The spread of scores between the 5th and 95th percentiles was similar for Indigenous and non-Indigenous females, at 303 and 307 score points, respectively. Although not shown in the figure, the distribution of scores for Indigenous females increased in subsequent PISA cycles with a difference of 316 score points between the 5th and 95th percentiles in PISA 2003 and 332 score points in PISA 2006. This was not the case for non-Indigenous females, for whom the difference between the 5th and 95th percentile decreased to 292 score points in PISA 2003 and 277 score points in PISA 2006.

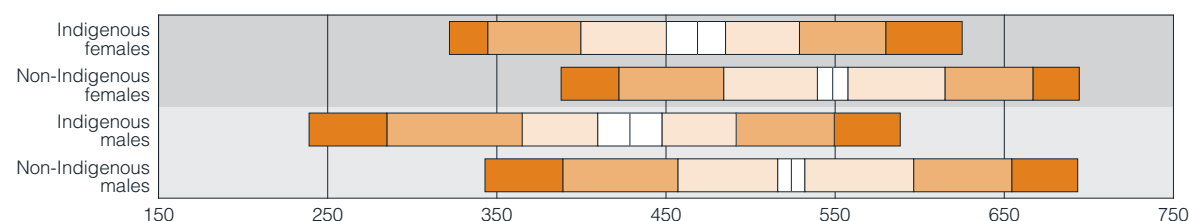


Figure 2.4: Distribution of Indigenous and non-Indigenous students on the reading literacy scale for PISA 2000

The distribution of results on reading literacy was wider for Indigenous males than Indigenous females. The spread of reading literacy scores for Indigenous males was similar across the PISA cycles, with a difference of 350 score points between the 5th and 95th percentile in PISA 2000, 344 score points in PISA 2003 and 344 score points in PISA 2006. The distribution of reading literacy scores for non-Indigenous males in 2000 was narrower than that for Indigenous males at 333 score points. The difference between the 5th and 95th percentile in PISA 2003 and PISA 2006 decreased from 327 score points to 313 score points.

Table 2.4: Spread of scores over all PISA cycles, by gender

	Difference between 5th and 95th percentiles			
	Indigenous		non-Indigenous	
	Females	Males	Females	Males
2000	303	350	307	333
2003	316	344	292	327
2006	332	345	277	313

Figure 2.5 shows the percentage of Indigenous and non-Indigenous female and male students at each proficiency level on the reading literacy scale. At the higher end of the proficiency scale similar percentages of Indigenous female and male students achieved Level 5, five and four per cent respectively. Almost twice the proportion of Indigenous females as males achieved Level 4.

At the lower end of the proficiency scale there were substantial proportions of both Indigenous male (38%) and Indigenous female (29%) students who did not achieve proficiency Level 2. In both cases these proportions were much higher than the proportion of non-Indigenous students at the same level.

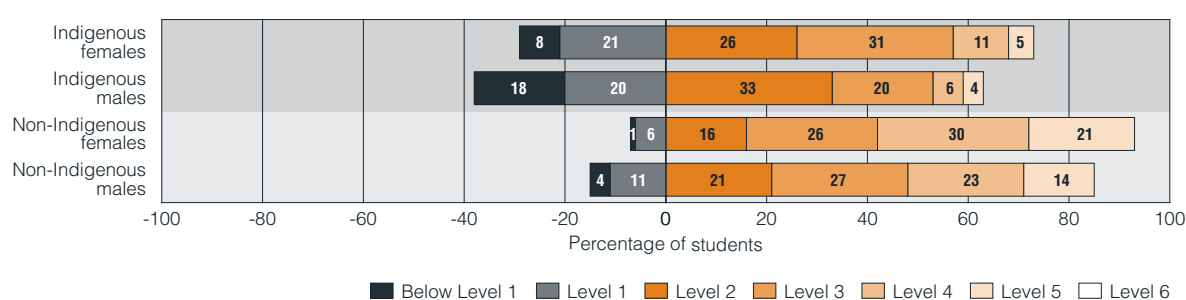


Figure 2.5: Reading literacy proficiency levels for Indigenous and non-Indigenous students by gender for PISA 2000

Performance on the reading literacy subscales

As discussed at the beginning of this chapter, reading literacy was the major domain of assessment for PISA 2000. As such, three reading literacy subscales were defined – retrieving information; interpreting texts and reflection and evaluation —and can be used to explore the performance of Indigenous students in reading literacy in further detail than possible using the overall scale score. Figure 2.6 shows the proficiency descriptions for each of the levels for the three reading literacy subscales. The following subsections describe performance in each of these areas.

Proficiency level	Retrieving information	Interpreting texts	Reflection and evaluation
5	Locate and possibly sequence or combine multiple pieces of deeply embedded information, some of which may be outside the main body of the text. Infer which information in the text is relevant. Deal with highly plausible and/or extensive competing information.	Either construe the meaning of nuanced language or demonstrate a full and detailed understanding of text.	Critically evaluate or hypothesise, drawing on specialised knowledge. Deal with concepts that are contrary to expectations and draw on a deep understanding of long or complex texts.
625.6 score points			
4	Locate and possibly sequence or combine multiple pieces of embedded information, each of which may need to meet multiple criteria, in a text with unfamiliar context or form. Infer which information in the text is relevant to the task.	Use a high level of text-based inference to understand and apply categories in an unfamiliar context, and to construe the meaning of a section of text by taking into account the text as a whole. Deal with ambiguities, ideas that are contrary to expectation and ideas that are negatively worded.	Use formal or public knowledge to hypothesise about or critically evaluate a text. Show accurate understanding of long or complex texts.
552.9 score points			
3	Locate, and in some cases recognise, the relationship between, pieces of information, each of which may need to meet multiple criteria. Deal with prominent competing information.	Integrate several parts of a text in order to identify a main idea, understand a relationship or construe the meaning of a word or phrase. Compare, contrast or categorise taking many criteria into account. Deal with competing information.	Make connections or comparisons, give explanations, or evaluate a feature of text. Demonstrate a detailed understanding of the text in relation to familiar, everyday knowledge, or draw on less common knowledge.
480.2 score points			
2	Locate one or more pieces of information, each of which may be required to meet multiple criteria. Deal with competing information.	Identify the main idea in a text, understand relationships, form or apply simple categories, or construe meaning within a limited part of the text when the information is not prominent and low-level inferences are required.	Make a comparison or connections between the text and outside knowledge, or explain a feature of the text by drawing on personal experience and attitudes.
407.5 score points			
1	Take account of a single criterion to locate one or more independent pieces of explicitly stated information.	Recognise the main theme or author's purpose in a text about a familiar topic, when the required information in the text is prominent.	Make a simple connection between information in a text and common, everyday knowledge.
334.8 score points			

Figure 2.6: Description of proficiency levels for the reading literacy subscales

Indigenous students' performance in retrieving information

Retrieving information refers to locating one or more pieces of information in a text that are needed to form the correct response to a question. Indigenous students achieved a mean score of 451 points on the retrieving information subscale, which was significantly lower than the mean score for non-Indigenous students (by 86 points), 47 points lower than the score for students across OECD countries, and one hundred and five score points lower than the mean score for students in Finland (Table 2.5). These scores represent differences of around half a proficiency level lower

than the OECD average, one proficiency level lower than that of non-Indigenous Australian students and almost one and a half proficiency levels lower than that of Finnish students.

Table 2.5: Means and standard errors for Indigenous and non-Indigenous students on the retrieving information subscale for PISA 2000

	Mean	SE
Indigenous students	451	7.6
Non-Indigenous students	537	3.5
OECD average	498	0.7
Finland	556	2.8

Figure 2.7 shows the distribution of scores on the retrieving information subscale for Indigenous and non-Indigenous students by gender. Indigenous females scored higher than Indigenous males on retrieving information – 467 score point compared to 434 score points. This difference of 33 score points equates to almost half of one proficiency level. However, Indigenous females' performance was 85 score points lower than that of non-Indigenous females, while Indigenous males' performance was 90 score points lower than that of non-Indigenous males.

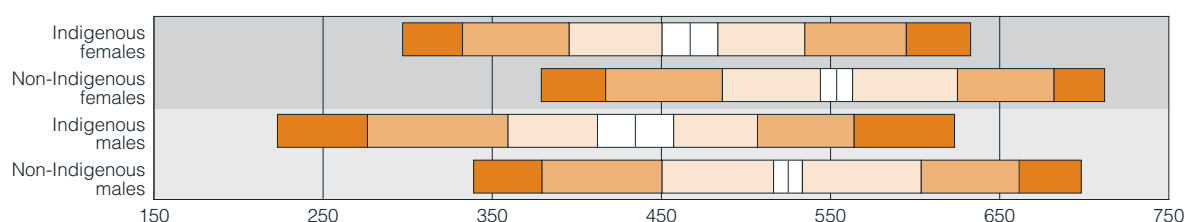


Figure 2.7: Distribution of Indigenous and non-Indigenous students on the retrieving information subscale by gender for PISA 2000

Only 16 per cent of Indigenous students performed at the upper end of the retrieving information subscale (Level 4 or 5), compared to 47 per cent of non-Indigenous students who performed at the same levels. Across the OECD, around one third of students performed at these higher levels. At the lower end of the proficiency scale, 33 per cent of Indigenous students were not able to achieve Level 2, compared to 11 per cent of non-Indigenous students and 20 per cent of students across all OECD countries. Figure 2.8 shows the proportion of Indigenous and non-Indigenous students at each proficiency level for the retrieving information subscale, along with results for the OECD average and Finland.

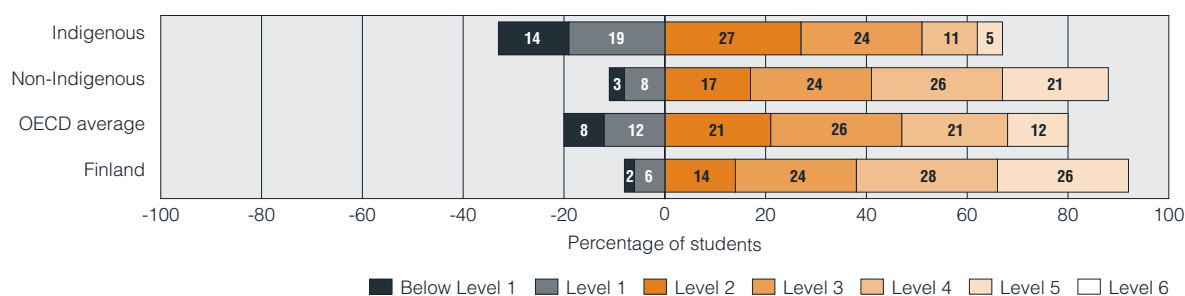


Figure 2.8: Proficiency levels on the retrieving information subscale for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2000

Indigenous students' performance in interpreting texts

Interpreting texts is defined as constructing meaning and drawing inferences from one or more parts of a text. Indigenous students achieved a mean score of 446 on this subscale, which was 83 points lower than the mean score for non-Indigenous students, 55 score points lower than the OECD average and 109 score points lower than the average Finnish score. This average score placed Indigenous students around half a proficiency level below the OECD average, one proficiency level below non-Indigenous Australian students and almost one-and-a-half proficiency levels below Finnish students (Table 2.6).

Table 2.6: Means and standard errors for Indigenous and non-Indigenous students on the interpreting texts subscale for PISA 2000

	Mean	SE
Indigenous students	446	5.8
Non-Indigenous students	529	3.4
OECD average	501	0.6
Finland	555	2.9

Figure 2.9 shows the distribution of scores for Indigenous and non-Indigenous students by gender on the interpreting texts subscale. The mean score for Indigenous females on this subscale was 462 score points, which was significantly higher than the mean score for Indigenous males of 429 score points. The difference of 33 score points equates to almost half a proficiency level.

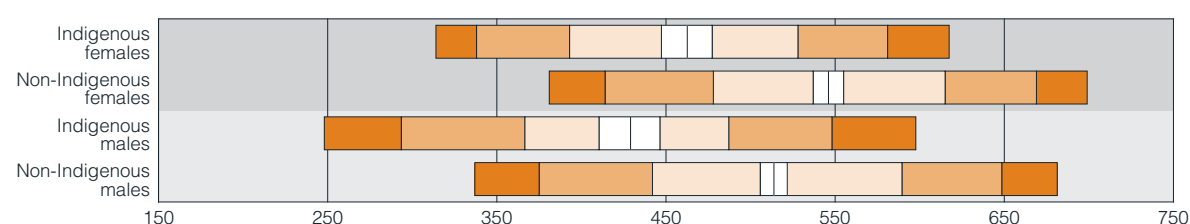


Figure 2.9: Distribution of Indigenous and non-Indigenous students on the interpreting text subscale by gender for PISA 2000

Figure 2.10 shows that thirty-five per cent of Indigenous students did not achieve Level 2 on the interpreting texts subscale. In comparison, 12 per cent of non-Indigenous students, seven per cent of Finnish students and 18 per cent of students from across all OECD countries failed to attain this level of proficiency in text interpretation. Thirteen per cent of Indigenous students were achieving at Levels 4 and 5, far fewer than the 43 per cent of non-Indigenous students and 54% of Finnish students who attained these higher levels of proficiency.

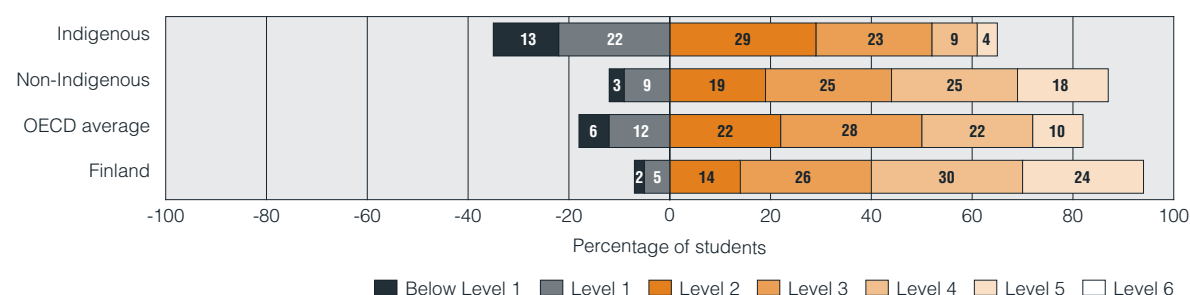


Figure 2.10: Proficiency levels on the interpreting text subscale for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2000

Indigenous students' performance in reflection and evaluation

Reflection and evaluation is defined as relating a text to one's experience, knowledge and ideas. The mean score for Indigenous students on this subscale was 450 score points, which was a statistically significant 78 score points lower than the mean score for non-Indigenous students (Table 2.7). The results on the reflection and evaluation subscale were similar to that on the retrieving information subscale. The average score of Indigenous Australian students placed them close to half a proficiency level lower than the average across the OECD countries, and almost one and a half proficiency levels lower than Finnish students.

Table 2.7: Means and standard errors for Indigenous and non-Indigenous students on the reflection and evaluation subscale for PISA 2000

	Mean	SE
Indigenous students	450	5.8
Non-Indigenous students	528	3.4
OECD average	502	0.7
Finland	533	2.7

Figure 2.11 shows the distribution of scores for Indigenous and non-Indigenous students by gender on the reflection and evaluation subscale. The mean score for Indigenous females on the reflection and evaluation subscale was 470 score points, which was 41 score points (or more than half a proficiency level) higher than for Indigenous males. Indigenous females performed 80 score points lower than non-Indigenous females, which was similar to the difference in performance between Indigenous and non-Indigenous males on this subscale.

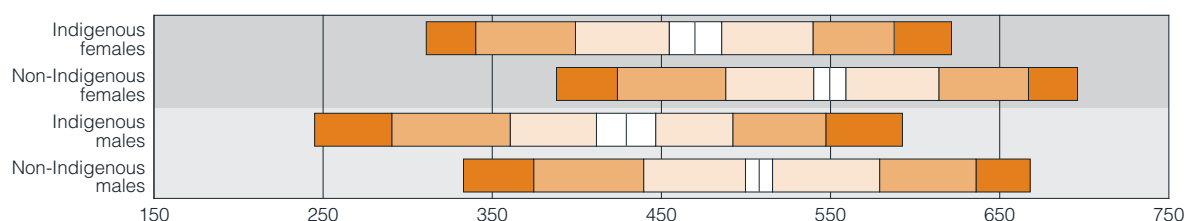


Figure 2.11: Distribution of Indigenous and non-Indigenous students on the reflection and evaluation subscale by gender for PISA 2000

Figure 2.12 shows the percentage of students at each proficiency level on the reflection and evaluation subscale. Approximately 33 per cent of Indigenous students did not achieve Level 2, compared to 12 per cent of non-Indigenous students, eight per cent of Finnish students, and 18 of students across all OECD countries who did not reach this minimum benchmark. At the upper end of the proficiency scale, there were 15 per cent of Indigenous students compared to 42 per cent of non-Indigenous students who achieved Level 4 or 5 on this subscale.

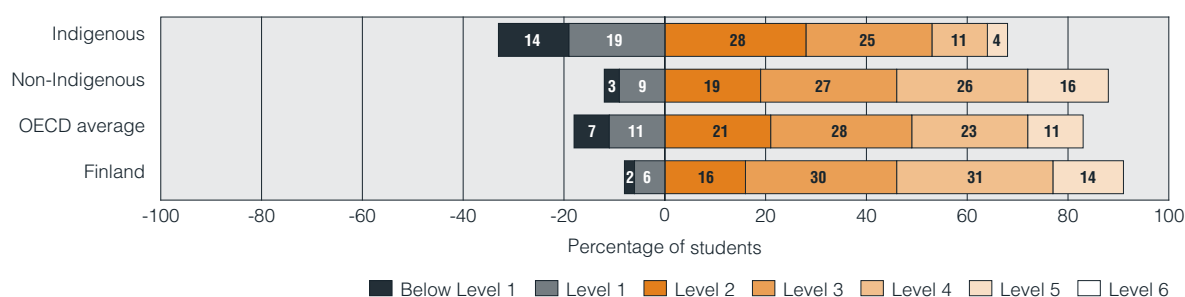


Figure 2.12: Proficiency levels on the reflection and evaluation subscale for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2000

Performance in reading literacy over time

One of the main aims of PISA is to examine student performance over time so that policy makers can monitor learning outcomes in both an international and national context. Although the optimal reporting of trends will occur between each full assessment of a literacy domain (for example, in reading between PISA 2000 and PISA 2009, in which the major focus will again be on reading literacy), PISA has been designed so that it is possible to compare results between each three-year cycle. Nevertheless, care needs to be taken in making comparisons involving minor domains, as there are a smaller number of test items included in minor domains and also small refinements continue to be made in PISA's methodology which may have an effect on comparability over time.

At a national level, there were no statistically significant differences in the average reading performance of students in PISA 2000 and PISA 2003. Between PISA 2003 and PISA 2006, however, there was a significant decrease in the average reading literacy performance of Australian students.

Table 2.8 shows the mean scores for Indigenous students for PISA 2000, PISA 2003 and PISA 2006 and the differences in performance between each cycle. Although there appears to have been a decline in the average reading literacy performance of Indigenous students across the three PISA cycles, these changes are not statistically significant.

Table 2.8: Mean reading literacy scores and standard errors for PISA 2000, PISA 2003 and PISA 2006, and differences between performance in cycles for Indigenous students

PISA 2000		PISA 2003		PISA 2006		Differences between					
						PISA 2000 and PISA 2003		PISA 2003 and PISA 2006		PISA 2000 and PISA 2006	
Mean	SE	Mean	SE	Mean	SE	Diff.	SE	Diff.	SE	Diff.	SE
448	3.1	444	8.6	434	6.9	-4	10.6	-10	11.9	-14	9.1

Summary

Indigenous students have performed relatively poorly in reading literacy in each of the three PISA cycles, performing substantially lower than non-Indigenous students and also substantially lower than students on average across all OECD countries.

Across all three PISA cycles, it is apparent that Indigenous students are over-represented in the lower proficiency levels and under-represented in the high proficiency levels. In PISA 2000, four per cent of Indigenous students achieved at the highest proficiency level in reading literacy and more than one third of Indigenous students failed to attain proficiency Level 2. Similar results were found in PISA 2003 and PISA 2006.

Indigenous females scored significantly higher than Indigenous males in all PISA cycles. This difference represents more than half of a proficiency level.

At the higher end of the reading literacy proficiency scale, there were similar percentages of Indigenous female and male students who achieved Level 5. At the lower end of the proficiency scale, there were more Indigenous males than Indigenous females who had not achieved Level 2.

Investigation on the three subscales (retrieving information, interpreting texts and reflection and evaluation) showed Indigenous students performed at a similar level on each of the subscales. Differences between Indigenous and non-Indigenous students' performances on each of the subscales were also consistent, however, with more than one whole proficiency level separating them. Approximately 15 per cent of Indigenous students were able to achieve Level 4 or Level 5 in each of these subscales; however, one third of Indigenous students were not able to achieve Level 2.

Despite these differences, and the finding that the average performance of Australian students as a whole has decreased across the three PISA cycles, the performance of Indigenous students has not changed significantly in the past nine years.

Mathematical literacy

In PISA 2003 the main focus of assessment was mathematical literacy. In this cycle the mathematical literacy framework was expanded and proficiency levels were defined and described for mathematical literacy overall, as well as for four subscales.

This chapter starts with a description of mathematical literacy and how this domain is measured⁸. The subsequent sections examine the performance of Indigenous and non-Indigenous students in mathematical literacy in the PISA assessments.

Definition of mathematical literacy

The PISA mathematical literacy domain focuses on the capacities of students to analyse, reason and communicate ideas effectively as they pose, formulate, solve and interpret mathematical problems in a variety of situations. The PISA assessment framework defines mathematical literacy as:

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

(OECD, 2006, p.72)

In this conception, mathematical literacy is about meeting life needs and functioning in society. Mathematical literacy is expressed through using and engaging with mathematics, making informed judgements, and understanding the usefulness of mathematics in relation to the demands of life.

The PISA mathematics assessment directly confronts the importance of the functional use of mathematics by placing primary emphasis on a real-world problem situation, and on the mathematical knowledge and competencies that are likely to be useful in dealing effectively with such a problem. The PISA mathematics framework was written to encourage an approach to teaching and learning mathematics that gives strong emphasis to the processes associated with confronting a problem in a real-world context, transforming the problem into one amenable to mathematical treatment, making use of the relevant mathematical knowledge to solve it, and evaluating the solution in the original problem context. If students can learn to do these things, they will be much better equipped to make use of their mathematical knowledge and skills throughout their lives.

⁸ Information about the mathematical literacy assessment framework has been taken from the PISA 2006 National Report, *Exploring Scientific Literacy: How Australia measures up*.

How mathematical literacy is measured

The PISA framework for mathematical literacy is organised into three broad components: the situations and contexts in which problems are presented and that are used as sources of stimulus material; the mathematical content to which different problems and questions relate; and the mathematical competencies that need to be activated in order to connect the real world, in which problems are generated, with mathematics and then to solve problems.

The mathematical tasks given to students in each cycle of PISA were equally divided between the four overarching ideas (space and shape, change and relationships, quantity and uncertainty).

Situations and Context

An important aspect of mathematical literacy is engagement with mathematics: using and doing mathematics in a variety of situations. Students were shown written materials that described various situations that they could conceivably confront, and which required them to apply their mathematical knowledge, understanding or skill to analyse and deal with the situation. Four situations are defined in the PISA mathematical literacy framework: personal, educational or occupational, public, and scientific. Assessment items are placed within each of these contexts.

The situations differ in terms of how directly the problem affects students' lives, that is, the degree of immediacy and directness in the connection between the student and the problem context. For example, personal situations are closest to the student and are characterised by the direct perceptions involved. The situations also differ in the extent to which the mathematical aspects are explicit. Although some tasks in the assessment refer only to mathematical objects, symbols or structures, and make no reference to matters outside the mathematical world, more typically, the problems are not stated in explicit mathematical terms. This reflects the strong emphasis in the PISA mathematical literacy assessment on exploring the extent to which students can identify mathematical features of a problem when it is presented in a non-mathematical context, and can activate their mathematical knowledge to explore and solve the problem and to make sense of the solution in the context or situation in which the problem arose.

Mathematical Content

The PISA framework defines mathematical content in terms of four broad knowledge domains and includes the kinds of problems individuals may come across through interaction with day-to-day phenomena and that are based on a conception of the ways in which mathematical content presents itself to people. These broad knowledge domains, referred to as overarching ideas, reflect historically well-established branches of mathematical thinking and underpin mathematical curricula in education systems throughout the world. Together, these broad content areas cover the range of mathematics that 15-year-old students need as a foundation for life and for further extending their horizon in mathematics. There are four overarching ideas:

- ▶ *Space and shape* relates to spatial and geometric phenomena and relationships, drawing on the curriculum of geometry. Space and shape requires looking for similarities and differences when analysing the components of shapes, recognising shapes in different representations and different dimensions as well as understanding the properties of objects and their relative positions, and the relationship between visual representations (both two- and three-dimensional) and real objects.
- ▶ *Change and relationships* relates most closely to the curriculum area of algebra and recognises the world is not a constant – every phenomenon is a manifestation of change. These changes can be presented in a number of ways, including a simple equation, an algebraic expression, a graph or table. As different representations are appropriate in different situations, translation between representations is an important skill when dealing with situations and tasks.

- *Quantity* involves numeric phenomena and quantitative relationships and patterns. It relates to the understanding of relative size, the recognition of numerical patterns, and the use of numbers to represent quantities and quantifiable attributes of real world objects (counting and measuring). Furthermore, quantity deals with the processing and understanding of numbers that are represented in various ways.
- *Uncertainty* involves probabilistic and statistical phenomena and relationships. Uncertainty is present in daily life, where a great deal of information is often presented as precise and having no error, when in fact there is a varying degree of uncertainty.

Although the overarching ideas together generally encompass the range of mathematical topics that students are expected to have learned, the approach to content in PISA is somewhat different in terms of mathematical instruction and the curricular strands taught. The assessment in PISA is related more to the application of mathematical knowledge rather than what content has been learnt.

Competencies

While the overarching ideas define the main areas of mathematics that are assessed in PISA, they do not make explicit the mathematical processes that students apply as they attempt to solve problems. The PISA mathematics framework uses the term ‘mathematisation’ to define the cycle of activity for investigating and solving real-world problems. Beginning with a problem situated in reality, students must organise it according to mathematical concepts. They progressively trim away the reality in order to transform the problem into one that is amenable to direct mathematical solution. Students can then apply specific mathematical knowledge and skills to solve the mathematical problem, before using some form of translation of the mathematical results into a solution that works for the original problem context; for example, this may involve the formulation of an explanation or justification of proof.

Various competencies are called into play as the mathematisation process is employed. The PISA mathematics framework discusses and groups the competencies in three competency clusters: reproduction, connections, and reflections.

Mathematical literacy performance: scale scores

Indigenous students’ PISA results on mathematical literacy were significantly lower than that of non-Indigenous students. Results for the three completed cycles of PISA are shown in Table 3.1, together with results for all Australian students and the OECD average.

Table 3.1: Means and standard errors for Indigenous and non-Indigenous students on the overall mathematical literacy scale

Student group	PISA 2000		PISA 2003		PISA 2006	
	Mean	SE	Mean	SE	Mean	SE
Indigenous	449	7.5	440	5.4	442	7.3
Non-Indigenous	535	3.4	526	2.1	522	2.3
Australia	533	3.5	524	2.1	520	2.2
OECD average	500	0.7	500	0.6	498	0.5

In PISA 2000, Indigenous students achieved a mean score 86 points lower than that of non-Indigenous students. The large differences in mathematical literacy performance continued in subsequent PISA cycles, with Indigenous students performing 86 score points lower than non-Indigenous students in PISA 2003 and 80 score points lower in PISA 2006. In mathematical literacy, one proficiency level equates to 62 score points. Indigenous students also performed significantly lower (by almost one proficiency level) than the OECD average.

Figure 3.1 presents the distribution of performance scores for PISA 2003 on the mathematical literacy scale. Although many Indigenous students performed at very low levels, there were also some Indigenous students who performed very well. This figure shows that there was a spread of 304 score points between the 5th and 95th percentile for Indigenous students. The spread of scores for non-Indigenous students between the 5th and 95th percentile was similar, at 310 score points. The spread of scores found in PISA 2000 and PISA 2006 was comparable to that of PISA 2003.

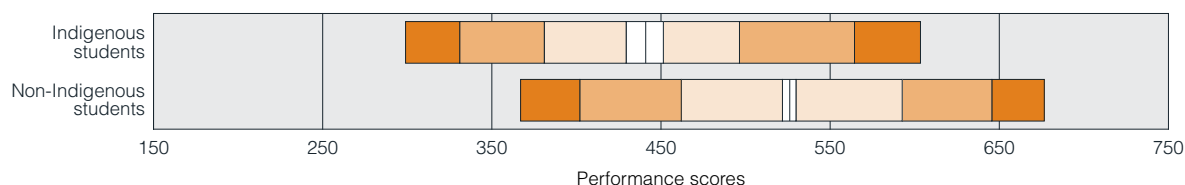


Figure 3.1: Distribution of Indigenous and non-Indigenous students on the mathematical literacy scale for PISA 2003

Mathematical literacy performance: proficiency levels

For mathematical literacy in PISA 2003, six levels of proficiency were defined and described. Each proficiency level equates to 62 score points. The information about the items in each level has been used to develop summary descriptions of the kinds of mathematical competencies associated with different levels of proficiency. As a set, the descriptions encapsulate a representation of growth in mathematical literacy.

Mathematical proficiency Level 6

These students can conceptualise, generalise and utilise information based on their investigation and modelling of complex problem situations. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situations. Students who scored higher than 669.3 were proficient at Level 6 on the mathematical literacy scale.

There were very few Indigenous students who achieved this high level of mathematical literacy proficiency. Only one per cent of Indigenous students achieved Level 6, while six per cent of non-Indigenous students, eleven per cent of students from Hong Kong-China (the highest performing country in mathematics in PISA 2003) and four per cent of students across OECD countries performed at this level.

Mathematical proficiency Level 5

Students at Level 5 can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning. A score higher than 607.0 but lower than or equal to 669.3 points placed students at Level 5.

Four per cent of Indigenous students achieved at Level 5, compared to 14 per cent of non-Indigenous students. Across all OECD countries, an average of 11 per cent of students achieved at this level, while 20 per cent of students from Hong Kong-China did so.

Mathematical proficiency Level 4

At Level 4, students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic ones, linking them directly to aspects of real-world situations. Students at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions. Students whose scores were higher than 544.7 but lower than or equal to 607.0 points achieved a reading proficiency at Level 4.

Eight per cent of Indigenous students achieved a proficiency of Level 4, compared to 24 per cent of non-Indigenous Australian students. The average proportion of students reaching Level 4 across the OECD countries was 19 per cent, while 25 per cent of students from Hong Kong-China performed at Level 4.

Mathematical proficiency Level 3

Students performing at Level 3 can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications reporting their interpretations, results and reasoning. A score higher than 482.4 but lower than or equal to 544.7 points placed students at Level 3.

Seventeen per cent of Indigenous students achieved Level 3, while 25 per cent of both non-Indigenous students and of Hong Kong-Chinese students were proficient in this level. Twenty per cent of students across all OECD countries were placed at Level 3.

Mathematical proficiency Level 2

At Level 2, students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and making literal interpretations of the results. A score higher than 420.1 but lower than or equal to 482.4 points placed students at Level 2.

Twenty-seven per cent of Indigenous students achieved this level, compared to 18 per cent of non-Indigenous students, 14 per cent of students from Hong Kong-China and 21 per cent of students in OECD countries.

Mathematical proficiency Level 1

Students at Level 1 can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli. Students whose scores were higher than 357.8 but lower than or equal to 420.1 points achieved a reading proficiency at Level 1.

Twenty-five per cent of Indigenous students were placed at this level, while four per cent of non-Indigenous students and students from Hong Kong-China performed at this level. On average, 13 per cent of students across OECD countries performed at proficiency level 1.

Not yet reached mathematical proficiency Level 1

Students performing below 357.8 score points, that is, below Level 1 are unable to complete the most basic type of mathematics that PISA seeks to measure. Students performing at this level would be expected to solve fewer than half of the tasks in an assessment made up of items drawn solely from Level 1. This raises grave concerns for the students placed at this level and the OECD have argued that performance at this level of proficiency points to serious difficulties for young people in using mathematics to further their education, assist in learning throughout life and adapt to societal change.

Almost twenty per cent of Indigenous students, or one in every five, were unable to demonstrate a proficiency of Level 1 in mathematical literacy, compared to four per cent of non-Indigenous students and four per cent of students from Hong Kong-China. Eight per cent of students across OECD countries were placed below Level 1.

The percentage of Indigenous and non-Indigenous students at each proficiency level for the overall mathematical literacy scale are shown in Figure 3.2. The figure also includes the OECD average and results for Hong Kong-China for comparison.

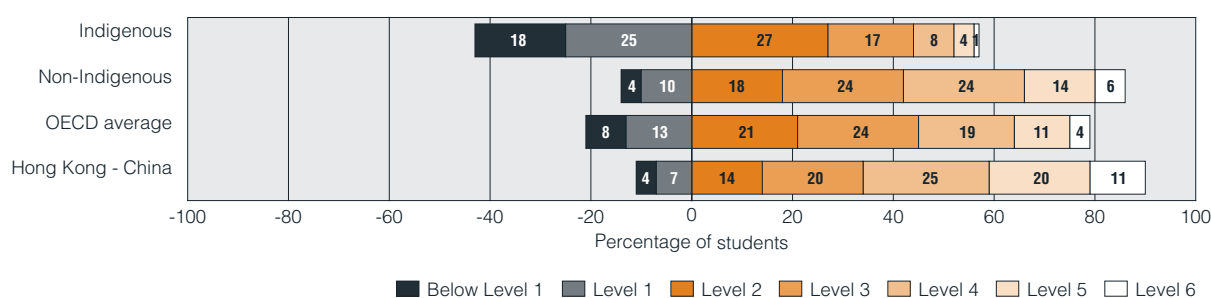


Figure 3.2: Mathematical literacy proficiency levels for Indigenous and non-Indigenous students, the OECD average and Hong Kong-China for PISA 2003

There are large differences between the percentage of Indigenous students who achieved Level 2 (the minimum standard accepted by OECD) or higher compared to the other student groups. Fifty-seven per cent of Indigenous students achieved at least Level 2, while 86 per cent of non-Indigenous students and 90 per cent of Hong Kong-Chinese students performed at these levels. Across the participating OECD countries, the average proportion of students performing at Level 2 or higher was 79 per cent.

At the lower end of the mathematical literacy scale, 43 per cent of Indigenous students did not achieve a proficiency of Level 2. This is in comparison to fourteen per cent of non-Indigenous students, eleven per cent of Hong Kong-Chinese students and 21 per cent of students across all OECD countries.

The percentages of Indigenous and non-Indigenous students who performed at each level on the mathematical literacy scale in PISA 2006 are shown in Table 3.2. Viewed in combination with the proportions displayed in Figure 3.2, these show that the under-representation of Indigenous students in the upper proficiency levels and the over-representation in the lower levels is evident over the two most recent cycles of PISA.

Table 3.2: Mathematical literacy performance for Indigenous and non-Indigenous students for PISA 2006

	Below Level 1	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Indigenous	17	22	29	20	10	2	0
Non-Indigenous	3	9	20	27	24	12	4

Indigenous students' performance from an international perspective

From Figure 3.3, in which country means and distributions of results on the mathematical literacy scale are shown, it can be seen that Indigenous students are one of the lowest performing groups compared to other students across the OECD in PISA 2003. Hong Kong-China was the highest performing country with a mean score of 550 points. The average performance of Indigenous students was 110 score points or one-and-three-quarters of a proficiency level lower than that of students from Hong Kong-China, and 60 score points, or approximately one proficiency level, lower than the OECD average in mathematical literacy.

Students in thirty countries performed at a level significantly higher than Indigenous Australian students. These countries were those in Figure 3.3 from Hong Kong-China through to Portugal. There were two countries, Serbia and Greece, in which students achieved equivalent results to Indigenous Australian students. Students in seven countries (Turkey, Uruguay, Thailand, Mexico, Indonesia, Tunisia and Brazil) performed significantly lower on average than Indigenous students.

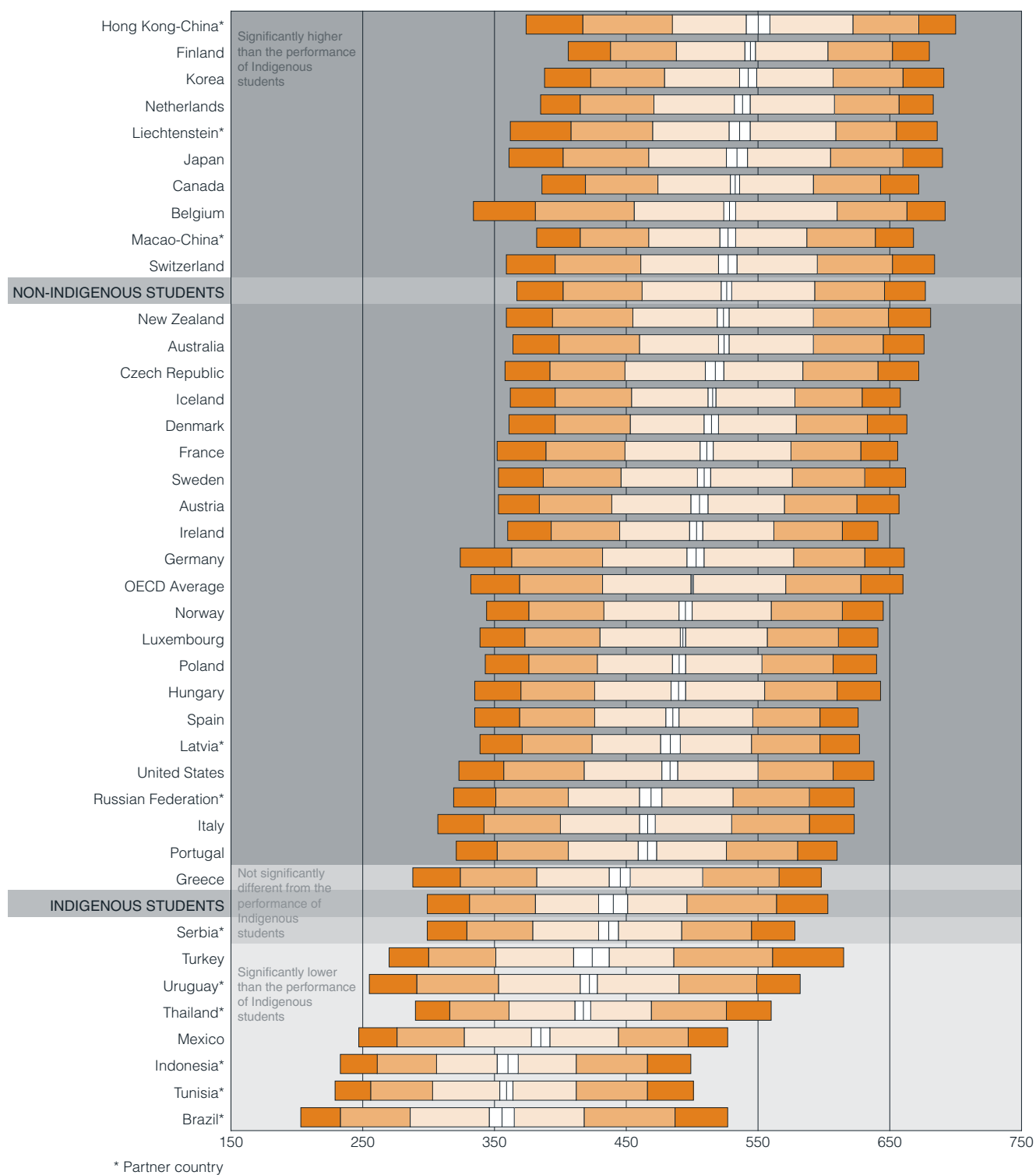


Figure 3.3: International student performance in mathematical literacy for PISA 2003 including Indigenous and non-Indigenous performance

Mathematical literacy performance by gender

In PISA 2003, more than half of the participating countries had significant gender differences in mathematical literacy that favoured males. There was only one country (Iceland) in which females significantly outperformed their male peers. The performance advantage of males in this domain has continued in PISA 2006.

For both Indigenous and non-Indigenous students, there were no significant differences between females and males in PISA 2000 and PISA 2003 in mathematical literacy. In PISA 2006, however, non-Indigenous males performed significantly higher than non-Indigenous females with mean scores of 529 and 515 points, respectively. There was no such gender difference for Indigenous students.

On average across the PISA cycles, Indigenous females performed 49 score points or approximately three-quarters of a proficiency level lower than the OECD average for females. The difference between the average score for Indigenous males across the PISA cycles and the OECD average for males was larger at 62 score points, which is the equivalent of one proficiency level.

Table 3.3: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall mathematical literacy scale

Student group		PISA 2000		PISA 2003		PISA 2006	
		Mean	SE	Mean	SE	Mean	SE
Indigenous	Females	453	11.3	446	4.9	436	10.9
	Males	445	9.1	435	8.5	448	8.4
Non-Indigenous	Females	529	5.0	523	2.7	515	2.4
	Males	541	4.0	529	2.9	529	3.2
OECD average	Females	495	0.9	494	0.8	492	0.6
	Males	506	1.0	506	0.8	503	0.7

In PISA 2000 the spread of scores between the 5th and 95th percentiles for Indigenous females on the mathematical literacy scale was 281 score points. This figure increased to 308 score points in PISA 2003, and to 316 score points in PISA 2006. On the other hand, the spread of scores between the 5th and 95th percentiles for Indigenous males has decreased in each PISA cycle. In PISA 2000, there were 321 score points between the 5th and 9th percentiles for Indigenous males. In PISA 2003 and PISA 2006 the distribution of these scores decreased to 300 and 293 score points, respectively. The mean scores and distribution of scores for Indigenous and non-Indigenous students by gender on the mathematical literacy scale for PISA 2003 are shown in Figure 3.4.

The distribution of scores between the 5th and 95th percentiles for Indigenous females and non-Indigenous females was similar in PISA 2000. In PISA 2003 and PISA 2006, however, the spread of scores for non-Indigenous females was narrower than that for Indigenous females.

In PISA 2000, there was a greater spread of performance for Indigenous males than for non-Indigenous males. In PISA 2003, Indigenous males had a narrower spread between the 5th and 95th percentiles than that of non-Indigenous male students. In PISA 2006, the spread of results between the 5th and 95th percentiles for Indigenous males was very similar to that for non-Indigenous males.

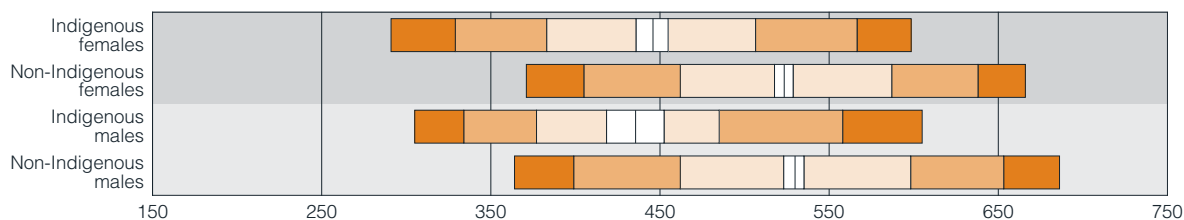


Figure 3.4: Distribution of Indigenous and non-Indigenous students on the mathematical literacy scale for PISA 2003

The percentages of Indigenous and non-Indigenous females and males at each proficiency level for the overall mathematical literacy scale are shown in Figure 3.5⁹. Very few Indigenous males and females (4%) were able to perform some of the highly complex tasks required to reach Level 5 or Level 6. Approximately five times the proportion of non-Indigenous students as Indigenous students were performing at these high levels.

Thirty-nine per cent of Indigenous females and 46 per cent of Indigenous males performed below Level 2, including 18% of both males and females who did not reach Level 1.

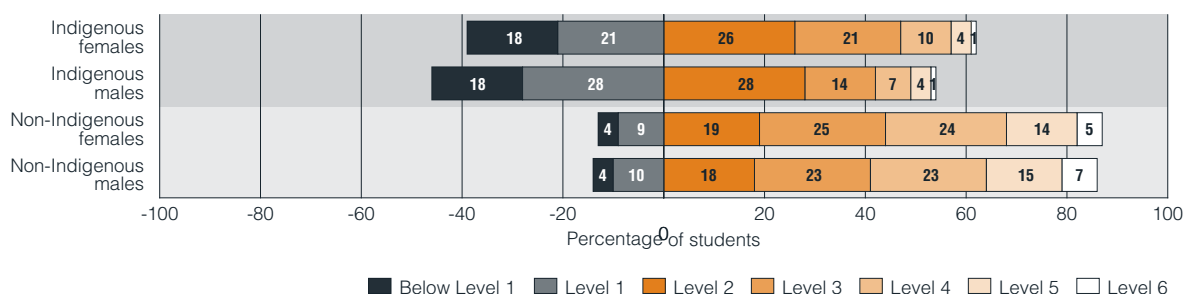


Figure 3.5: Mathematical literacy proficiency levels for Indigenous and non-Indigenous students by gender for PISA 2003

Performance on the mathematical literacy subscales

In addition to the overall mathematical literacy scale, results are also available for each of the subscales developed for PISA 2003: quantity, space and shape, change and relationships, and uncertainty. The results on the subscales can provide valuable information on the relative strengths and weaknesses of Indigenous students.

Indigenous students' performance in quantity

Indigenous students achieved a mean score of 435 points on the quantity subscale, while non-Indigenous students scored 84 points, or one-and-a-third proficiency levels higher, with a mean score of 519 points. Indigenous students performed around one proficiency level lower than the average for the OECD. Table 3.4 shows the mean scores for Indigenous and non-Indigenous students, students from Hong Kong-China and the OECD average on the quantity subscale.

⁹ Fewer than one per cent of Indigenous males and females achieved Level 6 and subsequently this proportion is not shown in this figure.

Table 3.4: Means and standard errors for Indigenous and non-Indigenous students on the quantity subscale for PISA 2003

	All		Females		Males	
	Mean	SE	Mean	SE	Mean	SE
Indigenous students	435	6.0	443	5.4	428	9.4
Non-Indigenous students	519	2.0	518	2.7	520	2.8
OECD average	501	0.6	498	0.8	504	0.8
Hong Kong-China	545	4.2	546	4.1	544	6.0

While the mean score for Indigenous females appeared to be higher than that of Indigenous males, there was no statistically significant difference between their performances on the quantity subscale. The mean and distribution of scores for Indigenous and non-Indigenous students by gender on the quantity subscale are shown in Figure 3.6. The distributions of scores between the 5th and 95th percentiles for Indigenous females and males were similar at 305 and 308 score points respectively. The spread of scores for Indigenous students was slightly narrower than for non-Indigenous students.

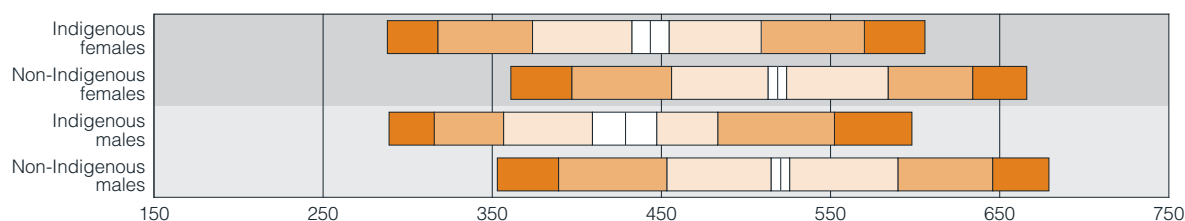


Figure 3.6: Distribution of Indigenous and on-Indigenous students on the quantity subscale by gender for PISA 2003

Figure 3.7 shows the percentage of students at each proficiency level on the quantity subscale. At the upper end of the quantity subscale, only five per cent of Indigenous students performed at Level 5 or 6, while 18 per cent of non-Indigenous students, 28 per cent of students from Hong Kong-China and 15 per cent of students from across all OECD countries were placed at this level.

At the lower end of the quantity subscale, 44 per cent of Indigenous students were not able to achieve Level 2 compared to 16 per cent of non-Indigenous students, 11 per cent of students from Hong Kong-China and 22 per cent of students across all OECD countries.

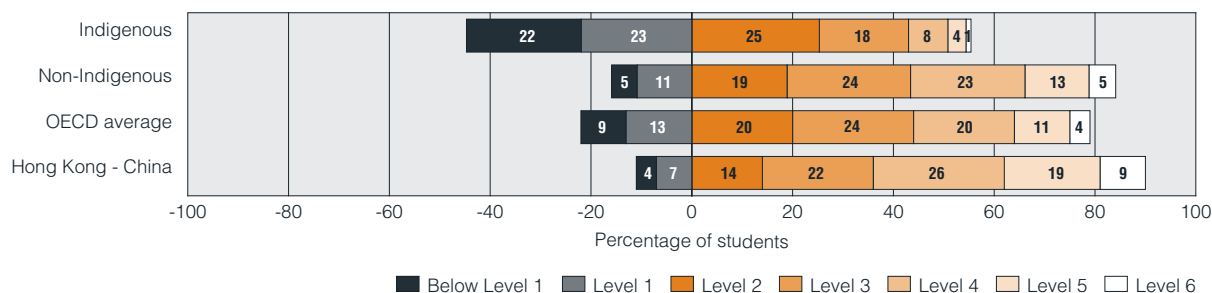


Figure 3.7: Proficiency levels on the quantity subscale for Indigenous and non-Indigenous students, Hong Kong-Chinese students and OECD average for PISA 2003

Indigenous students' performance in space and shape

The performance of Indigenous and non-Indigenous students on this subscale, along with results for Hong Kong-China and the OECD average are shown in Table 3.5.

Indigenous students again scored significantly lower than non-Indigenous students, with mean scores of 439 and 522 score points, respectively. Indigenous students scored 57 points (or almost one proficiency level) lower than the OECD average, and 119 score points (or almost two proficiency levels) lower than students from Hong Kong-China.

Table 3.5: Means and standard errors for Indigenous and non-Indigenous students on the space and shape subscale for PISA 2003

	All		Females		Males	
	Mean	SE	Mean	SE	Mean	SE
Indigenous students	439	6.9	442	5.4	436	12.1
Non-Indigenous students	522	2.3	516	2.9	529	3.1
OECD average	496	0.6	488	0.8	505	0.8
Hong Kong-China	558	4.8	556	5.0	560	6.8

Table 3.5 shows the mean scores and Figure 3.8 shows the distribution of scores for Indigenous and non-Indigenous students by gender. There was no significant difference between the average performances of Indigenous males (436 score points) and females (442 score points). Among non-Indigenous students, males performed at a significantly higher level than females, with mean scores of 529 and 516, respectively.

Among the various mathematical literacy subscales, the shape and space subscale shows the largest gap between high and low performing students for females. The spread of scores for Indigenous females was 340 score points, while on other subscales the spread of scores was approximately 320 score points. For non-Indigenous females the spread was 328 score points, compared to 300 score points on other subscales.

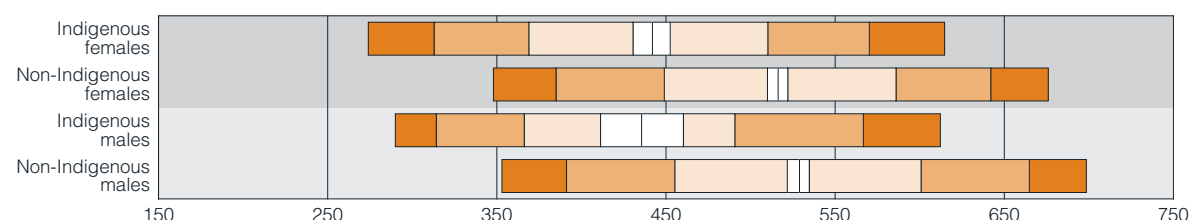


Figure 3.8: Distribution of Indigenous and on-Indigenous students on the space and shape subscale by gender for PISA 2003

Only a small proportion of Indigenous students (5%) were able to perform the highly complex tasks required to reach Level 5 and 6 on the space and shape subscale. There were 20 per cent of non-Indigenous students, 36 per cent of Hong Kong-Chinese students and 16 per cent of students from all OECD countries who performed at these high levels. Forty-three per cent of Indigenous students compared to 17 per cent of non-Indigenous students, 11 per cent of students from Hong Kong-China and 25 per cent of students across all OECD countries were not able to complete tasks at Level 2 in the space and shape subscale (Figure 3.9).

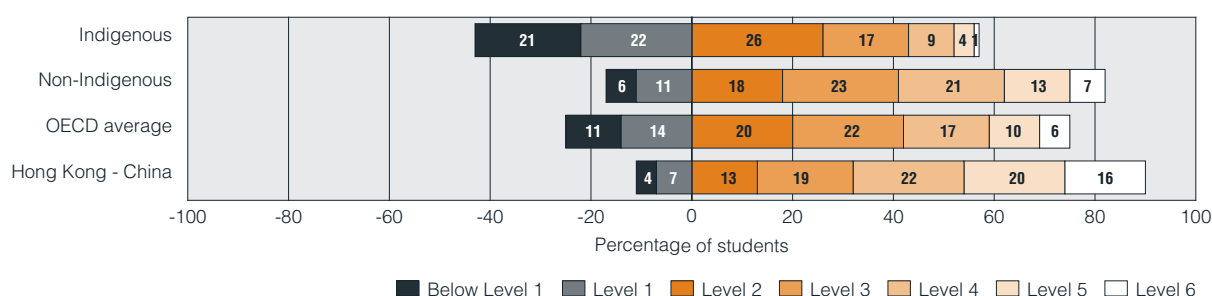


Figure 3.9: Proficiency levels on the space and shape subscale for Indigenous and non-Indigenous students, Hong Kong - Chinese students and OECD average for PISA 2003

Indigenous students' performance in change and relationships

Indigenous students achieved a mean score of 441 points on the change and relationships subscale, which was significantly lower than the mean scores for non-Indigenous students, students from Hong Kong-China and students across OECD countries (Table 3.6). The average performance of Indigenous Australian students was around one-and-a-half proficiency levels lower than that of non-Indigenous Australian students, more than one-and-a-half proficiency levels lower than students from Hong Kong-China and around one proficiency level lower than the OECD average.

Table 3.6: Means and standard errors for Indigenous and non-Indigenous students on the change and relationships subscale for PISA 2003

	All		Females		Males	
	Mean	SE	Mean	SE	Mean	SE
Indigenous students	441	7.3	449	5.6	432	11.6
Non-Indigenous students	527	2.3	525	2.8	530	3.1
OECD average	499	0.7	493	0.8	504	0.8
Hong Kong-China	540	4.7	539	4.8	540	6.8

The mean score for Indigenous females on the change and relationships subscale was 449 score points, which was not significantly different to the mean score for Indigenous males at 432 points.

Figure 3.10 shows the distribution of scores on the change and relationships subscale for Indigenous and non-Indigenous students by gender. The spread of scores for Indigenous females was 317 score points, which was slightly wider than that for Indigenous males (307 score points). For non-Indigenous students, the gap between highest and lowest performing males on the change and relationships subscale (334 score points) was wider than that for females (301 score points).

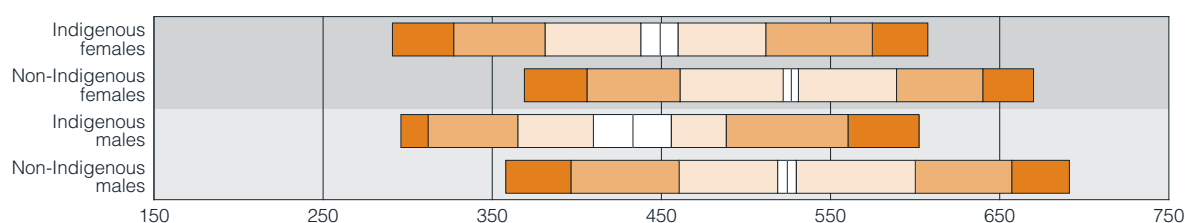


Figure 3.10: Distribution of Indigenous and non-Indigenous students on the change and relationships subscale by gender for PISA 2003

Figure 3.11 shows the proficiency levels for Indigenous and non-Indigenous students on the change and relationship subscale, along with results for the OECD average and Hong Kong-China. Only five per cent of Indigenous students were able to achieve at the upper end of the change and relationship subscale, performing at Level 5 or 6. This was less than one quarter of the proportion of non-Indigenous students performing at the same levels (21%), which was slightly higher than the OECD average of 16 per cent. At the lower end of the proficiency scale, 41 per cent of Indigenous students were not able to achieve Level 2, compared to 13 per cent of non-Indigenous students and 14 per cent of students from Hong Kong-China and 23 per cent of students across all OECD countries.

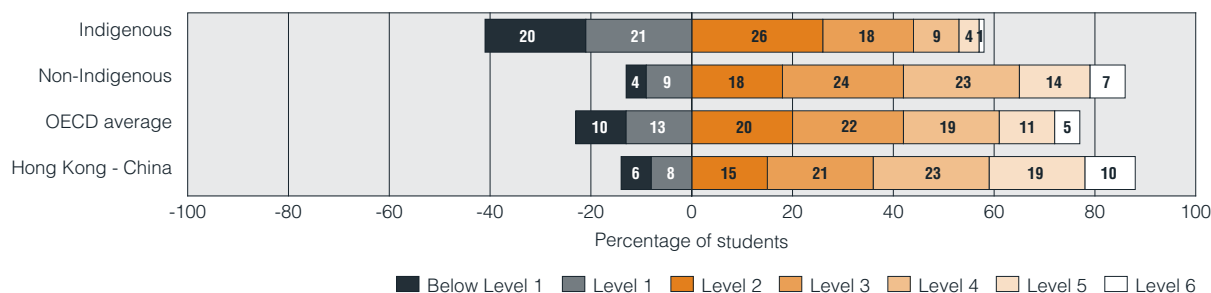


Figure 3.11: Proficiency levels on the change and relationship subscale for Indigenous and non-Indigenous students, Hong Kong-Chinese students and OECD average for PISA 2003

Indigenous students' performance in uncertainty

The performance of Indigenous and non-Indigenous students on the uncertainty subscale are shown in Table 3.7.

Indigenous students' mean (442 score points) on the uncertainty subscale was again significantly lower than that of non-Indigenous students (533 score points) and the OECD average (502 score points). The average performance of Indigenous students was almost one-and-a-half proficiency levels lower than the performance of non-Indigenous students, and approximately one proficiency level lower than the OECD average.

Table 3.7: Means and standard errors for Indigenous and non-Indigenous students on the uncertainty subscale for PISA 2003

	All		Females		Males	
	Mean	SE	Mean	SE	Mean	SE
Indigenous students	442	6.8	447	6.2	438	10.4
Non-Indigenous students	533	2.2	529	2.8	537	2.9
OECD average	502	0.6	496	0.8	508	0.7
Hong Kong-China	558	4.6	552	4.6	564	6.6

As with the other mathematical literacy subscales, there was no statistically significant difference between the average scores of Indigenous males (438) and females (447) on the uncertainty subscale. Non-Indigenous males performed significantly better than non-indigenous females on this subscale, however, with mean scores of 537 and 529 points, respectively.

The distribution of scores for Indigenous and non-Indigenous females and males on the uncertainty subscale are shown in Figure 3.12. For Indigenous students, the difference between the 5th and 95th percentiles was similar for male and female students, close to 320 score points. Among non-Indigenous students, the spread of scores was larger for males, at 330 points, than the spread of scores for females, which was 302 points.

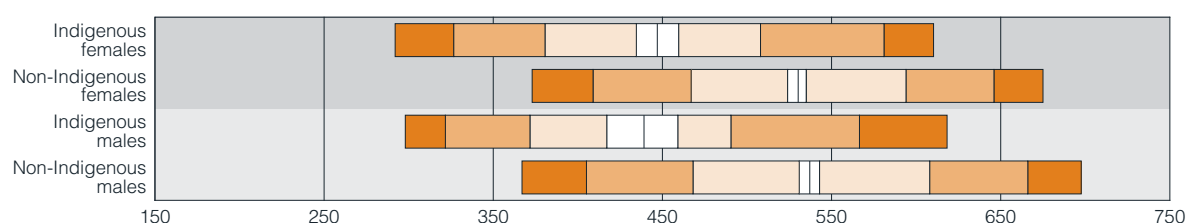


Figure 3.12: Distribution of Indigenous and on-Indigenous students on the uncertainty subscale by gender for PISA 2003

At the upper end of the uncertainty subscale, only five per cent of Indigenous students, or one in every twenty students, performed at Level 5 or 6, while 23 per cent of non-Indigenous students, 34 per cent of students from Hong Kong-China and 15 per cent of students from across all OECD countries were placed at this level. At the lower end of the uncertainty subscale, 40 per cent of Indigenous students were not able to achieve a proficiency of Level 2, compared with 13 per cent of non-Indigenous students, nine per cent of students from Hong Kong-China and 20 per cent of students across all OECD countries who did not reach this standard. Figure 3.13 shows the percentage of students at each proficiency level on the uncertainty subscale.

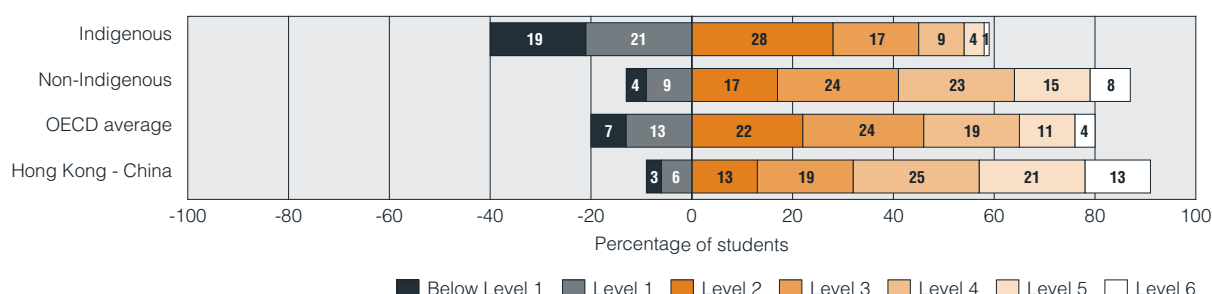


Figure 3.13: Proficiency levels on the uncertainty subscale for Indigenous and non-Indigenous students, Hong Kong - Chinese students and OECD average for PISA 2003

Performance in mathematical literacy over time

In the previous chapter, reading literacy performance across PISA cycles was examined. The cautions that were outlined in Chapter 2 also apply when comparing student performance in mathematical literacy over time.

As the first major domain assessment of mathematical literacy took place in 2003, it is only possible to compare mathematical literacy from 2003 onwards. Table 3.8 shows the mean performance of Indigenous students in PISA 2003 and PISA 2006. Across these two cycles, there was an increase of two score points in the average performance of Australian students, which is not a statistically significant change.

Table 3.8: Mean mathematical literacy scores and standard errors for PISA 2003 and PISA 2006, and differences between performance in cycles for Indigenous students

PISA 2003		PISA 2006		Differences between PISA 2003 and PISA 2006	
Mean	SE	Mean	SE	Diff.	SE
440	5.4	442	7.3	2	9.2

Summary

Indigenous students' results in mathematical literacy in PISA were substantially lower than those of non-Indigenous students, and also substantially lower than the OECD average.

On the mathematical literacy proficiency scale in PISA 2003, only a small proportion of Indigenous students achieved Level 5 or 6, while around one in five non-Indigenous students were performing at these levels. At the lower end of the mathematical literacy scale, 43 per cent of Indigenous students did not achieve a proficiency of Level 2 compared to 14 per cent of non-Indigenous students.

While there was little difference in the proportion of male and female students achieving at the highest proficiency levels in mathematics, a greater proportion of male Indigenous students than female Indigenous students failed to achieve proficiency level 2.

The performance of Indigenous students on the quantity and space and shape subscales was much lower than that of non-Indigenous students. This difference was even larger on the uncertainty and change and relationships subscales. Among Indigenous students, there were no significant gender differences on any of the subscales.

On each of the subscales, there were approximately five per cent of Indigenous students performing at the upper end of the proficiency level (Level 5 or 6) while approximately 40% or more of Indigenous students achieved at Level 2 or below.

There were no significant differences between the performance of Indigenous students in PISA 2003 and PISA 2006.

Scientific literacy

Scientific literacy was the major domain of assessment for PISA 2006. This allowed the scientific literacy framework to be expanded and scientific literacy performance to be assessed in far greater detail than in the previous PISA cycles.

This chapter begins with a description of scientific literacy and how this domain is measured in PISA¹⁰. The performance of Indigenous and non-Indigenous students is then presented in a format similar to the previous two chapters.

Definition of scientific literacy

In PISA, scientific literacy is defined as:

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

(OECD, 2006, p. 12)

Scientific literacy relates to the ability to think scientifically and to use scientific knowledge and processes to both understand the world around us and to participate in decisions that affect it. Increasingly, science and technology are shaping our lives. Scientific literacy is considered to be a key outcome of education for all students by the end of schooling, not just for future scientists, given the growing centrality of science and technology in modern societies. The ability to think scientifically about evidence and the absence of evidence for claims that are made in the media and elsewhere is vital to daily life.

The assessment framework for science includes three strands:

- ▶ Scientific knowledge or concepts: These constitute the links that aid understanding of related phenomena. In PISA, while the concepts are familiar ones relating to physics, chemistry, biological sciences, and Earth and space sciences, students are required to apply their knowledge of the content of the items and not just recall them.
- ▶ Scientific processes or competencies: These are centred on the ability to acquire, interpret and act upon evidence. Three such processes present in PISA are: i) identifying scientific issues, ii) explaining phenomena scientifically, and iii) using scientific evidence.

¹⁰ Information about the scientific literacy assessment framework has been taken from the PISA 2006 National Report, *Exploring Scientific Literacy: How Australia measures up*.

- Situations and context: These concern the application of scientific knowledge and the use of scientific processes. The framework identifies three main areas: science in life and health, science in Earth and environment, and science in technology.

How scientific literacy is measured

The scientific literacy framework in PISA 2006 comprises four interrelated aspects: the contexts in which tasks are embedded, the competencies that students need to apply, the knowledge domains involved, and students' attitudes towards science.

The PISA 2006 science items were distributed across the three scientific competencies. Twenty-two per cent of the science tasks given to students in the PISA assessment were related to identifying scientific issues, 48 per cent of science tasks related to explaining phenomena scientifically and the remaining 30 per cent of tasks were devoted to using scientific evidence.

Context

One of the foci of PISA is assessing the extent to which young people are prepared for their future lives, and so the items for the PISA science assessment are situated in general life, not just life at school. In the PISA 2006 science assessment, the focus of the items was on situations relating to the self, family and peer groups (*personal*), to the community (*social*) and to life across the world (*global*). Some items were framed in an *historical* situation, in which an understanding of the advances in scientific knowledge can be assessed.

Competencies

The PISA 2006 science assessment items required students to identify scientifically-oriented issues, explain phenomena scientifically, and use scientific evidence. These three competencies were chosen because of their importance to the practice of science and their connection to key cognitive abilities such as inductive and deductive reasoning, systems-based thinking, critical decision making, transformation of information (e.g. creating tables or graphs out of raw data), thinking in terms of models and use of science.

Scientific knowledge

In PISA 2006, scientific knowledge refers to both knowledge of science and knowledge about science itself. The areas of students' knowledge of science assessed in PISA 2006 were selected from the major fields of physics, chemistry, biology, Earth and space science, and technology. The assessment focused on the extent to which students were able to apply their knowledge in contexts of relevance to their lives.

Four content areas are defined within knowledge of science and represent knowledge required for understanding the natural world and for making sense of experiences in personal, social and global contexts.

As well as knowledge of science, PISA 2006 assessed knowledge about science, for which there were two categories: scientific enquiry (which centres on enquiry as the central process of science and the various components of that process) and scientific explanations (which are the results of scientific enquiry).

Attitudes

An important goal of science education is helping students develop interest in science and support for scientific enquiry. Attitudes towards science play an important role in students' decisions to develop their science knowledge further, pursue careers in science, and use scientific concepts

and methods productively throughout their lives. PISA's view of scientific literacy includes not just a student's performance in science assessments, but also their disposition towards science. This includes attitudes, beliefs, motivational orientations, self-efficacy, and values.

Scientific literacy performance: scale scores

Indigenous students performed significantly lower on average in scientific literacy than non-Indigenous students. Table 4.1 shows that Indigenous students scored, on average, more than one proficiency level (equivalent to 75 score points) lower than non-Indigenous students in scientific literacy in each of the three cycles of PISA. The results for Australia and the OECD average have been included in the table for comparison.

In PISA 2000, Indigenous students achieved a mean score of 448 score points, which was 81 score points lower than the mean of 529 score points for non-Indigenous students. In the next cycle of PISA, in 2003, there was a difference of 93 score points between Indigenous and non-Indigenous students' performances. In PISA 2006, Indigenous students achieved a mean score of 441 score points for scientific literacy, compared to a mean score of 529 score points for non-Indigenous students. On average, Indigenous students performed about 60 score points lower than the OECD average across the three PISA cycles. In each cycle, the difference between the mean scores of Indigenous and non-Indigenous students was statistically significant.

Table 4.1: Means and standard errors for Indigenous and non-Indigenous students on the overall scientific literacy scale

Student group	PISA 2000		PISA 2003		PISA 2006	
	Mean	SE	Mean	SE	Mean	SE
Indigenous	448	9.5	434	7.7	441	7.8
Non-Indigenous	529	3.5	527	2.0	529	2.3
Australia	528	3.5	525	2.1	527	2.3
OECD average	500	0.7	500	0.6	500	0.5

Figure 4.1 shows the distribution of performance scores for Indigenous and non-Indigenous students, as well as the OECD average on the scientific literacy scale for PISA 2006. The spread of scores shows that although the average performance of Indigenous students is significantly lower than that of non-Indigenous students and the OECD average, and that there are some Indigenous students whose performance is of great concern, there are also some students who are performing at reasonably high levels.

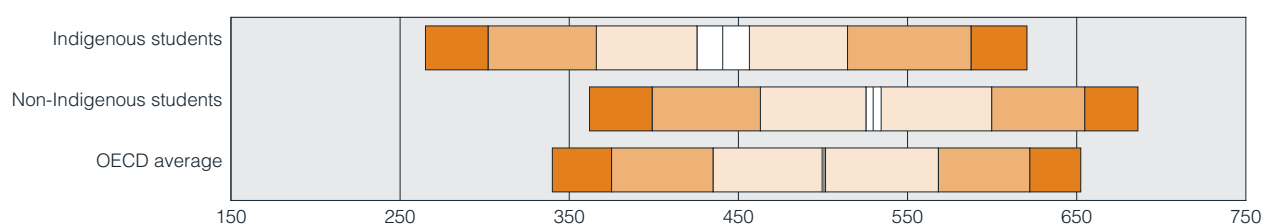


Figure 4.1: Distribution of Indigenous and non-Indigenous students on the scientific literacy scale for PISA 2006

The spread of scientific literacy scores between the 5th and 95th percentile for Indigenous students has become wider in each PISA cycle. In PISA 2000, the spread of scores for Indigenous students was 311 score points. In PISA 2003, the spread of scores increased to 332 score points and in PISA 2006 the spread of scores for Indigenous students between the 5th and 95th percentile was increased further to 356 score points.

The spread of scores for non-Indigenous students was very similar to the spread of scores for Indigenous students in PISA 2000 and PISA 2003 (309 and 331 score points respectively). In PISA 2006, however, the distribution of scores for Indigenous students was 32 points wider than that of non-Indigenous students (324 score points).

Scientific literacy performance: proficiency levels

In PISA 2006, descriptions were developed to characterise the overall student performance at each of six scientific literacy proficiency levels. The development of three scientific subscales (identifying scientific issues, explaining phenomena scientifically and using scientific evidence) adds further information about students' competencies in science. In scientific literacy, one proficiency level equates to 75 score points.

Science proficiency Level 6

Students at this level can consistently identify, explain and apply scientific knowledge and knowledge about science in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they are willing to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations. Students who scored 707.9 score points and above were placed in the highest proficiency level.

In PISA 2006 fewer than half a per cent of Indigenous students performed at this highest proficiency level. There were three per cent of non-Indigenous students, four per cent of Finnish students (Finland being the highest performing country in PISA 2006) and one per cent of students across all OECD countries who achieved at this level.

Science proficiency Level 5

At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and knowledge about science to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis. Students whose scores were higher than 633.3 but lower than or equal to 707.9 points achieved a reading proficiency at Level 5.

Only three per cent of Indigenous students were placed at Level 5, compared to 12 per cent of non-Indigenous students and 17 per cent of Finnish students. On average, eight per cent of students from OECD countries achieved this level of proficiency.

Science proficiency Level 4

Students who achieved this level of scientific proficiency can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence. Students whose scores were higher than 558.7 but lower than or equal to 633.3 points achieved a reading proficiency at Level 4.

Twelve per cent of Indigenous students were placed at Level 4. One quarter of non-Indigenous students and also approximately one third of students from Finland achieved at Level 4, while the OECD average was around one fifth of students at this level.

Science proficiency Level 3

Students classified at Level 3 can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge. Students whose scores were higher than 484.1 but lower than or equal to 558.7 points achieved a reading proficiency at Level 3.

Approximately 20 per cent of Indigenous students and almost 30 per cent of non-Indigenous students, Finnish students and student across all OECD countries achieved a science proficiency of Level 3.

Science proficiency Level 2

At Level 2 students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving. Students whose scores were higher than 409.5 but lower than or equal to 484.1 points achieved a reading proficiency at Level 2.

Approximately 25 per cent of Indigenous students achieved Level 2, compared to 20 per cent of non-Indigenous students and 14 per cent of Finnish students. Almost one quarter of all students across the OECD were able to achieve a proficiency of Level 2.

Science proficiency Level 1

Students at Level 1 have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence. Students whose scores were higher than 334.9 but lower than or equal to 409.5 points achieved a science proficiency of Level 1.

Twenty-three per cent of Indigenous students were placed at this level, compared to nine per cent of non-Indigenous students and four per cent of students from Finland. Across the participating OECD countries, an average of 14 per cent of students performed at Level 1 on the science literacy assessments.

Not yet reached science proficiency Level 1

Science tasks any easier than the Level 1 tasks in PISA no longer fit PISA's concept of scientific literacy. Students who scored below this level have not demonstrated understanding of even the most basic type of information and the OECD have argued that this points to serious deficiencies in these students' ability to meet the challenges of the future and adapt to societal change.

Seventeen per cent of Indigenous students were unable to demonstrate Level 1 science skills in PISA, compared to three per cent of non-Indigenous students, one per cent of Finnish students and five per cent of students across all OECD countries.

Figure 4.2 shows the percentage of Indigenous and non-Indigenous students, Finnish students and students from the OECD at each scientific literacy proficiency level, from below Level 1 to Level 6.

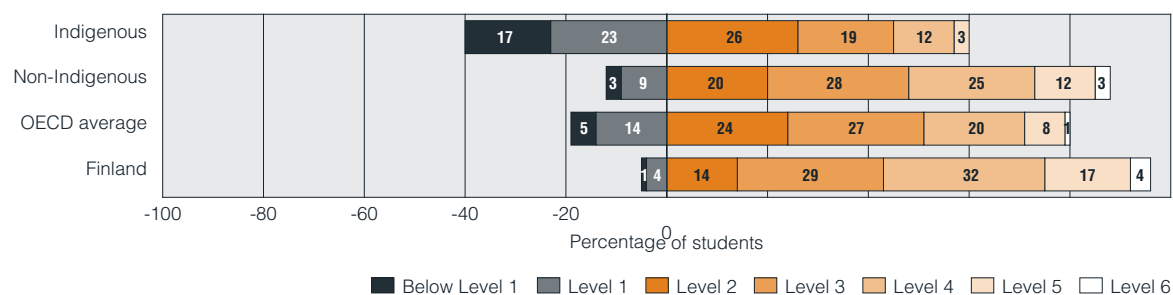


Figure 4.2: Scientific literacy proficiency levels for Indigenous and non-Indigenous students, the OECD average and Finland for PISA 2006

Around 60 per cent of Indigenous students were able to achieve Level 2 or higher, compared to 88 per cent of non-Indigenous students and 81 per cent of students across all OECD countries.

At the lower end of the science proficiency scale, approximately 40 per cent of Indigenous students were not able to achieve a proficiency of Level 2. Level 2 is the base level at which the OECD argues that students are able to demonstrate scientific competencies that will enable them to actively participate in life situations related to science and technology. These results indicate that a large proportion of Indigenous students are performing below this baseline and that these students do not have the sufficient skills to allow them to meet the challenges of the 21st century.

In contrast, 12 per cent of non-Indigenous Australian students and 19 per cent of students across all OECD countries were performing below Level 2, while in Finland only four per cent of students had not reached this level.

Indigenous students' performance from an international perspective

Figure 4.3 shows the international student performance on scientific literacy for PISA 2006, with the mean and distribution of scores for Indigenous and non-Indigenous Australian students included to illustrate Indigenous students' performance in a world-wide context.

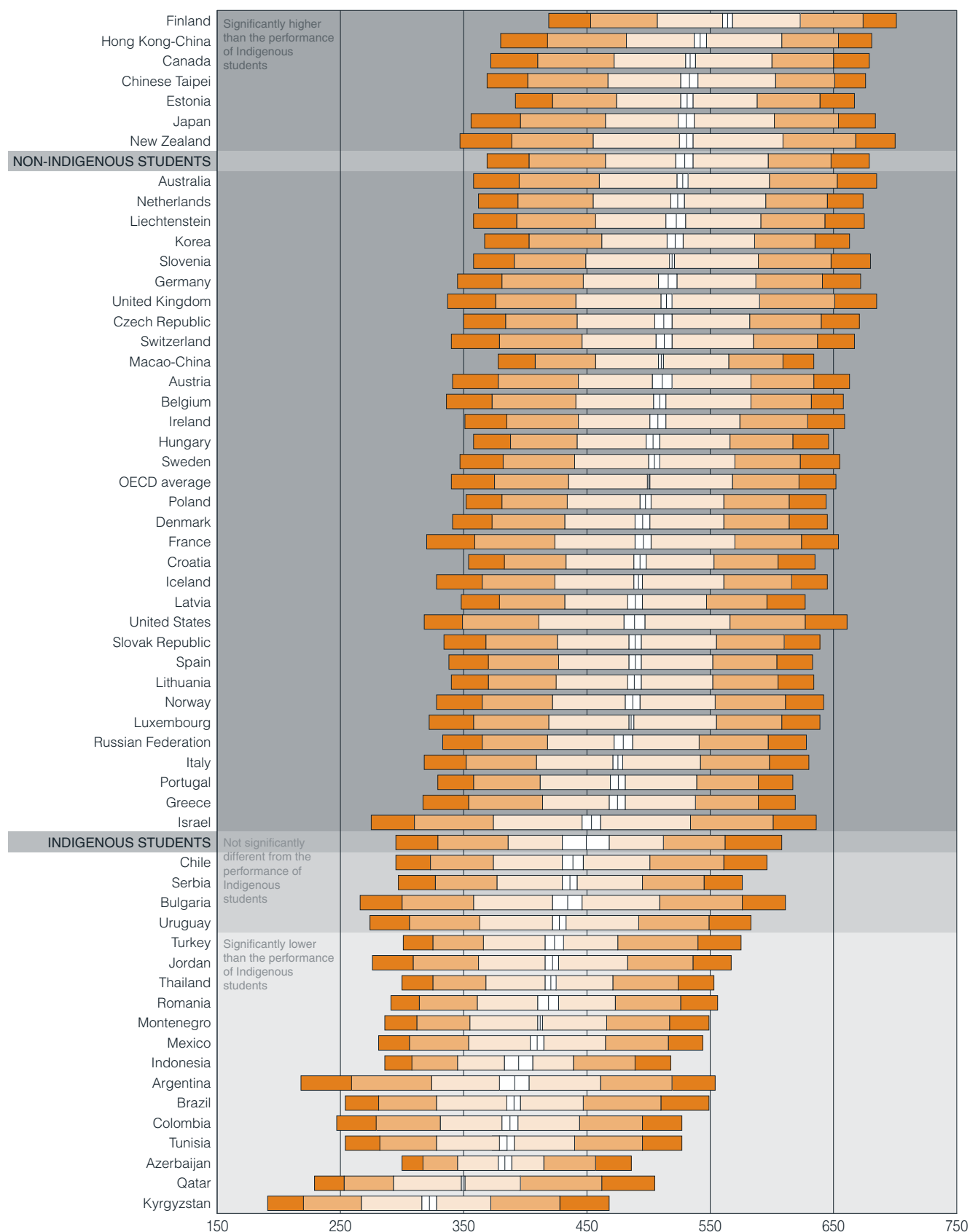


Figure 4.3: International student performance in scientific literacy for PISA 2006 including Indigenous and non-Indigenous performance

The results show that the score for Finland, the highest scoring country, was about one-and-a-half proficiency levels higher than the average performance of Indigenous students. Students in the majority of countries, from Finland through to Greece, performed significantly higher than Indigenous Australian students. Indigenous students scored at a level not significantly different to students in four countries: Israel, Chile, Serbia and Bulgaria. Indigenous students scored significantly higher than students in fifteen countries (from Uruguay to Kyrgyzstan).

Scientific literacy performance by gender

In PISA 2006, there were twenty countries with significant gender differences in scientific literacy. Females significantly outperformed males in Qatar, Jordan, Bulgaria, Thailand, Argentina, Turkey, Greece, Lithuania, Slovenia, Azerbaijan, Latvia and Kyrgyzstan. Significant gender differences in favour of males were found in Chile, the United Kingdom, Luxembourg, Brazil, Denmark, the Netherlands, Mexico and Switzerland. There was a small, but statistically significant, difference in favour of males for the OECD average performance in scientific literacy.

Although Indigenous females appeared to perform at a higher level in scientific literacy compared to Indigenous males in PISA 2000, PISA 2003 and PISA 2006, these differences were not statistically significant (Table 4.2).

Indigenous females performed about 50 score points lower on average than female students from all OECD countries across the three PISA cycles. This difference was equivalent to almost three-quarters of a proficiency level. There were larger differences found between the performance of Indigenous males and the OECD average for males. Across the three PISA cycles, there was an average difference of about 65 score points, or almost one proficiency level, between the performance of Indigenous males and the OECD average for males.

Table 4.2: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall scientific literacy scale

Student group		PISA 2000		PISA 2003		PISA 2006	
		Mean	SE	Mean	SE	Mean	SE
Indigenous	Females	455	10.7	447	6.4	443	11.7
	Males	440	16.1	422	11.6	439	10.1
Non-Indigenous	Females	532	4.9	527	2.8	529	2.6
	Males	527	3.8	527	2.8	530	3.2
OECD average	Females	501	0.8	497	0.8	499	0.6
	Males	501	0.9	503	0.7	501	0.7

Figure 4.4 shows the mean and distribution of scores for Indigenous and non-Indigenous students on the PISA 2006 scientific literacy scale by gender. The spread of scores for Indigenous females was 371 score points. This spread of scores was wider than that for non-Indigenous females, at 309 score points between the 5th and 95th percentile. The spreads of scores between the 5th and 95th percentile for Indigenous and non-Indigenous males were 345 and 336 score points, respectively.

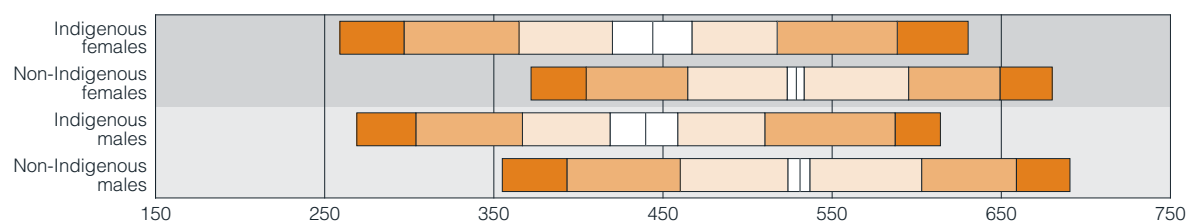


Figure 4.4: Distribution of Indigenous and non-Indigenous students on the scientific literacy scale for PISA 2006

Figure 4.5 shows the percentage of Indigenous and non-Indigenous female and male students at each proficiency level for scientific literacy. The proportions of Indigenous females and males performing at each proficiency level were similar; approximately 40 per cent of Indigenous females and males performed below Level 2. These figures were much higher compared to the corresponding proportions for non-Indigenous females and males, with approximately 10 per cent achieving below Level 2.

At the higher end of the scientific literacy proficiency scale, 16 per cent of non-Indigenous males and thirteen per cent of non-Indigenous females achieved at Level 5 or Level 6, compared to three per cent of Indigenous males and four per cent of Indigenous females.

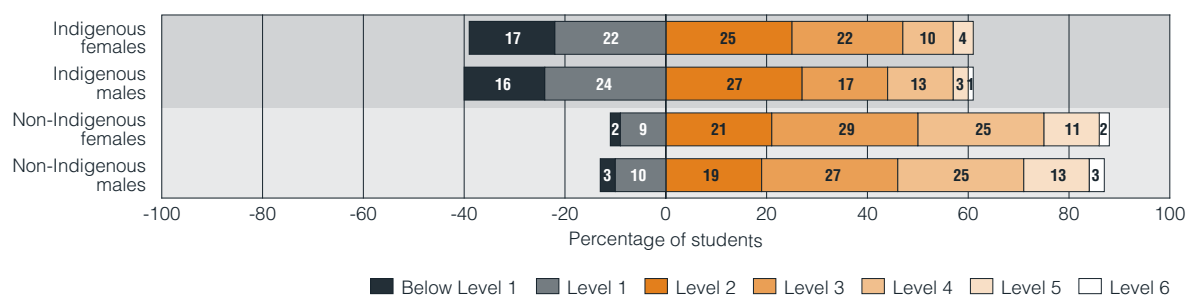


Figure 4.5: Scientific literacy proficiency levels for Indigenous and non-Indigenous students by gender for PISA 2006

Performance on the scientific literacy subscales

In PISA 2006 three key competencies were chosen for further exploration because of their importance to the practice of science and their connections to key cognitive abilities, such as inductive and deductive reasoning, systems-based thinking, critical decision making, transformation of information (e.g. creating tables or graphs out of raw data), thinking in terms of models, and use of science. These three scientific subscales are labelled as identifying scientific issues, explaining phenomena scientifically, and using scientific evidence.

Indigenous students' performance in identifying scientific issues

The essential features of this competency are recognising issues that are possible to investigate scientifically, identifying keywords to search for scientific information, and recognising the key features of a scientific investigation.

Indigenous students achieved a mean score of 453 score points on the identifying scientific issues scale, which was 85 score points (or more than one proficiency level) lower than that of non-Indigenous students, who achieved a mean score of 538 score points. Indigenous students performed more than half of a proficiency level lower than students across all OECD countries, who achieved a mean score of 499 points.

Figure 4.6 shows the distribution of scores for Indigenous and non-Indigenous students by gender on the identifying scientific issues subscale. While the average score of Indigenous females appears higher than that of Indigenous males on the identifying scientific issues subscale (466 compared to 441), there was no statistically significant difference in their performances. In comparison, a significant difference was found between the average performances of non-Indigenous males (528) and females (548) on this subscale.

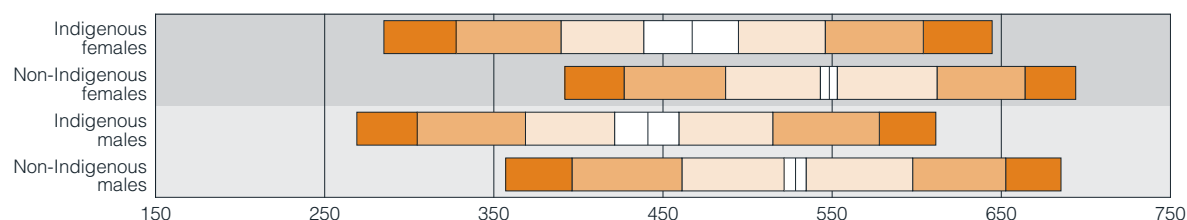


Figure 4.6: Proficiency levels on the identifying scientific issues subscale for Indigenous and non-Indigenous students by gender for PISA 2006

The proficiency levels for Indigenous and non-Indigenous students on the identifying scientific issues subscale are shown in Figure 4.7 along with results for Finland and the OECD average. Approximately one third of Indigenous students did not achieve Level 2, compared to one tenth of non-Indigenous students, one twentieth of Finnish students and one fifth of students across all OECD countries. At the upper end of the identifying scientific issues scale, only four per cent of Indigenous students achieved Level 5 or 6, compared to 16 per cent of non-Indigenous students who performed at these levels.

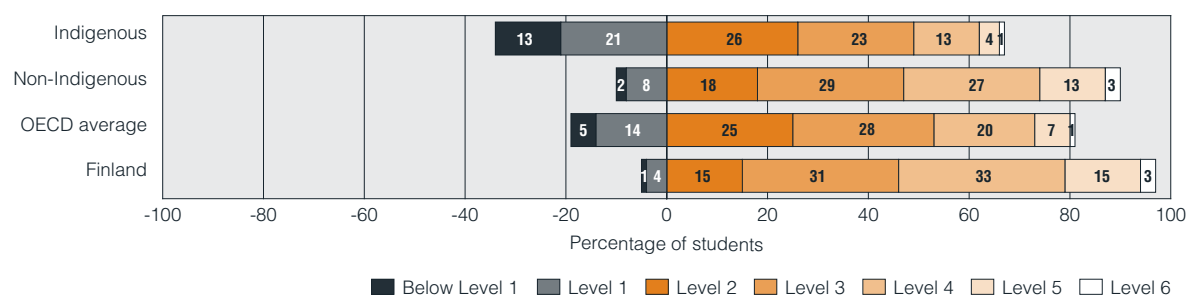


Figure 4.7: Proficiency levels on the identifying scientific issues subscale for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2006

Indigenous students' performance in explaining phenomena scientifically

The main areas in the 'explaining phenomena scientifically' competency are applying knowledge of science in a given situation, describing or interpreting phenomena scientifically and predicting changes, and identifying appropriate descriptions, explanations and predictions.

Indigenous students did not perform as well on the explaining phenomena scientifically subscale as on the identifying scientific issues subscale. Indigenous students achieved a mean score of 438 score points, while non-Indigenous students scored 97 points, or more than one-and-a-third proficiency levels, higher. Indigenous students performed more than half a proficiency level lower than students across all OECD countries on this subscale.

Figure 4.8 shows the distribution of scores for Indigenous and non-Indigenous students by gender on the explaining phenomena scientifically subscale. While the average score of Indigenous females on this subscale appears higher than that of Indigenous males (432 score points compared to 443), this difference was not statistically significant. Non-Indigenous males performed significantly better than non-Indigenous females on the explaining phenomena scientifically subscale, with mean scores of 529 and 516, respectively.

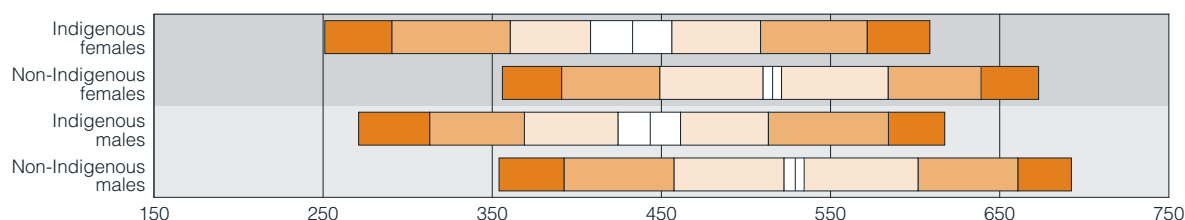


Figure 4.8: Proficiency levels on the explaining phenomena scientifically subscale for Indigenous and non-Indigenous students by gender for PISA 2006

Figure 4.9 shows the proficiency levels for Indigenous and non-Indigenous students on the explaining phenomena scientifically subscale, along with the OECD average and the results for Finland. Only three per cent of Indigenous students were able to achieve at the upper end of the explaining phenomena scientifically subscale, performing at Level 5 or 6. There were more than four times as many non-Indigenous students who performed at the same levels (14%), which was similar to the OECD average of 12 per cent of students.

At the lower end of the scale, 41 per cent of Indigenous students were not able to achieve Level 2, compared to 13 per cent of non-Indigenous students and 18 per cent of students across all OECD countries.

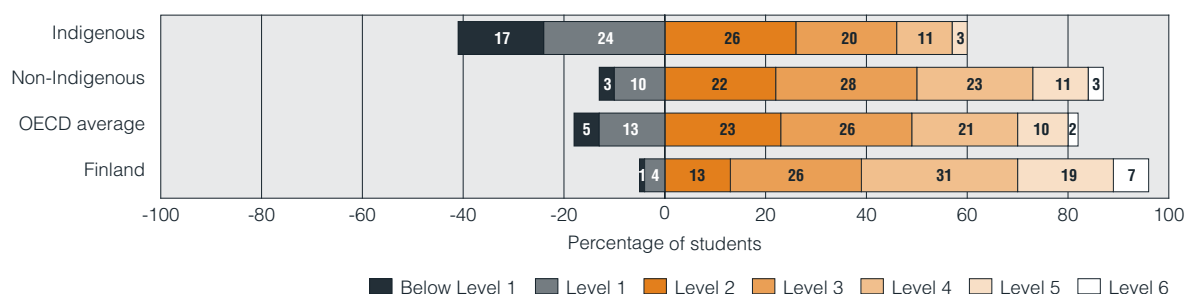


Figure 4.9: Proficiency levels on the explaining phenomena scientifically subscale for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2006

Indigenous students' performance in using scientific evidence

The 'using scientific evidence' competency required students to synthesise knowledge about science and knowledge of science as they apply both of these to a life situation or a contemporary social problem.

Indigenous students' performance on the using scientific evidence subscale was similar to that on the explaining phenomena scientifically subscale. Indigenous students achieved a mean score of 439 score points, which was 95 score points (or more than one proficiency level) lower than the mean score of 534 score points for non-Indigenous students.

Figure 4.10 shows the distribution of scores on the using scientific evidence subscale for Indigenous and non-Indigenous students by gender. There were no significant gender differences found between the performance of Indigenous females and males, who both achieved a mean score of 439 score points. Non-Indigenous females and males also performed similarly on this subscale, with mean scores of 536 and 533 points, respectively. Indigenous females performed 97 score points lower than non-Indigenous females and a similar gap was found between Indigenous males and non-Indigenous males with a difference of 94 score points.

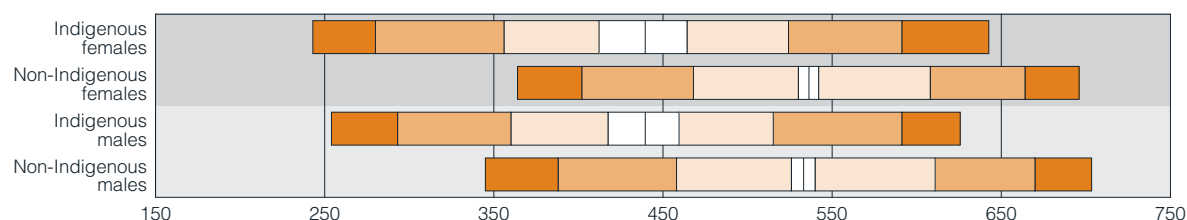


Figure 4.10: Proficiency levels on the using scientific evidence subscale for Indigenous and non-Indigenous students by gender for PISA 2006

Figure 4.11 shows the proportion of Indigenous and non-Indigenous students at each proficiency level on the using scientific evidence subscale. Close to 40 per cent of Indigenous students did not achieve Level 2, compared to 12 per cent of non-Indigenous students, five per cent of Finnish students and 22 per cent of students across all participating OECD countries. At the upper end of the proficiency scale, there were five per cent of Indigenous students who achieved Level 5 or 6, while 18 per cent of non-Indigenous students attained these higher levels of proficiency in using scientific evidence.

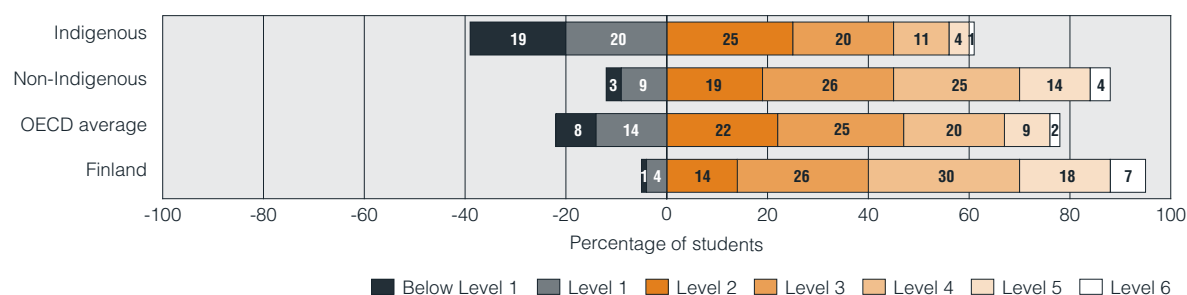


Figure 4.11: Proficiency levels on the using scientific evidence for Indigenous and non-Indigenous students, Finnish students and the OECD average for PISA 2006

Summary

Results on the overall scientific literacy scale show that Indigenous students performed significantly lower on average than non-Indigenous students, and significantly lower than the OECD average across the three PISA cycles.

Very few (3%) Indigenous students achieved at the highest proficiency level on the scientific literacy scale, while 15 per cent of non-Indigenous students performed at this level. At the lower end of the scale, there were a substantial proportion of Indigenous students who did not achieve a proficiency of Level 2 - four in every ten Indigenous students did not reach this minimum benchmark in scientific literacy. There were no statistically significant differences in the performance of Indigenous females and Indigenous males.

Indigenous students performed at a similar level on the explaining phenomena scientifically and using scientific evidence subscale, and performed at a higher level on the identifying scientific issues subscale. There were no significant gender differences for Indigenous students' performance on any of the scientific literacy subscales.

Summary and conclusions

PISA assesses how well 15-year-old students approaching the end of their compulsory schooling are prepared for meeting the challenges they will face in their lives beyond school. The three-yearly assessment provides an opportunity to monitor the performance of these students in reading, mathematical and scientific literacy.

A special focus for Australia has been to ensure that there is a sufficiently large sample of Australia's Indigenous students so that valid and reliable analysis can be conducted. Indigenous students performed at a substantially and statistically lower level in reading, mathematical and scientific literacy compared to their non-Indigenous peers. Table 5.1 shows the mean scores for Indigenous and non-Indigenous students for reading, mathematical and scientific literacy when they were major domains in the PISA assessments of 2000, 2003 and 2006 respectively. In reading literacy, mathematical literacy and scientific literacy in PISA 2000, 2003 and 2006 respectively, Indigenous students performed more than 80 score points (or more than one proficiency level) lower than non-Indigenous students and more than 50 score points lower than the OECD average.

The performance of students was also described in PISA using proficiency levels, which provide a profile of what students have achieved in terms of skills and knowledge. Across the domains, Indigenous students were overrepresented at the lower levels and underrepresented at the upper levels.

Table 5.1 also shows the percentage of Indigenous and non-Indigenous students not achieving Level 2 (the two lowest proficiency levels) and the percentage of students achieving the two highest proficiency levels (Level 4 and 5 in reading literacy and Level 5 and 6 in mathematical and scientific literacy). More than one third of Indigenous students have not been able to achieve Level 2 in reading, mathematical or scientific literacy. Only 12 per cent of Indigenous students were able to achieve Level 4 or 5 in reading literacy, and no more than 5 per cent in mathematical and scientific literacy. Similar results were reported when assessing the performance of Indigenous students in the subscales of each of the literacy domains, with Indigenous students performing at levels significantly below those of non-Indigenous students.

Table 5.1: A summary of Indigenous and non-Indigenous performance from PISA 2000, 2003 and 2006

PISA	Indigenous students	Non-Indigenous students	Indigenous students		Non-Indigenous students	
	Mean and SE	Mean and SE	< Proficiency Level 2	Proficiency Level 4 & 5 (for reading) Level 5 & 6 (for maths & science)	< Proficiency Level 2	Proficiency Level 4 & 5 (for reading) Level 5 & 6 (for maths & science)
Reading literacy (2000)	448 (5.8)	531 (3.4)	33	12	12	44
Mathematical literacy (2003)	440 (5.4)	526 (2.1)	43	5	14	20
Scientific literacy (2006)	441 (7.8)	529 (2.3)	39	4	12	15

Significant gender differences were found between Indigenous males and females in reading literacy, favouring Indigenous females by 34 score points. No significant gender differences in mathematical and scientific literacy were found for Indigenous students.

The performance of Indigenous students in PISA continues to raise concern about the educational disadvantage faced by Indigenous students. From an international perspective, they are performing well below the OECD average and from a national perspective, they are achieving well below the performance of non-Indigenous students.

There have been two PISA assessments since 2000, and the results have shown that the performance of Indigenous students has not changed statistically over time. These results suggest that to date, initiatives to improve the education of Indigenous students through educational policy have had little effect. In terms of real-life functioning and future opportunities, Indigenous students remain at a substantial disadvantage.

Further evidence from PISA 2006 has shown that although there was a higher percentage of Indigenous students who were slightly older and in higher year levels (i.e. they have more years of schooling) than in previous PISA cycles, overall performance across the three literacy domains has not improved. Raising the performance of Indigenous students and closing the gap between Indigenous and non-Indigenous students needs to be addressed using different approaches than those that have been used to date.

This report has focused on the achievement of Indigenous students and their performance in PISA. A following report will examine the impact of background factors, including socioeconomic status, and psychological factors such as attitudes and beliefs on the performance of Indigenous students.

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The achievement of Australia's Indigenous students in PISA 2000 — 2006

ISBN 978-0-86431-901-2



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