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Achievement of Australia's Early Secondary Indigenous Students: Findings from TIMSS 2003

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EXECUTIVE SUMMARY

The primary aim of this report is to examine the performance of Australia's Indigenous students who participated as part of the early secondary school (Year 8) cohort of the IEA Trends in International Mathematics and Science Study (TIMSS 2003). The performance of Indigenous students in this report has been compared to that of Australia's non-Indigenous students across a number of variables that are known to affect student achievement in TIMSS generally (Martin, Mullis, Gonzalez & Chrostowski, 2004; Mullis, Martin, Gonzalez & Chrostowski, 2004). In total, 562 Year 8 Indigenous students from 207 schools across Australia participated in the study. Indigenous status in the report includes both Australian Aboriginal and Torres Strait Islander people.

The analyses in this report categorised Indigenous students according to variables including gender, the student's state and geographic location, student background characteristics and attitudes to learning, education resources in students' homes, and the school's socioeconomic composition. The average performance of Indigenous students in mathematics and science has been disaggregated by these variables in an attempt to identify those characteristics that may relate to Indigenous educational achievement.

The analyses showed considerable differences in the level of Indigenous and non-Indigenous student achievement, and confirms findings from a large body of studies that have shown that Australia's Indigenous students consistently perform at levels well below their non-Indigenous counterparts across all content domains in international studies (Lokan, Greenwood & Cresswell, 2001; Thomson, Cresswell & De Bortoli, 2004; Thomson & Fleming, 2004a, 2004b). Some of the examined variables related in a consistent manner to the mathematics and science achievement of Indigenous and non-Indigenous students. However in some circumstances, the relationship between some variables exacerbates or assists Indigenous achievement to a greater extent compared to that of non-Indigenous students. These main findings are summarised below:

- In mathematics Indigenous students achieved, on average, 79 score points lower than their non-Indigenous counterparts, and 38 score points lower than the international mean. The performance of Australia's Indigenous students is similar to that of students in Macedonia, Jordan and Lebanon. In science, Indigenous students performed 72 score points lower than non-Indigenous students, and 16 score points lower than the international mean. On an international level, the performance of Australia's Indigenous students in science is comparable to that of students in Iran and Armenia.
- Indigenous student achievement in both mathematics and science has not changed since TIMSS 1994/95. There was also little change in non-Indigenous performance in either content domain from TIMSS 1994/95 to TIMSS 2002/03.
- The low proportion of Indigenous students achieving the TIMSS international benchmarks is of concern. More than one third (38%) of Indigenous students did not reach the lowest benchmark in mathematics and one-fifth of Indigenous students did not reach the lowest benchmark in science.
- In mathematics, male Indigenous students outscored female Indigenous students by 30 score points and in science the difference was 35 points; however neither of these differences was found to be statistically significant.
- Fewer than one per cent of Indigenous female students reached the advanced benchmark in mathematics, over three-quarters did not achieve above the lowest benchmark and nearly half of Indigenous female students failed to reach even the lowest benchmark. In science fewer than one per cent of female Indigenous students reached the advanced level of achievement in science, more than 60 per cent did not achieve above the lowest benchmark, and nearly one-third failed to reach the lowest benchmark.

- Self-confidence had a positive relationship with Indigenous achievement (for both male and female students) in mathematics and science. However, the impact of self-confidence on Indigenous achievement was different for male and female Indigenous students. Moderate to high levels of self-confidence saw male Indigenous achievement reach a level similar to the international average for both content domains. For female Indigenous students, only the highest level of self-confidence in learning mathematics or science saw achievement rise to a level equivalent to the international average.
- Significant positive correlations were observed between non-Indigenous students' enjoyment and value in learning mathematics and science and their performance. These correlations were not observed for Indigenous students.
- At least one-quarter of all Indigenous students indicated their wish to complete TAFE, the same proportion as non-Indigenous students with the same educational aspiration. The percentages of Indigenous students wishing to undertake university studies (in both mathematics and science) are significantly lower than those of their non-Indigenous counterparts.
- Indigenous students who speak English infrequently in the home achieve at a level below that of their more frequent English-speaking counterparts and appear to be at an even greater educational disadvantage.
- Books in the home were found to be an important educational resource. Indigenous students with more than 100 books in the home scored at a level equivalent to the international mean in both mathematics and science.
- Computers in the home and having a study desk or area in which to work were found also to be important educational resources. Science achievement for Indigenous students with a computer at home was at a level not significantly different to the international mean. In mathematics, those Indigenous students who either used a computer at home and at school, or home but not at school, scored at a level similar to the international mean. Together with the finding about books in the home, this suggests that having a home environment that is able to provide educational aids has a positive relationship with Indigenous school achievement.
- More than half of the Indigenous students sampled (59%) attended schools where more than one-quarter of the student population came from economically disadvantaged homes compared with 32 per cent of non-Indigenous students. Average mathematics and science achievement in such schools is lower than in schools with fewer disadvantaged students.
- Thirteen per cent of Indigenous students, compared to 34 per cent of non-Indigenous students, attended schools in which absenteeism was deemed by the principal not to be a problem. Fifteen per cent of Indigenous students and 9 per cent of non-Indigenous students attended schools in which the principal considered absenteeism to be a serious problem. In schools with few absenteeism problems, Indigenous achievement in mathematics and science is similar to the international mean; in those schools where it is a serious problem, Indigenous performance is significantly lower than the international mean.

A great disparity exists between the mathematics and science achievement of Australia's Indigenous and non-Indigenous students. However, a number of characteristics appear to be related to higher levels of Indigenous academic achievement, including being male, living in an urban environment, speaking English in the home (always or almost always), having high self-confidence in undertaking educational pursuits, holding aspirations of future TAFE or university study and having a home environment rich with educational resources and support.

Furthermore, while educational discussion and policy talks of improving the educational achievement of Indigenous students as a whole, the TIMSS results suggest that a specific focus on improving Indigenous females' educational outcomes in mathematics and science should be encouraged.

Achievement of Australia's Early Secondary Indigenous Students: Findings from TIMSS 2003

1. INTRODUCTION

Improving the educational outcomes of Indigenous[1] Australian students is an issue high on the political agenda. In 2001, the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) urged that ameliorating Indigenous educational outcomes was a national priority (MCEETYA, 2000). Significant efforts have been made to improve the educational outcomes of Indigenous students in Australia, and in many cases outcomes have improved, but the degree of educational disadvantage experienced by Indigenous students remains substantial. The third annual national report into Indigenous education in 2005 found that serious gaps persist between Indigenous and non-Indigenous outcomes in literacy, numeracy, student attendance, retention into senior secondary education, Year 12 certificates and completion rates in vocational education and training (VET) and higher education (Department of Education, Science and Training [DEST], 2005).

Indigenous educational policy has emphasised the importance of monitoring Indigenous students' educational outcomes nationally as a means of assessing the on-going efficacy of implemented educational policy. Much data has already been gathered on Indigenous students' literacy levels, in particular for primary school-aged children (eg Frigo, Corrigan, Adams, Hughes, Stephens & Woods, 2003). Results from the OECD's *Programme for International Student Assessment (PISA)* in 2000 and in 2003 indicated that Australia's Indigenous 15-year-old students performed at a lower level in all three areas of assessment: reading literacy, mathematical literacy and scientific literacy - than non-Indigenous students. In addition, the achievement levels of Indigenous students were lower than the international mean in all three assessment areas, whereas the achievement levels of non-Indigenous Australian students were well above the international mean in each of the three areas (De Bortoli & Cresswell, 2004; Thomson, Cresswell & De Bortoli, 2004).

Data from the *Trends in International Mathematics and Science Study (TIMSS)* 2003[2] also provides an opportunity to examine the educational achievement of Indigenous students in curriculum-based science and mathematics achievement. In 2002, TIMSS collected data from students Australia-wide. Within this sample, Indigenous students were deliberately over sampled (relative to actual numbers of Indigenous students) to permit a more detailed statistical analyses of Indigenous student achievement than would be possible under normal sampling conditions. This report presents these analyses and summary of Australian middle school Indigenous students' science and mathematics achievement in TIMSS 2003, in comparison to non-Indigenous Australian students' achievement, as well as in comparison to students' achievement in other countries. The report focuses on the early secondary school years (Year 8) as the self-report data on Indigenous status are more robust at this level than at Year 4, the other year level at which TIMSS assesses performance.

Those wishing to examine the achievement of Australian students as a whole should consult the following publications: *Summing it up: Mathematics achievement in Australian schools in TIMSS 2002* and *Examining the evidence: Science achievement in Australian schools in TIMSS 2002* (Thomson & Fleming, 2004a, 2004b).

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1 In this report, the terms 'Australian Indigenous students' and 'Indigenous students' refer to both Australian Aboriginal and Torres Strait Islander students.

2 For comparability across countries and across assessments, testing for TIMSS is conducted at the end of the school year. The countries in the southern hemisphere tested in late 2002, while the remaining countries tested at the end of their 2002-2003 school year in 2003. Internationally the study is called TIMSS 2003 and this report uses this convention.

WHAT IS TIMSS?

- TIMSS is a project of the International Association for the Evaluation of Educational Achievement (IEA).
- In 2002 (in southern hemisphere countries) and 2003 (in northern hemisphere countries), the IEA conducted the latest cycle of the Trends in International Mathematics and Science Study (TIMSS). The initial *Third International Mathematics and Science Study* (as it was then called) was conducted in 1994 and 1995 with students at Years 4 and 5, Years 8 and 9 and Year 12, followed by a partial repeat of TIMSS in 1998 and 1999 in which only students at the lower secondary level (Years 8 and 9) participated.
- TIMSS now collects educational achievement data in mathematics and science from two defined populations of students: Year 4 students and Year 8 students.
- Student assessment in TIMSS is based upon assessment frameworks that were developed after extensive analysis of national curricula across all participating countries. The TIMSS tests examine how well Year 4 and Year 8 students have mastered the factual and procedural knowledge outlined in school mathematics and science curricula.
- Participating students answered a pen and paper assessment booklet at school during regular class time. Students also answered a questionnaire which asked about their home backgrounds, attitudes to school and learning and experiences in their mathematics and science classrooms.
- School principals and the students' mathematics and science teachers also completed detailed questionnaires that examined the socio-demographic variables of the school and its teachers. The questionnaires also asked about mathematics and science curriculum coverage and implementation, as well as teacher preparation, resource availability and the use of information technology.

COUNTRIES IN TIMSS 2003

Testing for TIMSS 2003 was carried out in 46 countries at Year 8 level. These countries are shown in Figure 1.

❽ Armenia
❽ Australia
❽ Bahrain
❽ Belgium (Flemish)
❽ Botswana
❽ Bulgaria
❽ Chile
❽ Chinese Taipei
❽ Cyprus
❽ Egypt
❽ England
❽ Estonia
❽ Ghana
❽ Hong Kong, SAR
❽ Hungary
❽ Indonesia
❽ Iran, Islamic Republic of
❽ Israel
❽ Italy
❽ Japan
❽ Jordan
❽ Korea, Republic of
❽ Latvia
❽ Lebanon
❽ Lithuania
❽ Macedonia, Republic of
❽ Malaysia
❽ Moldova
❽ Netherlands
❽ New Zealand
❽ Norway
❽ Palestinian National Authority
❽ Philippines
❽ Romania
❽ Russian Federation
❽ Saudi Arabia
❽ Scotland
❽ Serbia & Montenegro
❽ Singapore
❽ Slovak Republic
❽ Slovenia
❽ South Africa
❽ Sweden
❽ Tunisia
❽ United States

Figure 1 Countries that participated in TIMSS 2003

WHAT DOES TIMSS MEASURE?

The TIMSS curriculum model

The curriculum (broadly defined) provides the organisational structure for TIMSS. Based around three levels, the curriculum model considers how educational opportunities are provided to students, and what contextual factors influence how students utilise such opportunities.

These three levels are as follows:

- *The intended curriculum* – represents the mathematical and scientific knowledge students are expected to learn. The intended curriculum is specified at a national or system level and states a society's goals and intentions for teaching and learning.
- *The implemented curriculum* – refers to what is actually taught in the classroom, who teaches it, and how it is taught. Although it is heavily influenced by the intended curriculum, the implemented curriculum is also determined, to a great extent, by a school's ethos and the personal characteristics of teachers who deliver the curriculum to students.
- *The attained curriculum* – characterises what part of the curriculum is actually learnt by the students. In conjunction with the implemented curriculum, the characteristics of individual students (including student ability, attitudes, interests and motivation) play a large part in shaping the attained curriculum.

TIMSS tests are developed to generate achievement data that are valid and reliable for their intended purpose. They include items that require students to select a response from a set of multiple choices and questions that require students to solve a problem and construct a response in an open-ended format. The mathematics items cover five content domains (number, algebra, measurement, geometry and data) and four cognitive domains (knowing facts and procedures, using concepts, solving routine problems and reasoning). The science items also cover five content domains (life science, chemistry, physics, earth science, and environmental science) and three cognitive domains (factual knowledge, conceptual understanding and reasoning and analysis).

Reporting results in TIMSS

Students' scores are reported on separate scales for science and mathematics. As results need to be comparable within and across countries and within and across assessments for accurate interpretation, the reporting metric for TIMSS was established by setting the average of the mean scores of the countries that participated in TIMSS 1995 at Year 8 level to 500 with a standard deviation of 100. To enable comparisons between 1995 and 2003 the TIMSS 2003 data was also placed on this scale.

Results can be reported as average scores (including a standard error) and as a percentage of those students who attain standards of student achievement that have been benchmarked on an international scale. These international benchmarks were developed by the IEA International Study Centre using scale anchoring techniques (see Thomson & Fleming, 2004b, for more detail on the techniques used in TIMSS), and help to explain student performance across countries. Internationally, it was decided that performance should be measured at four levels. These four levels summarise achievement at the:

- '*Advanced International Benchmark'* (which was set at 625). To attain this benchmark in mathematics, students are able to organise information, make generalisations, solve non-routine problems, and draw and justify conclusions from data. To attain the benchmark in science, students are able to demonstrate a grasp of some complex and abstract science concepts.
- *'High International Benchmark'* (which was set at 550). In mathematics, this required that students are able to apply their understanding and knowledge in a wide variety of relatively complex situations. In science, it required that students demonstrate conceptual understanding of some science cycles, systems and principles.
- *'Intermediate International Benchmark'* (which was set at 475). This benchmark was attained by students who were able to apply basic mathematical knowledge in straightforward situations, and by students in science who were able to recognise and communicate basic scientific knowledge across a range of topics.
- '*Low International Benchmark*' (which was set at 400). To achieve the lowest defined benchmark in mathematics, some basic mathematical knowledge was expected. This might include basic computations with whole numbers without a calculator, multiplication of two-place decimal numbers by three-place decimal numbers with calculators available, or reading

information from a line on a graph. To achieve the lowest benchmark in science, students were expected to be able to recognise some basic facts from the life and physical sciences. They would be expected to have some knowledge of the human body and heredity, and demonstrate familiarity with some everyday physical phenomena.

TIMSS IN AUSTRALIA

In Australia, the Australian Council for Educational Research (ACER) was responsible for managing the TIMSS 2003 project. This included project planning, collecting data from Australian schools, data analysis and the delivery of final reports. A National Advisory Committee, (including representatives from the Australian Government and each of the state and territory education authorities, subject matter experts, and representatives from the Catholic and independent school sectors, teachers' unions and the Indigenous community), oversaw the main aspects of the project.

Sampling design

The international sample design for TIMSS is referred to as a two-stage stratified cluster sample design. The first stage involves a random sample of schools, which in Australia was stratified by state and by sector (a school's status as government, independent or Catholic). The schools are selected with probability proportional to size. The second stage required sampling one classroom from the target year in each sampled school. In total, 364 secondary schools were originally selected for participation in TIMSS 2003. Of these 364 schools, 189 schools provided data for Indigenous students in Year 8. Teachers were also asked to administer the TIMSS questionnaires and tests to all students in the selected year level who identified as Aboriginal or Torres Strait Islanders, thus providing a larger sample of Indigenous students for reporting purposes.

Who were the participants?

The total Indigenous lower secondary cohort examined in this report is comprised of the 206 Indigenous Year 8 students selected as part of the random sample of classes, plus those Indigenous students who were in Year 8 at TIMSS-selected schools, but not within a TIMSS-selected class for testing. This included an extra 356 Indigenous students, bringing the total sample size to 562.

The proportions of Indigenous students sampled as part of the random sample comprise about 4 per cent of the whole sample at Year 8 level.

Students' backgrounds

Gender

As Table 1 illustrates, there were similar proportions of male and female students in the Indigenous and non-Indigenous samples. Overall, there were slightly fewer males than females sampled in Australia.

Table 1 Percentage of male and female students across Indigenous and non-Indigenous samples

Gender	Non-Indigenous	Indigenous	Total
Female	51	52	51
Male	49	48	49

Age

As displayed in Table 2, there was little difference in the average ages of Indigenous and non-Indigenous Year 8 students. As most schools have a policy on automatic promotion from grade to grade the ages should indeed be similar.

Table 2 Average age of Indigenous and non-Indigenous students in Year 8 samples

	Mean Age	Median Age
Indigenous	14.0 (0.15)	14.0
non-Indigenous	13.8 (0.01)	13.8

Note: Standard errors of the mean are shown in parentheses

Geolocation

In 2001, MCEETYA agreed to improve national reporting of student outcomes by geographic location, including incorporating the Accessibility/Remoteness Index of Australia (ARIA), as supported by the Australian Bureau of Statistics, into the MCEETYA classification of geographic location. The structure for classifying geographic location adopted by MCEETYA divides Australia into three broad zones: Metropolitan, Provincial and Remote. Almost two-thirds of all sampled students live in urban areas, but only half of the Indigenous students sampled do so. Almost one in five Indigenous students sampled for TIMSS 2003 live in what are classified as remote areas, compared with just one in 50 non-Indigenous students. These proportions are shown in Figure 2.

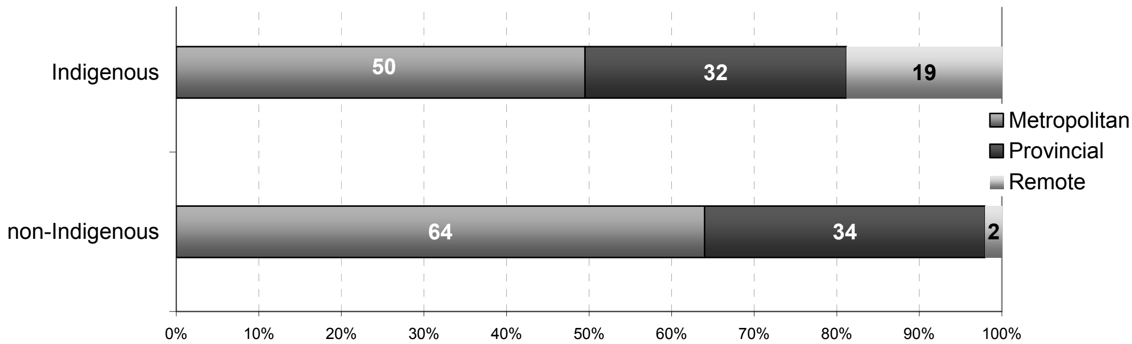

Figure 2 Distribution of Indigenous and non-Indigenous students by geographic location

In the next chapter, the mathematics and science achievement of Indigenous students in TIMSS 2003 is examined and compared with non-Indigenous achievement, using both mean scores and performance at international achievement benchmarks.

2. MATHEMATICS AND SCIENCE ACHIEVEMENT IN TIMSS 2003

This chapter examines mathematics and science achievement of Indigenous and non-Indigenous students in TIMSS 2003. There are two main ways in which achievement can be described – the first using the mean scores and the second using a measure of performance against internationally defined benchmarks. The first part of the chapter describes the mean scores for mathematics and science and situates both groups of Australian students internationally. Following this is a discussion about students' performance against benchmarks, achievement in each of the cognitive domains and changes between TIMSS 1995 and TIMSS 2003. Mathematics and science achievement is also described by gender and geographic location.

ACHIEVEMENT BY MEAN SCORES

Mathematics

The performance of Australia's non-Indigenous students compares well internationally and is significantly above the international mean for Year 8 mathematics. On the other hand, the performance of Australia's Indigenous students is significantly lower than the performance of non-Indigenous Australian students and significantly lower than the international mean.

On average, Australian Indigenous students scored 79 points (more than three-quarters of a standard deviation) lower than non-Indigenous Australian students in mathematics. The performance level of non-Indigenous students is comparable to the performance of students in highly-developed countries such as the United States of America, England, New Zealand and Scotland and Sweden, although the average age of Australian students is lower than the averages for each of these countries. Indigenous Year 8 students' performance is similar to students' performance in countries such as Macedonia, Jordan and Lebanon, and the average age of the Indigenous students is lower than that for most of these countries. Table 3 displays the international distribution of mathematics scale scores at Year 8.

Confidence Intervals and Standard Errors

In this report, student achievement is often described by a mean score. Each mean score is calculated from the sample of students who undertook the TIMSS assessments in Year 8, and is referred to as the *sample* mean. These sample means are an approximation of the actual mean score, known as the population mean, had *all* students in Year 8 actually sat the TIMSS assessments. Since the sample mean is just one point along the range of student achievement scores, more information is needed to gauge whether our 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 and accuracy as a population mean. Confidence intervals provide a range of scores within which we are 'confident' that the population mean actually lies. For example, in this report, estimates of population means are often presented with 95 per cent confidence intervals. These intervals reflect a 95 per cent chance that the estimation of a population mean lies within plus or minus 1.96 standard deviations of the sample mean (the standard deviation indicates how closely individual scores cluster around a mean score - generally 70% of all scores fall within one standard deviation of the mean).

However, the degree of variation around a mean is related to sample size. The larger a sample population, the more precise our confidence intervals and estimations of population means become. Due to the small number of Indigenous students sampled in TIMSS 2003 (although the extra sample of Indigenous students ameliorates these effects to some extent), the confidence intervals for the sample means for Indigenous students are much larger than those for non-Indigenous students. As a result, caution should be exercised when interpreting differences in mean scores between Indigenous and non-Indigenous students, and any trends in mean scores for Indigenous students across a number of variables.

Table 3 Distribution of mathematics achievement at Year 8

All Year 8 TIMSS 2003 countries	Mean scale score (se)	Average Age
Singapore	605 (3.6)	14.3
Korea, Rep. of †	589 (2.2)	14.6
Hong Kong, SAR	586 (3.3)	14.4
Chinese Taipei	585 (4.6)	14.2
Japan	570 (2.1)	14.4
Belgium (Flemish)	537 (2.8)	14.1
Netherlands	536 (3.8)	14.3
Estonia	531 (3.0)	15.2
Hungary	529 (3.2)	14.5
Malaysia	508 (4.1)	14.3
Latvia	508 (3.2)	15.0
Russian Federation	508 (3.7)	14.2
Slovak Republic	508 (3.3)	14.3
Non-Indigenous Australian students	***508 (4.5)***	***13.9***
Australia	**505 (4.9)**	**13.9**
United States	504 (3.3)	14.2
Lithuania	502 (2.5)	14.9
Sweden	499 (2.6)	14.9
Scotland	498 (3.7)	13.7
England	498 (4.7)	14.3
Israel	496 (3.4)	14.0
New Zealand	494 (5.3)	14.1
Slovenia	493 (2.2)	13.8
Italy	484 (3.2)	13.9
Armenia	478 (3.0)	14.9
Serbia & Montenegro	477 (2.6)	14.9
Bulgaria	476 (4.3)	14.9
Romania	475 (4.8)	15.0
International mean	**467 (0.5)**	**14.5**
Norway	461 (2.5)	13.8
Moldova, Rep. Of	460 (4.0)	14.9
Cyprus	459 (1.7)	13.8
Macedonia, Rep. Of	435 (3.5)	14.6
Lebanon	433 (3.1)	14.6
Indigenous Australian students	***429 (7.6)***	***14.0***
Jordan	424 (4.1)	13.9
Iran, Islamic Rep. of	411 (2.4)	14.4
Indonesia	411 (4.8)	14.5
Tunisia	410 (2.2)	14.8
Egypt	406 (3.5)	14.4
Bahrain	401 (1.7)	14.1
Palestinian National Authority	390 (3.1)	14.1
Chile	387 (3.3)	14.2
Morocco	387 (2.5)	15.2
Philippines	378 (5.2)	14.8
Botswana	366 (2.6)	15.1
Saudi Arabia	332 (4.6)	14.1
Ghana	276 (4.7)	15.5
South Africa	264 (5.5)	15.1

†Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.

( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

Science

As in mathematics, the performance of Australia's non-Indigenous students compares well internationally and is significantly above the international mean at Year 8 science. On the other hand, the performance of Australia's Indigenous students is significantly lower than the performance of non-Indigenous Australian students and significantly lower than the international mean.

On average, Australian Indigenous students scored 72 points (almost three-quarters of a standard deviation) lower than non-Indigenous Year 8 Australian students in science. Non-Indigenous Year 8 students' performance can again be compared to students' performance in countries such as United States of America, New Zealand, Netherlands and Sweden, and again the average age of the Australian students is lower than the average age for these countries. Indigenous Year 8 students' performance is similar to students' performance in countries such as Iran and Armenia, and their average age is at the lower end for this group of countries. The international distribution of science scale scores at Year 8 is displayed in Table 4.

Table 4 Distribution of science achievement at Year 8

All Year 8 TIMSS 2003 countries	Mean scale score (se)	Average Age
Singapore	578 (4.3)	14.3
Chinese Taipei	571 (3.5)	14.2
†Korea, Rep. of	558 (1.6)	14.6
Hong Kong, SAR	556 (3.0)	14.4
Estonia	552 (2.5)	15.2
Japan	552 (1.7)	14.4
England	550 (4.3)	14.3
Hungary	543 (2.8)	14.5
Netherlands	536 (3.1)	14.3
Non-Indigenous Australian students	***530 (3.7)***	***13.9***
United States	527 (3.1)	14.2
Australia	**527 (3.8)**	**13.9**
Sweden	524 (2.7)	14.9
Slovenia	520 (1.8)	13.8
New Zealand	519 (4.9)	14.1
Lithuania	519 (2.1)	14.9
Slovak Republic	517 (3.2)	14.3
Belgium (Flemish)	516 (2.5)	14.1
Russian Federation	514 (3.7)	14.2
Latvia	512 (2.6)	15.0
Scotland	512 (3.4)	13.7
Malaysia	510 (3.7)	14.3
Norway	494 (2.2)	13.8
Italy	491 (3.1)	13.9
Israel	488 (3.1)	14.0
Bulgaria	479 (5.2)	14.9
Jordan	475 (3.8)	13.9
International Mean	**474 (0.6)**	**14.5**
Moldova, Rep. of	472 (3.4)	14.9
Romania	470 (4.9)	15.0
Serbia and Montenegro	468 (2.5)	14.9
Armenia	461 (3.5)	14.9
Indigenous Australian students	***458 (7.0)***	***14.0***
Iran, Islamic Rep. of	453 (2.3)	14.4
Macedonia, Rep. of	449 (3.6)	14.6
Cyprus	441 (2.0)	13.8
Bahrain	438 (1.8)	14.1
Palestinian Nat'l Auth.	435 (3.2)	14.1
Egypt	421 (3.9)	14.4
Indonesia	420 (4.1)	14.5
Chile	413 (2.9)	14.2
Tunisia	404 (2.1)	14.8
Saudi Arabia	398 (4.0)	14.1
Morocco	394 (3.3)	15.2
Lebanon	393 (4.3)	14.6
Philippines	377 (5.8)	14.8
Botswana	365 (2.8)	15.1
Ghana	255 (5.9)	15.5
South Africa	244 (6.7)	15.1

†Korea tested the same cohort of students as other countries, but later in 2003, at the beginning of the next school year.
( ) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

CHANGES IN ACHIEVEMENT OVER TIME

Australian students' mathematics and science achievement in TIMSS 2003 can be compared to the results obtained eight years earlier in TIMSS 1995. In order to carry out these comparisons, the International Study Centre used Item Response Theory methodology to scale the 2003 results in relation to the 1995 scores.

Internationally, achievement levels in many countries increased between TIMSS 1995 and TIMSS 2003. Australia's performance in mathematics remained largely static and improved in science (Masters, 2005, Thomson & Fleming, 2004a; 2004b). This section of the report investigates whether the extent of educational disadvantage evident for Indigenous students in previous TIMSS studies has changed.

Mathematics

In TIMSS 1995 the difference in average mathematics achievement between Indigenous and non-Indigenous Year 8 students was 74 score points[3]. In 2003, the magnitude of this gap increased slightly to 79 score points. Unfortunately, the achievement levels of both Indigenous students and non-Indigenous students in mathematics, and hence the gap between Indigenous and non-Indigenous scores, has remained static in the eight years between TIMSS 1995 and TIMSS 2003, despite educational policy efforts to reduce the gap in educational outcomes. These results are displayed graphically in Figure 3[4].

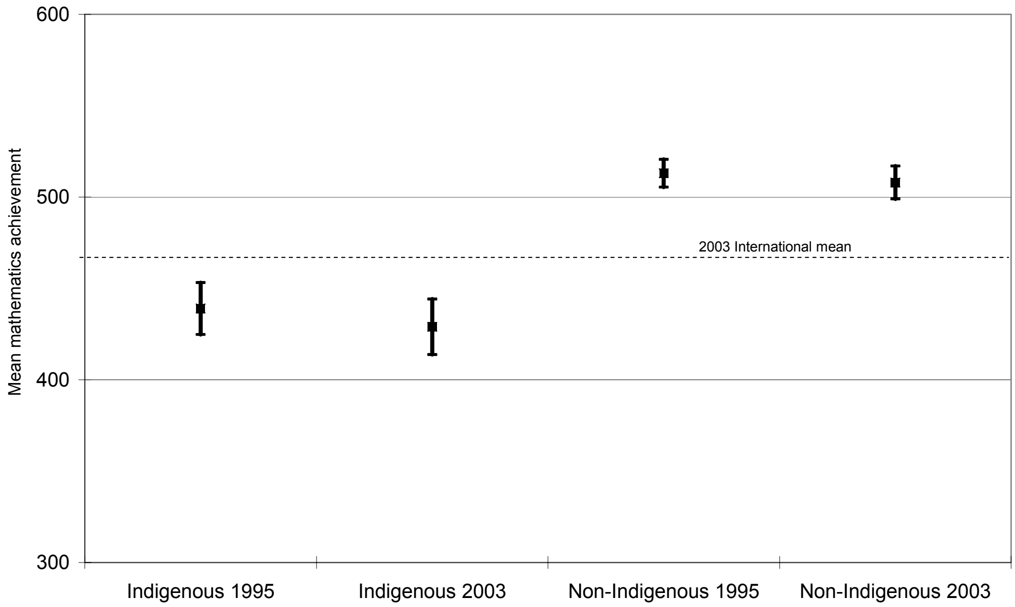

Figure 3 Mean mathematics achievement from TIMSS 1995 and TIMSS 2003 for Indigenous and non-Indigenous students

Science

In TIMSS 1995, Indigenous students' performance was 70 score points (0.70 of a standard deviation) lower than that of non-Indigenous students. The magnitude of this difference was around the same in the 2003 study, with Indigenous students' scores being 72 score points lower than non-Indigenous students' scores. Between 1995 and 2003 the science achievement scores for non-Indigenous students increased significantly; however while there was an increase of similar magnitude in scores for Indigenous students, the difference in the Indigenous mean score between TIMSS 1995 and TIMSS 2003 was not found to be statistically significant. The results for science achievement are displayed graphically in Figure 4.

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3 The means for students from TIMSS 1995 differ from those published in Lokan, Ford and Greenwood (1996). The scores for TIMSS 1995 were rescaled in 1999 using a 3-parameter psychometric model in place of the 1-parameter model initially used.

4 For reference, data underlying all figures presented in this report are included in Appendix A.

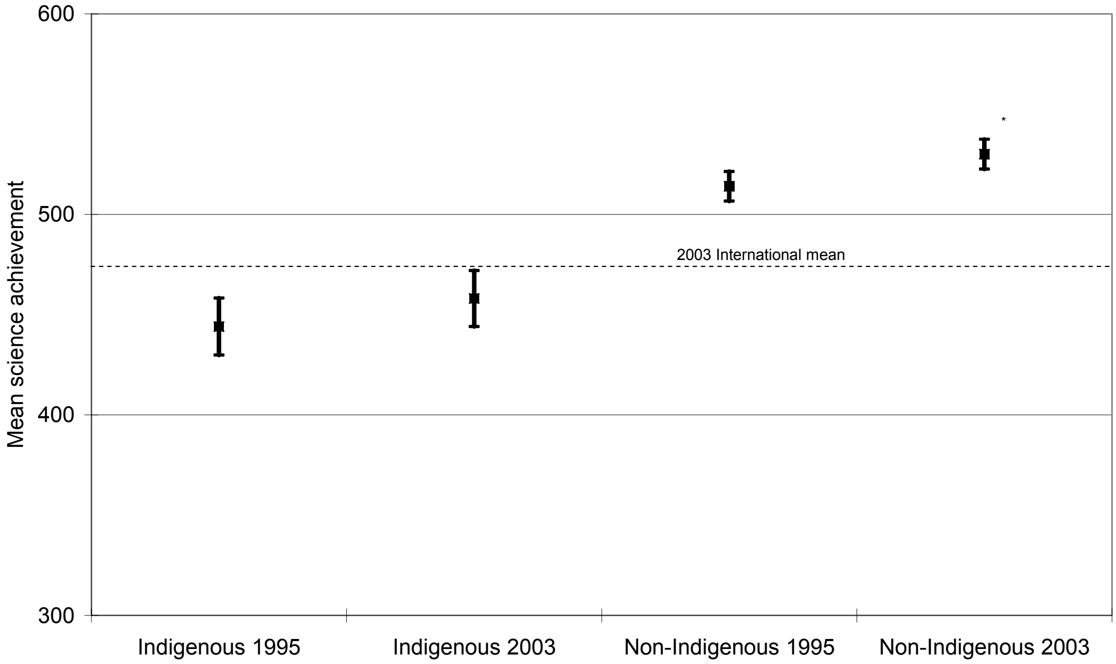

Figure 4 Mean science achievement from TIMSS 1995 to TIMSS 2003 for Indigenous and non-Indigenous students

PERFORMANCE AGAINST INTERNATIONAL BENCHMARKS

While the mean scores give a summary measure of students' achievement levels in a country, it is important that other measures are provided that give meaningful descriptions of what performance on the scale could mean in terms of the mathematics and science that students know and can do. In order to do this, points on each of the mathematics and science scales were identified to use as international benchmarks. Selected to represent the range of performance shown by students internationally, the advanced benchmark was set at 625, the high benchmark at 550, the intermediate benchmark at 475 and the low benchmark at 400. For the purposes of the figures presented in this report, the proportion of students not achieving at the low international benchmark is also included.

Australia's non-Indigenous Year 8 students performed well against the four international benchmarks in science and mathematics. In comparison, the performance of Australia's Indigenous students is of concern, with a large proportion of students not displaying even the most basic mathematical and scientific knowledge tested in TIMSS.

Mathematics

Figure 5 shows the proportion of Indigenous and non-Indigenous Australian students achieving at each of the benchmarks in mathematics, as well as the international proportions for comparison. The proportion of students achieving at the highest international benchmark is of interest, identifying as it does the highest performing students in each group. Seven per cent of non-Indigenous students but less than 1 per cent of Indigenous students achieved at this highest level. The proportion of Australian students overall achieving this benchmark is about the same as the international average, and similar to the proportion of students in the US, but does not compare favourably to the 44 per cent of Singaporean students who achieved at this level.

At the lowest levels, 37 per cent of Indigenous students and 9 per cent of non-Indigenous students did not meet the requirements for the lowest international benchmark.

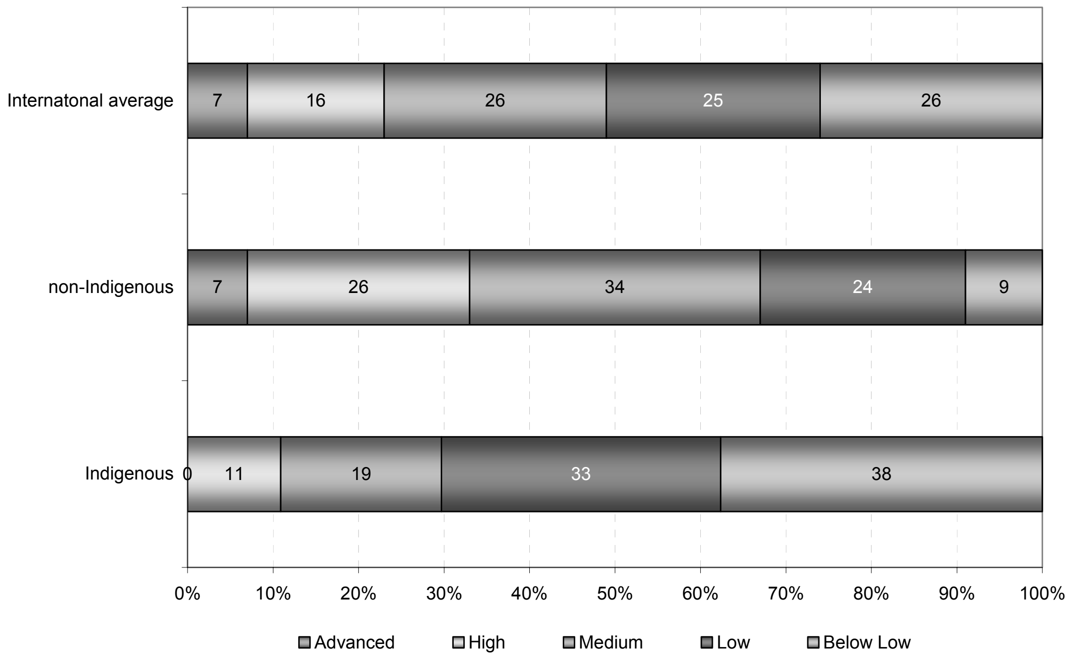

Figure 5 Proportion of Year 8 Australian Indigenous and non-Indigenous students reaching international benchmarks in mathematics

Trends in performance against benchmarks

Figure 6 compares Australian students' performance at the international benchmarks in mathematics for TIMSS 2003 and the performance of students in TIMSS 1995 against the same benchmarks.

The previous section described mathematics achievement as not changing between TIMSS 1995 and TIMSS 2003 for either group of students. There has also been little change in the proportions of students achieving each of the benchmarks. Although there were some slight changes in the distributions, none of the changes are significant.

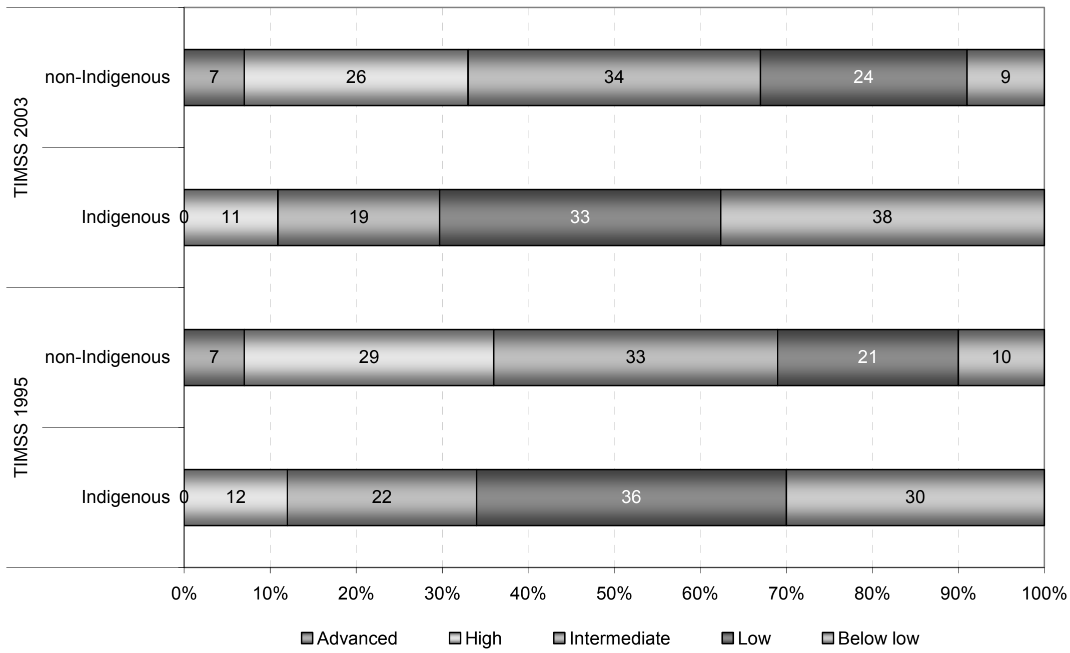

Figure 6 Performance at the Year 8 mathematics international benchmarks for Indigenous and non-Indigenous students, TIMSS 1995 and TIMSS 2003

Science

Figure 7 shows the proportion of Australian Indigenous and non-Indigenous students reaching each of the international benchmarks in science, as well as the international averages for comparison. The proportion of students achieving the advanced benchmark in science was similar to the proportion in mathematics for non-Indigenous students, but slightly better for Indigenous students, roughly 2 per cent of whom achieved this highest level. The proportion of non-Indigenous students achieving the advanced benchmark was around the same as the proportion at this level in the United States but, as was the case for mathematics, the proportion was well below that of high-performing Asian countries, such as Singapore, where 33 per cent achieved this level in science.

One-fifth of Indigenous students did not reach the lowest benchmark in science. This is five times the proportion of non-Indigenous students who did not reach this benchmark.

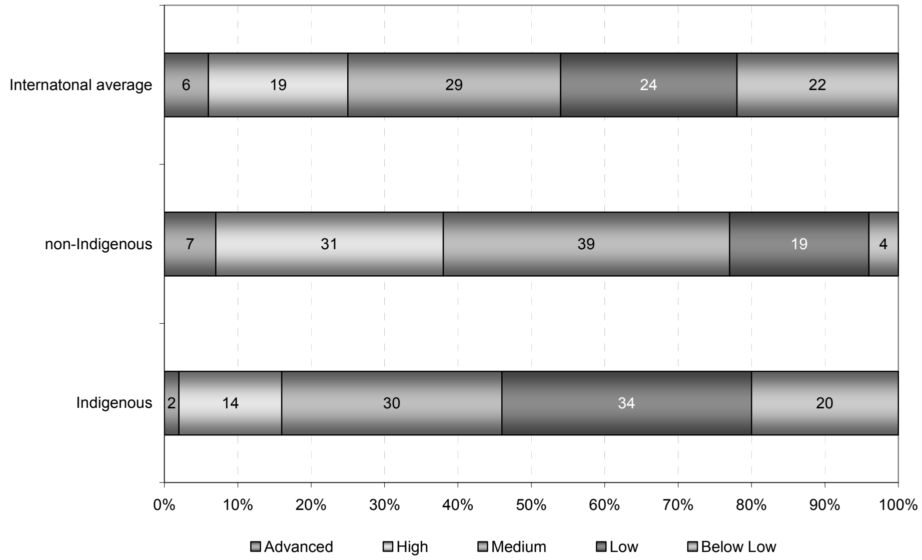

Figure 7 Proportion of Year 8 Australian Indigenous and non-Indigenous students reaching international benchmarks in science

Figure 8 shows the performance of Australian students' at the international benchmarks in science for TIMSS 2003 compared with that of students in TIMSS 1995 against the same benchmarks. As with mathematics, there have been few changes over the eight years.

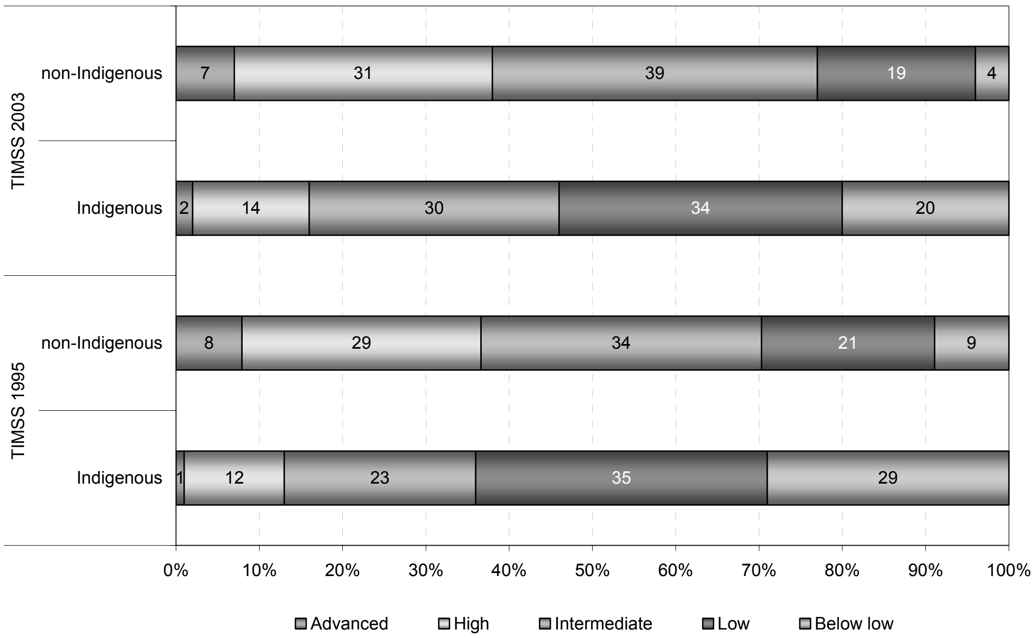

Figure 8 Performance at the Year 8 science international benchmarks for Indigenous and non-Indigenous students, TIMSS 1995 and TIMSS 2003

ACHIEVEMENT IN THE MATHEMATICS AND SCIENCE CONTENT DOMAINS

The mathematics and science assessments for TIMSS 2003 were organised around two dimensions: a content dimension and a cognitive dimension. Within each of these dimensions are more specific domains. The content domains for mathematics and science, which are discussed in this section of the report, define the specific subject matter covered by the TIMSS assessment.

The mathematics content dimension for the Year 8 assessment is comprised of five content domains: *number, algebra, measurement, geometry* and *data*. For each of these domains the mathematics framework identifies several topic areas to be included in the assessment. For example number is further categorised by whole numbers, fractions and decimals, integers and ratios, proportion and percentages. Table 5 shows the mathematics content domains.

Table 5 Mathematics content domains, TIMSS 2003, Year 8

Mathematics content domain	Topics
Number	Whole numbers Fractions and decimals Integers Ratios, proportion and percent
Algebra	Patterns Algebraic expressions Equations and formulas Relationships
Measurement	Attributes and units Tools, techniques and formulas
Geometry	Lines and angles Two- and three-dimensional shapes Congruence and similarity Locations and spatial relationships Symmetry and transformations
Data	Data collection and organisation Data representation Data interpretation Uncertainty and probability

Figure 9 shows the mean scores (and 95% confidence intervals) for Year 8 student achievement across the mathematics content domains. This figure shows that achievement levels for non-Indigenous students were significantly above the international mean in each of the content areas. The scores for Indigenous students were significantly lower than the international mean in all content areas other than in data.

The patterns of achievement across the mathematics content domain areas were very similar for Indigenous and non-Indigenous students in Australian schools in terms of the apparent strengths and weaknesses of students and the difference in scores between non-Indigenous and Indigenous students. For both groups of students, data is the strongest content area, and Indigenous students' achievement was similar to the international average in this area. The weakest content area is that of geometry.

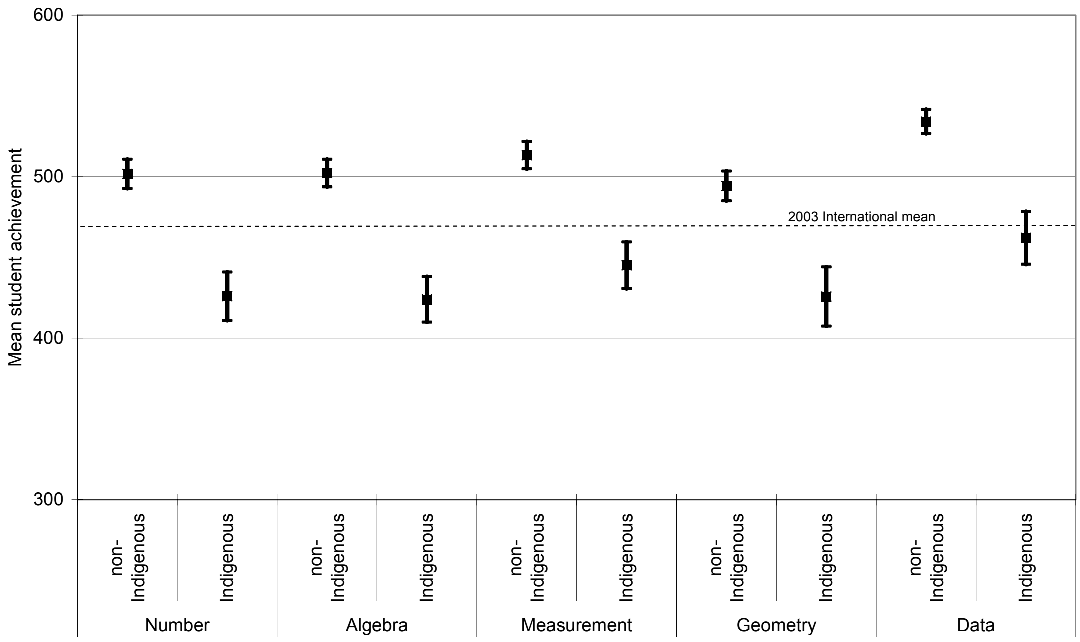

Figure 9 Mean achievement (and 95% confidence intervals) across mathematics content domains for Year 8 Indigenous and non-Indigenous students

The science content dimension for the Year 8 assessment is also comprised of five content domains: *life science, chemistry, physics, earth science* and *environmental science*. As with the mathematics content domains, for each of these domains the science framework identifies several topic areas to be included in the assessment. Table 6 shows the science content domains.

Table 6 Science content domains, TIMSS 2003, Year 8

Science content domain	Topics
Life science	Types, characteristics and classification of living things
	Structure, function and life processes in organisms
	Cells and their functions
	Development and life cycles of organisms
	Reproduction and heredity
	Diversity, adaptation and natural selection
	Ecosystems
	Human health
Physical Sciences	
Chemistry	Classification and composition of matter
	Particulate structure of matter
	Properties and used of water
	Acids and bases
	Chemical change
Physics	Physical states and changes in matter
	Energy types, sources and conversions
	Heat and temperature
	Light
	Sound and vibration
	Electricity and magnetism
	Forces and motion
Earth Science	Earth's structure and physical features
	Earth's processes, cycles and history
	Earth in the solar system and the universe
Environmental science	Changes in population
	Use and conservation of natural resources
	Changes in environments

Figure 10 shows the mean scores (and 95% confidence intervals) for Year 8 student achievement across the science content domains. This figure shows that achievement levels for non-Indigenous students were significantly above the international mean in each of the content areas. The scores for Indigenous students were statistically the same as the international mean in all content areas other than in chemistry. Achievement levels in science were more consistent than in mathematics; it was only in chemistry that achievement levels appeared to be poorer for Australian students. Indigenous students achieved at a level similar to the international mean in all other content areas.

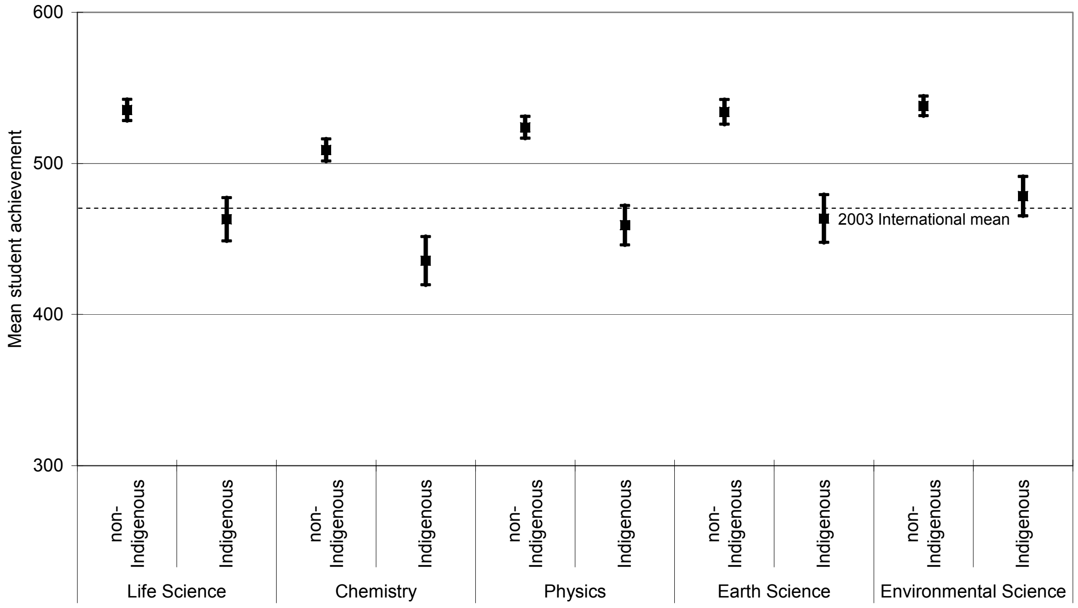

Figure 10 Mean achievement (and 95% confidence intervals) across science content domains for Year 8 Indigenous and non-Indigenous students

The fact that Indigenous and non-Indigenous students had the same strengths and weaknesses across the mathematics and science domain areas, albeit at different performance levels, indicates that the differences in student performance across the domain area (i.e. mathematics and science) may reflect differences between the Australian curriculum and the TIMSS assessment framework or differences in interests and attitudes between Indigenous and non-Indigenous Australian students, rather than differences within Australian schools in teaching to Indigenous and non-Indigenous students.

ACHIEVEMENT IN THE MATHEMATICS COGNITIVE DOMAINS

The reporting for TIMSS 2003 included for the first time, measures on the mathematics cognitive domains. These results were released in a separate international TIMSS 2003 Report in 2006. At the time of writing, development of science cognitive scales was being undertaken by the International Study Centre but was not complete.

To respond correctly to the TIMSS mathematics test items in the 2003 assessment, students needed to be familiar with the mathematics content of the items as discussed in the previous section, and just as importantly, items were also designed to elicit the use of particular cognitive skills. Three cognitive domains were defined in the TIMSS Assessment Frameworks and Specifications (Mullis et al., 2003) – *knowing facts, procedures and concepts*; *applying knowledge and conceptual understanding*; and *reasoning*. These are detailed in Table 7.

The first domain, *knowing facts, procedures and concepts*, covers what the student needs to know, while the second, *applying knowledge and conceptual understanding*, focuses on the ability of the student to apply what he or she knows to solve routine problems or answer questions. The third domain, *reasoning*, goes beyond the solution of routine problems and simple recall of facts to encompass unfamiliar situations, complex contexts, and multi-step problems. Whilst there is not a definitive hierarchy, it is fairly clear that one builds on the other. For more detailed descriptions of the cognitive domains, readers are directed to Thomson (2006).

Table 7 Mathematics cognitive domains, TIMSS 2003

Mathematics cognitive domain	Behaviours
Knowing facts, procedures and concepts	Recall Recognise Compute Retrieve Measure Classify/Order
Applying knowledge and conceptual understanding	Select Represent Model Implement Solve routine problems
Reasoning	Analyse Generalise Synthesise/Integrate Justify Solve non-routine problems

Figure 11 shows Indigenous and non-Indigenous students' performance on the mathematics cognitive domains. Non-Indigenous students scored at a level higher than the international mean in all cognitive domains; however Indigenous students' scores were significantly below those of other Australian students and significantly lower than the international mean other than in the domain of reasoning. This is of some interest, as many of the skills required to score well in this area are higher order skills, such as the capacity for logical, systematic thinking, and intuitive and inductive reasoning. Non-Indigenous students also performed better in this cognitive area, so it may be that a focus on the development of these skills is characteristic of mathematics teaching in Australia.

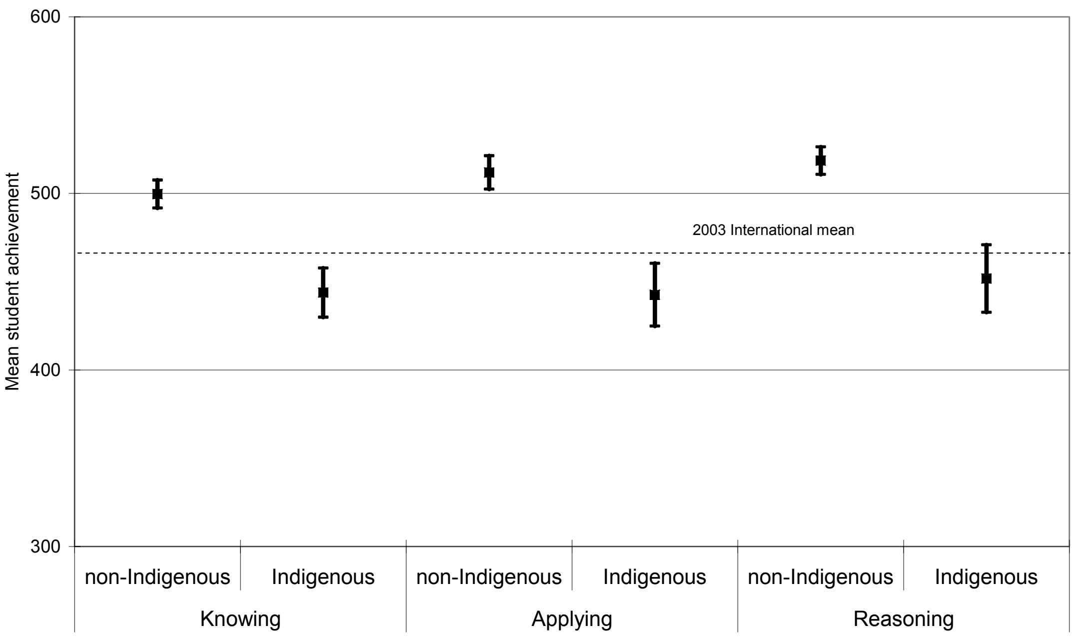

Figure 11 Mean achievement (and 95% confidence intervals) across mathematics cognitive domains for Year 8 Indigenous and non-Indigenous students

GENDER DIFFERENCES IN MATHEMATICS AND SCIENCE ACHIEVEMENT

Internationally and for Australia as a whole, on average, there was no significant difference between the achievement levels of males and females in mathematics. Table 8 provides the means and standard errors for Indigenous and non-Indigenous students by gender for TIMSS 2003.

Table 8 Mean achievement in mathematics and science, TIMSS 2003, by gender

		Non-Indigenous	Indigenous
Mathematics	Female	502 (5.6)	415 (10.5)
	Male	514 (5.7)	445 (11.7)
Science	Female	520 (4.5)	442 (10.6)
	Male	540 (4.7)	477 (8.6)

On average internationally, males scored a significant six scale points higher than females in science. In Australia, the gender difference was larger for both Indigenous students and non-Indigenous students. On average, non-Indigenous males scored significantly higher (20 scale points) than non-Indigenous females, and Indigenous males scored 35 scale points higher than Indigenous females. While the latter difference is very large it is not statistically significant due to the large standard errors in the Indigenous sample.

Achievement at the international benchmarks in mathematics and science by gender

The performance of Indigenous and non-Indigenous students can also be compared by gender using the international benchmarks. As can be seen in Figure 12, this comparison highlights some very severe problems in the performance of Indigenous students, females in particular. Fewer than 1 per cent of Indigenous female students reached the advanced benchmark in mathematics, over three-quarters did not achieve higher than the low benchmarks and nearly half of Indigenous female students failed to reach even the lowest benchmark. Indigenous male students' achievement is also of concern, with only 1 per cent achieving at the advanced benchmark, nearly two-thirds not achieving higher than the low benchmarks and just under one-third of Indigenous male students failing to meet the standards of the lowest benchmark.

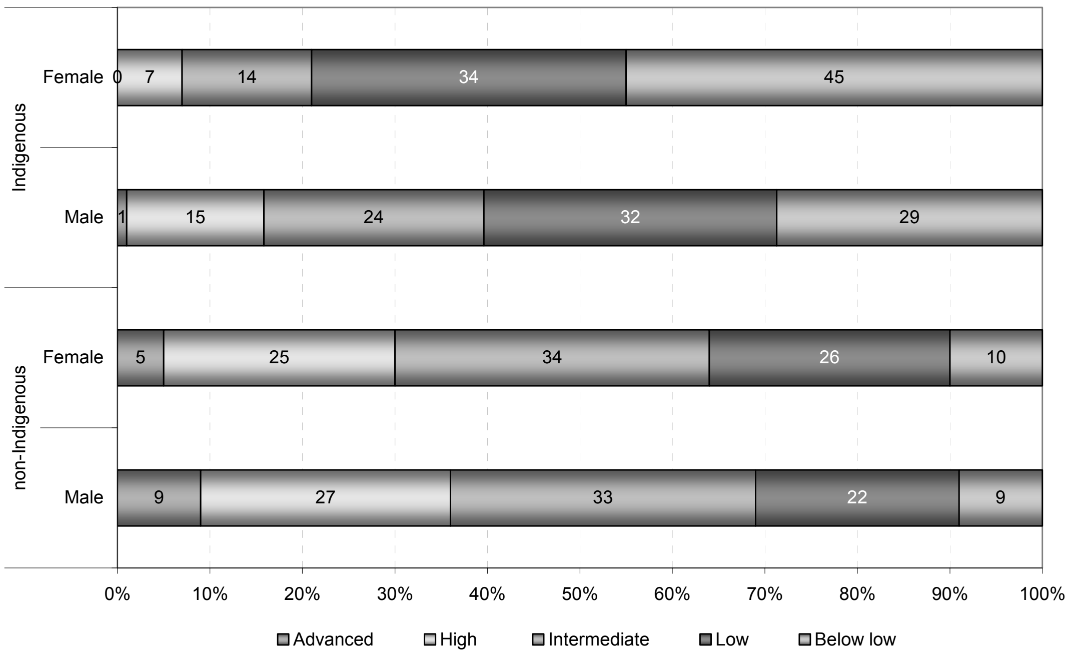

Figure 12 Percentage of Indigenous and Non-Indigenous students achieving at each international benchmark for mathematics by gender

The achievement of female Indigenous students across the international benchmarks for science is shown in Figure 13. This paints a similarly gloomy picture. Fewer than 1 per cent of Year 8 female Indigenous students reached the advanced level of achievement in science. More than 60 per cent of Indigenous female students did not achieve above the low benchmarks, with around a third of Indigenous female students failing to reach the lowest benchmark. For male Indigenous students, 4 per cent reached the advanced benchmark in science, but nearly half failed to achieve beyond the low benchmarks. Almost one in five male Indigenous students was unable to meet the lowest standard of the science benchmark.

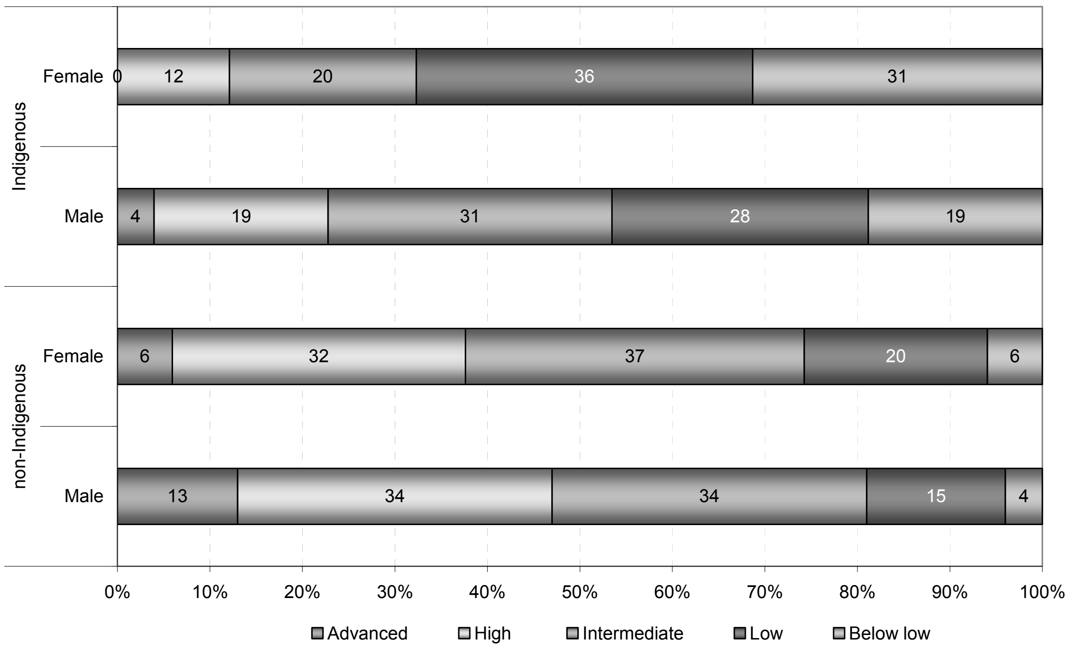

Figure 13 Percentage of Indigenous and Non-Indigenous students achieving at each international benchmark for science by gender

GEOGRAPHIC DIFFERENCES BETWEEN INDIGENOUS AND NON-INDIGENOUS STUDENTS

Classifying students according to the geographic location of the schools they attend is another way to examine Indigenous student achievement. According to Ainley (1994), the differences between Indigenous and non-Indigenous student achievement are smaller in metropolitan areas than in rural and (especially) remote locations. Each school involved in TIMSS 2003 was classified according to the Ministerial Council on Education, Employment, Training and Youth Affairs' Schools Geographic Location Classification. For the analyses in this report, only the broadest categories are used:

- Metropolitan – including mainland state capital cities and major urban districts with population of 1,000,000 or more (eg. Queanbeyan, Cairns, Geelong, Hobart);
- Provincial – including provincial cities and other non-remote provincial areas (eg Darwin, Ballarat, Bundaberg, Geraldton, Tamworth);
- Remote – Remote and very remote areas.

Figure 2 showed the distribution of Indigenous and non-Indigenous students by geolocation. Almost all non-Indigenous students lived in metropolitan and provincial areas; by contrast almost 20 per cent of Indigenous students (compared to 2 per cent of non-Indigenous) lived in areas classified as remote. Figure 14 and Figure 15 show the relationship between the geographic locations of Indigenous and non-Indigenous students' schools and their mathematics and science achievement respectively.

There were no significant differences in Indigenous students' performance in mathematics and science across the three geographic locations. However, when Indigenous students' results in metropolitan and provincial schools are combined, performance in these non-remote locations is significantly higher than that of Indigenous students in remote schools. As discussed by Ainley (1994) these figures may reflect the disadvantage associated with limited access to educational services in remote locations. Moreover, Indigenous students living in more remote communities may be faced with a conflict of values between a Western educational system and the more traditional aspirations of an Indigenous community (Ainley, 1994).

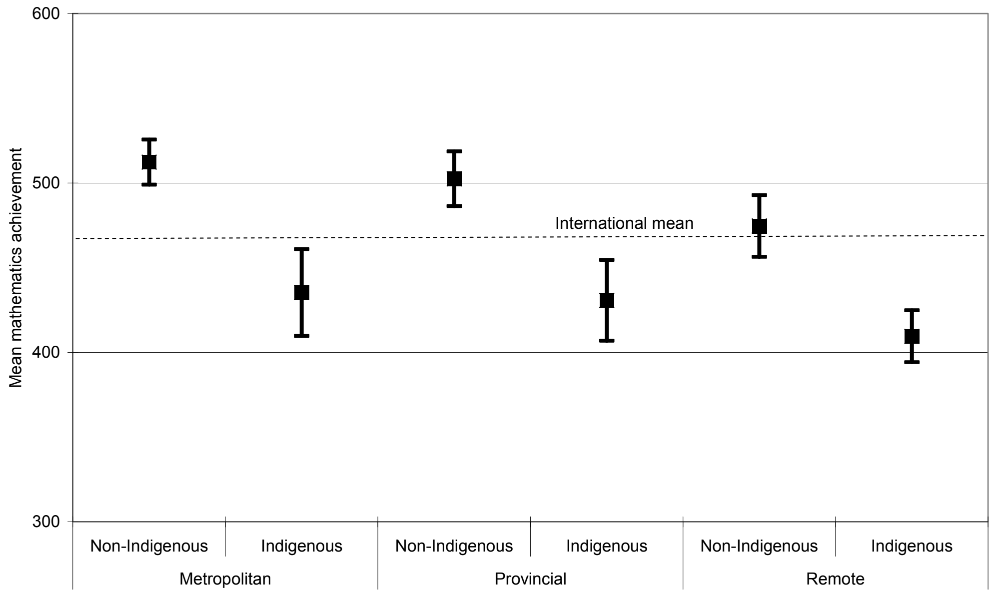

Figure 14 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by school geographic location

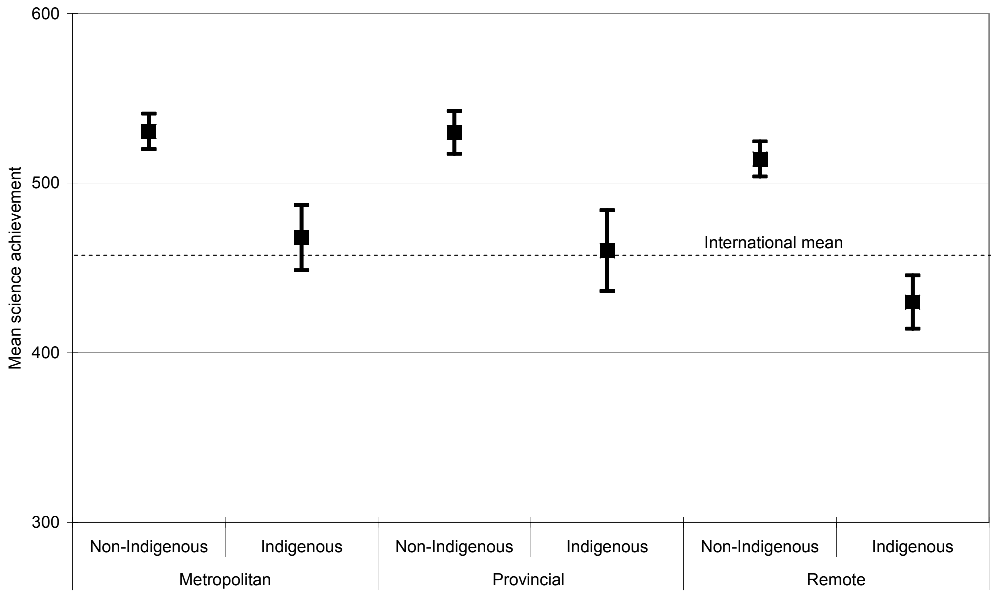

Figure 15 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by school geographic location

Figure 14 and Figure 15 illustrate that in mathematics and science, non-Indigenous students consistently achieve at a level that is significantly higher than Indigenous students within metropolitan, provincial and remotely located schools. Of these differences, the greatest apparent discrepancy between Indigenous and non-Indigenous student achievement in mathematics is in metropolitan schools, where the difference is a little more than three-quarters of a standard deviation, and in science in remote schools, where the difference is more than three-quarters of a standard deviation, as shown in Table 9. While these data need to be replicated on a larger scale, it could be that the differences found in mathematics and science, as noted by Ainley, could reflect greater disparities in mathematics than science. It should be borne in mind that only 2 per cent of non-Indigenous students attend remote schools, so it is difficult to draw many conclusions from these data about the extent of disadvantage by geographic location. More research needs to be carried out with a focus on the needs of students in remote educational settings.

Table 9 Differences between Indigenous and non-Indigenous student achievement in mathematics and science by school geographic location (scale score points)

	Mathematics			Science		
	Metropolitan	Provincial	Remote	Metropolitan	Provincial	Remote
Difference between Indigenous and non-Indigenous student achievement	77	72	65	63	70	85

This chapter has examined the achievement levels of Indigenous students – by mean scores and by benchmarks, by gender and geographic location. It also examined changes between TIMSS 1995 and TIMSS 2003. The next chapter examines some of the influences on students' achievement.

3. STUDENT CHARACTERISTICS, ATTITUDES AND ACHIEVEMENT

International and national reports based on TIMSS 2003 data have found that student achievement in mathematics and science is related to a number of student characteristics and attitudes (Martin *et al.*, 2004; Mullis *et al.,* 2004; Thomson & Fleming, 2004a, 2004b). Multilevel modelling carried out on the whole cohort for the Australian national reports found that the key factors (apart from Indigenous status) that were significant predictors of student achievement in mathematics and science were:

- Gender
- Language background
- Educational resources
- Books in the home
- Parental education
- Self-confidence
- Valuing mathematics/science
- Aspirations to higher education. (Thomson& Fleming, 2004a, 2004b)

This chapter explores these characteristics and attitudes in depth and examines their relationship with achievement.

STUDENT CHARACTERISTICS

There are a number of characteristics investigated by the TIMSS student questionnaire. These characteristics include student's language background, level of parental education and access to educational aids and resources, such as a computer or a quiet place for study/homework.

Effects of language background

International results from TIMSS 2003 showed that Year 8 students from homes where the language of the test was *always* or *almost always* spoken generally had higher average achievement (across all content areas) than those who spoke it less frequently (Mullis *et al.*, 2004). Australia's national results did not consistently reflect this trend. For mathematics, those students who spoke English at home always or almost always performed 29 scale points lower than those who spoke English in the home less frequently (average 532 scale points). In science, only a marginal difference was observed between these same groups of students. This section of the report provides a more detailed analysis of the relationship between the frequency of English spoken in the home with mathematics and science achievement for Indigenous students.

Previous research has highlighted the difficulties encountered by Indigenous Australian students who do not speak English in the home, finding that Indigenous students who did not speak standard Australian English in the home have lower school attendance (Purdie *et al.*, 2000) and also lower educational achievement than those who speak standard Australian English in the home (Frigo *et al.*, 2003). Twelve per cent of Australia's Indigenous students in TIMSS 2003 reported that they did not usually speak English in the home.

Mathematics achievement

Findings described in Chapter 2 of this report show a large discrepancy in achievement between Indigenous students and non-Indigenous students regardless of language spoken at home.

As can be seen in Figure 16, there is a slightly positive relationship between frequency of speaking English in the home and mathematics achievement for Indigenous students, in contrast to the more negative relationship found for non-Indigenous students. Indigenous students who spoke English more frequently in the home performed, on average, 27 score points higher than their Indigenous counterparts who did not speak English frequently. Indigenous students who did not speak English frequently scored one full standard deviation (100 score points) in mathematics lower than non-Indigenous students who speak English frequently in the home.

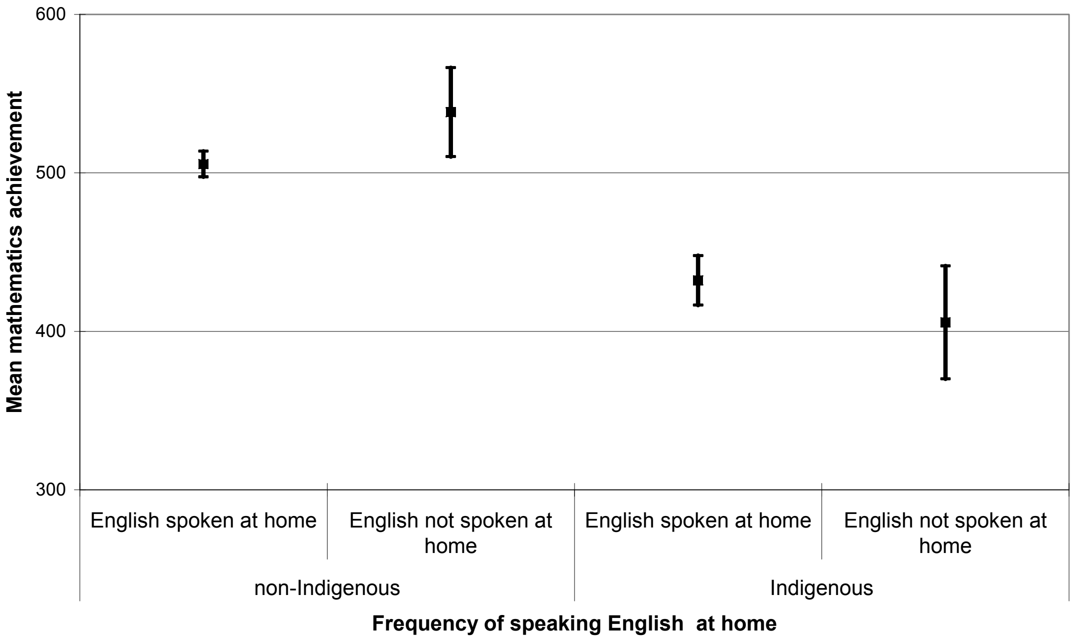

Figure 16 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students, by frequency of English spoken at home

Science achievement

Figure 17 shows that the relationship between language at home and achievement in science is similar to that seen for mathematics. Indigenous students who spoke English at home most of the time scored, on average, almost 50 scale points higher in science than those who did not, and this difference is significant. Indigenous students who did not speak English frequently scored more than one standard deviation (114 score points) in science lower than non-Indigenous students who speak English frequently in the home.

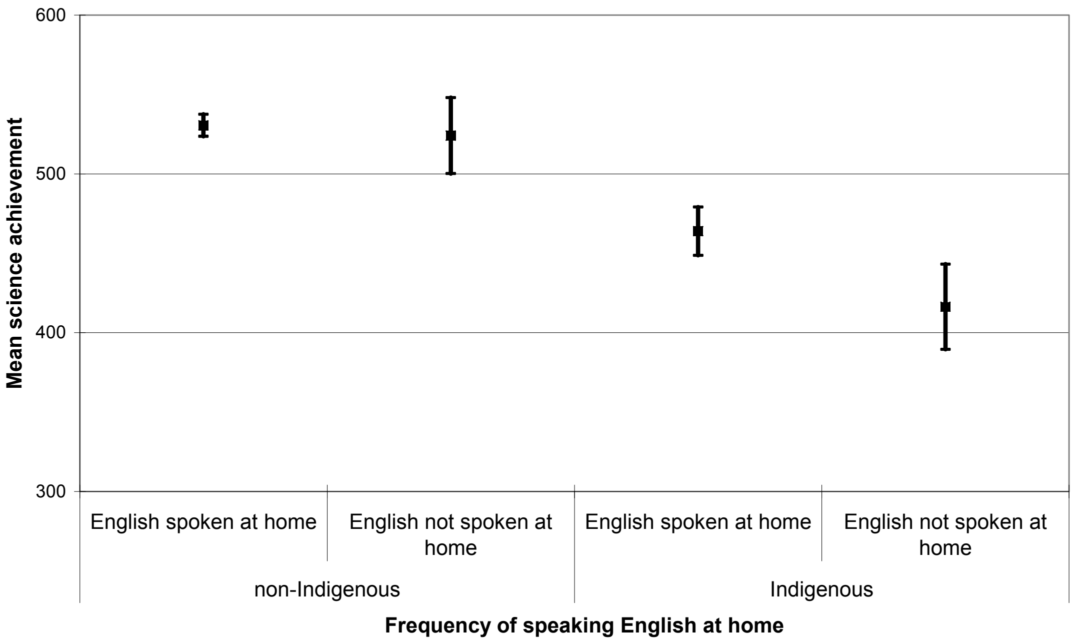

Figure 17 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students, by frequency of English spoken in the home

The relationship between extent of English spoken at home and achievement is likely to be mediated by factors such as the student's socioeconomic status and the value placed upon educational outcomes by members of the student's family and community. For Australian Indigenous students it is likely that speaking English infrequently in the home is a sign of living a more traditional lifestyle, and perhaps greater marginalisation from mainstream society.

For non-Indigenous students, students with a language background other than English are mostly immersed in an Australian culture at school, and thus English is the language of instruction. In Indigenous communities this may not be the case. As well, the curricula on which the TIMSS tests are based, are the distillation of curricula from the 60 participating countries, and whilst there is no "Indigenous curriculum", there is an absence of the tradition in mathematics and science that is historically part of western or eastern societies. Thus non-Indigenous students have the benefit of some familiarity with the content of the tests that Indigenous students in remote or traditional communities might not have.

Educational resources in the home

Previous TIMSS results have also shown that students from homes with extensive educational resources have higher achievement in mathematics and science than those students from home environments with lower levels of resources (Martin *et al.*, 2004; Mullis *et al.*, 2004; Thomson & Fleming, 2004a, 2004b). The following section of this report presents an analysis of the way other factors, such as the number of books, possession of a study desk and computer in the home and access to resources, affect Indigenous achievement in mathematics and science.

Number of books in the home

On an international and national level, the number of books in the home (as a proxy measure of socioeconomic status) has been found to relate positively to student achievement in both mathematics and science (Martin *et al.*, 2004; Mullis *et al.*, 2004; Thomson & Fleming, 2004a; Thomson & Fleming 2004b). In the TIMSS questionnaire students are asked to report on the approximate number of books in their homes, other than school books.

Table 10 shows the proportion of Indigenous and non-Indigenous students reporting each category of books in the home. Almost one-third of non-Indigenous students reported more than 200 books in their home, compared to half this proportion for Indigenous students. At the opposite end of the scale, a similar proportion of Indigenous students (16%) reported having none or very few books in the home, compared with only 5 per cent of non-Indigenous students.

Table 10 Books in the home for Indigenous and non-Indigenous students

	None or very few (0-10 books)	**One shelf** (11-25 books)	**One bookcase** (26-100 books)	**Two bookcases** (101-200 books)	**Three or more bookcases** (>200 books)
Non-Indigenous	5%	11%	30%	23%	31%
Indigenous	16%	24%	31%	15%	15%

On average, students from homes with extensive literary resources achieved at a significantly higher level in both mathematics and science in comparison to those students with few books. Table 11 provides the means and standard errors for Indigenous and non-Indigenous students, in mathematics and science, for each of the books in the home categories. This table shows that the achievement levels for both groups of students, in both mathematics and science, increase for each level of additional books in the home.

Table 11 Mathematics and science achievement for Indigenous and non-Indigenous students by number of books in the home

Number of Books	Mathematics				Science			
	non-Indigenous		Indigenous		non-Indigenous		Indigenous	
	Mean	se	Mean	se	Mean	se	Mean	se
None or very few (0-10 books)	452	8.3	405	14.9	473	6.9	421	11.3
One shelf (11-25 books)	485	6.2	416	12.7	501	4.9	448	8.2
One bookcase (26-100 books)	503	5.0	437	11.1	520	4.0	462	10.7
Two bookcases (101-200 books)	518	4.0	459	14.5	546	3.2	493	16.8
Three or more bookcases (>200 books)	530	4.2	462	15.1	559	3.5	505	19.7

For the purposes of these analyses, the number of books in the home was collapsed into two categories – less than 100 books and more than 100 books – with about half of the Indigenous students into each category. Collapsing categories in this way means that sample sizes in each category are larger, making standard errors (or level of uncertainty) smaller, and so more accurate comparisons can be made. Figure 18 presents achievement levels in mathematics and Figure 19 in science for students with up to 100 books and students with more than 100 books in the home.

Significant differences can be seen between students in the two groups, for both Indigenous and non-Indigenous students, in both mathematics and science. For Indigenous students, those with low levels of books in the home have achievement levels significantly lower than the international mean. Higher level of books in the home has a booster effect to the extent that their achievement levels are not significantly different to the international mean.

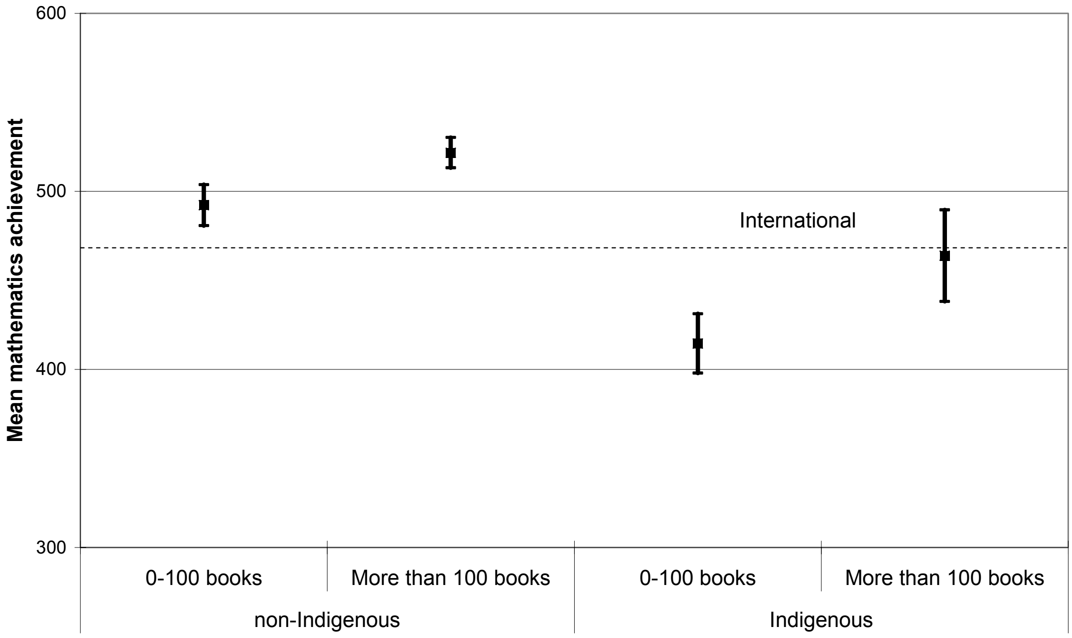

Figure 18 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by the number of books in the home

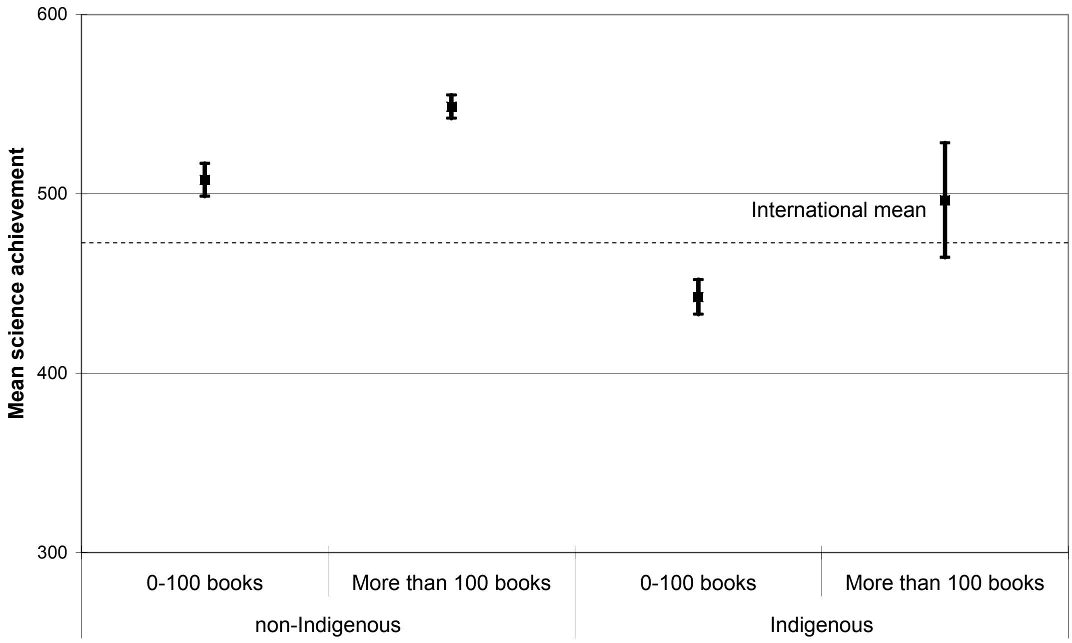

Figure 19 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by the number of books in the home

Educational possessions in the home

In addition to literary resources such as books, TIMSS has found that having study aids such as a computer, study desk or table, a calculator and a dictionary was also associated with higher student achievement. Table 12 shows the percentage of Indigenous and non-Indigenous students who reported having a computer, study desk, calculator and dictionary in the home. It is clear from this table that Indigenous students have significantly less access to educational resources than non-Indigenous counterparts. For example, overall, Australian students report one of the highest proportions of computer ownership in TIMSS, with 96 per cent reporting that they have a computer in the home. Of Indigenous students, however, a little more than three-quarters (78%) of Indigenous students reported having a computer in the home. The largest discrepancies appear to be in the proportion that have a computer and the proportion that have a study desk. It could be argued that having access to a computer at home is the most critical of these to student achievement in a digital age. Also of importance is a place of their own for students to work and only three-quarters of Indigenous students have such a space.

Table 12 Percentage of Indigenous and non-Indigenous students who report having a calculator, computer, study desk and dictionary in the home

Educational item in the home	non-Indigenous	Indigenous	International mean
Calculator	99 (0.2)	91 (3.0)	*
Computer	96 (0.3)	78 (2.7)	60 (0.2)
Study desk	92 (0.4)	77 (3.5)	83 (0.1)
Dictionary	98 (0.3)	89 (2.7)	*

Note: * question was not asked in all participating countries in TIMSS 2003

Table 13 provides details of achievement levels in mathematics and science by whether students have a computer or a study desk in their homes. In both cases, Indigenous (and non-Indigenous) students who have the particular item significantly outperform those students who do not have the item in the home. Having either a computer or a study desk meant that achievement levels for Indigenous students in science were not significantly different to the international mean, but this was not the case in mathematics.

Table 13 Achievement levels in mathematics and science by educational items in the home

Educational item	Mathematics achievement				Science achievement			
	Yes		*No*		*Yes*		*No*	
	Mean	se	Mean	se	Mean	se	Mean	se
Computer								
non-Indigenous	510	4.5	455	10.2	532	3.7	487	8.6
Indigenous	440	8.6	395	9.9	469	6.6	429	13.3
Study desk								
non-Indigenous	510	4.7	490	5.4	531	3.8	517	6.3
Indigenous	437	8.8	409	12.0	469	7.5	434	11.4

Access and availability of a computer for use

Of course having a computer in the home does not necessarily guarantee that the student will have access to that computer for their own use. Students were asked where they had access to a computer, and if so where they had access. The responses to these items are summarised in the five levels of access shown in Table 14. Eighty-four per cent of Australia's non-Indigenous students reported having access and use of a computer both at home and at school, a figure that is almost 20 percentage points greater than that reported by Indigenous students. The greatest difference between Indigenous and non-Indigenous achievement is for those students who report having use of a computer at school but not at home. Almost one quarter of Indigenous students fall into this category of computer usage, compared to only 4 per cent of non-Indigenous students. Finally, one in every 20 Indigenous students indicated that they did not use a computer at all. Although this figure is relatively small, it is still five times the frequency of non-Indigenous who do not use a computer. Very few students answered that they used computers in places other than home or school, and so along with the "do not use a computer at all", these categories have been omitted from the following achievement analyses.

Table 14 also show the relationships between the availability of computers for Indigenous and non-Indigenous students and achievement in mathematics. Achievement in science shows a similar pattern, and the table showing the science achievement scores is included in Appendix A.

Table 14 Level of availability and use of computers and mathematics achievement

Availability and Use of Computer	Non-Indigenous			Indigenous		
	%	Mean mathematics score	se	%	Mean mathematics score	se
Both at home and at school	84	514	4.5	65	459	13.3
At school but not at home	4	455	9.6	23	406	15.7
At home but not at school	10	501	7.6	5	452	24.8
Only at places other than home or school	1	448	18.7	2	460	14.7
Do not use a computer at all	1	421	20.1	5	418	21.8

For both Indigenous and non-Indigenous students, computer use in the home seems to be the key issue, with those students using computers at home scoring higher than students who did not. In particular, Indigenous students who used computers in the home as well as at school had achievement levels in both mathematics and science that were not significantly different to the international average, although achievement levels of Indigenous students were still significantly lower than those of non-indigenous students.

In both content domains, those Indigenous students who only use a computer at school performed at a level that was below the international average. This is of concern in light of the 23 per cent of Indigenous students who fall into this category of computer use. These data may suggest that for Indigenous students, being able to use a computer outside of school helps to reinforce their own computer skills, and indirectly assist learning in mathematics and science. It may also reflect the link between level of resources and level of achievement.

Parents' education level

Since parents are a child's first (and probably most important) educators, parental educational level is arguably the most important educational resource in a student's home (Martin *et al.*, 2004; Mullis *et al.*, 2004). Based upon previous TIMSS findings, this indeed appears to be the case, with higher levels of parents' education found to be associated with higher student achievement in almost all countries in TIMSS 2003 (Martin *et al.*, 2004; Mullis *et al.*, 2004; Thomson & Fleming, 2004a, 2004b).

Students were asked to indicate the highest level of education for each parent, and the percentage of Indigenous and non-Indigenous students reporting parents' education in each of the categories is shown in Table 15. Unfortunately, there was a high proportion of missing data (for both Indigenous and non-Indigenous students) in response to this question, as shown by the 'I don't know' responses.

Table 15 Percentage of Indigenous and non-Indigenous students by the highest education level of either parent

Parents' highest education level	Indigenous	non-Indigenous
Primary school	8	2
Lower secondary school	15	11
Upper secondary school	21	18
Post-secondary education but not university	10	21
University or higher	13	22
Don't know	33	26

It is apparent from this table that Indigenous students are under-represented in the higher categories of completed parental education. In particular, just under a quarter of these parents have completed some sort of post-secondary education or university study, a figure a little less than half the proportion of parents of non-Indigenous students. When taken in conjunction with findings that poor and illiterate parents can be a major factor inhibiting the educational outcomes of Indigenous students (Purdie *et al*., 2000), this indicates that those Indigenous students whose parents may have only completed primary or lower secondary education may be at particular risk of poor educational outcomes.

Parents' education levels and mathematics and science achievement

In general, students whose parents attained higher levels of education had higher mathematics and science achievement than those whose parents only attained lower levels of education, as shown in Figure 20 and Figure 21.

The relationship found between mathematics achievement and parental education level underlines the concerns expressed in the previous section. The average scale score of Indigenous students whose parents only completed primary school is 357 score points, a figure significantly below the national Indigenous average of 429. On an international level, the performance of these students is slightly below that of students living in Botswana and the Philippines. Almost one in ten Indigenous students, compared to one in 50 non-Indigenous students, had parents who had only completed primary school.

For all other levels of parental education, however, Indigenous students performed at a level similar to the international mean, although at no point equivalent to the non-Indigenous students with the same level of parental education. In addition, for those 13 per cent of Indigenous students with a parent who completed university study, performance in mathematics was only 19 scale points on average lower than the non-Indigenous national average (508).

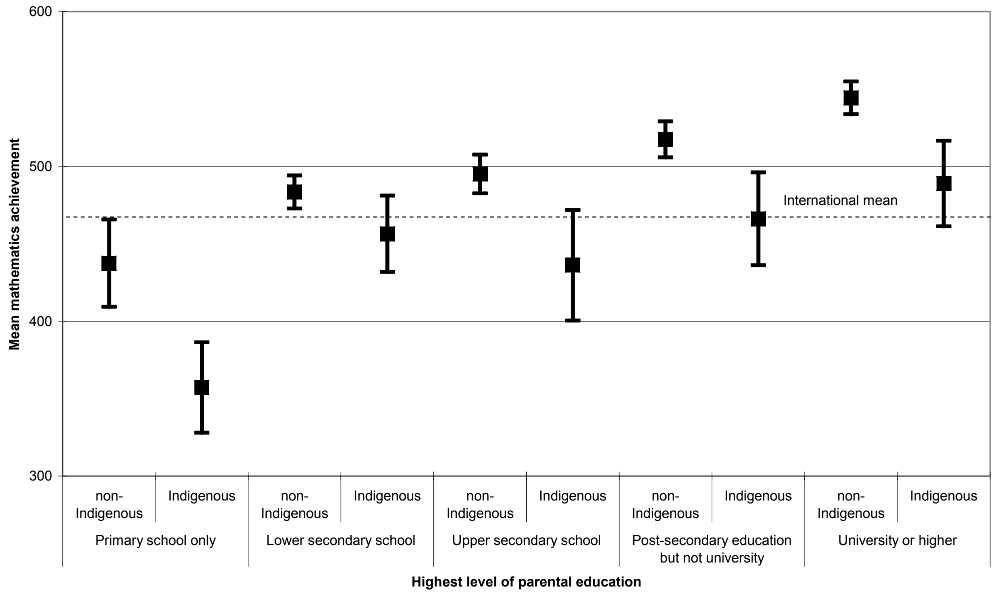

Figure 20 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by parents' highest education level

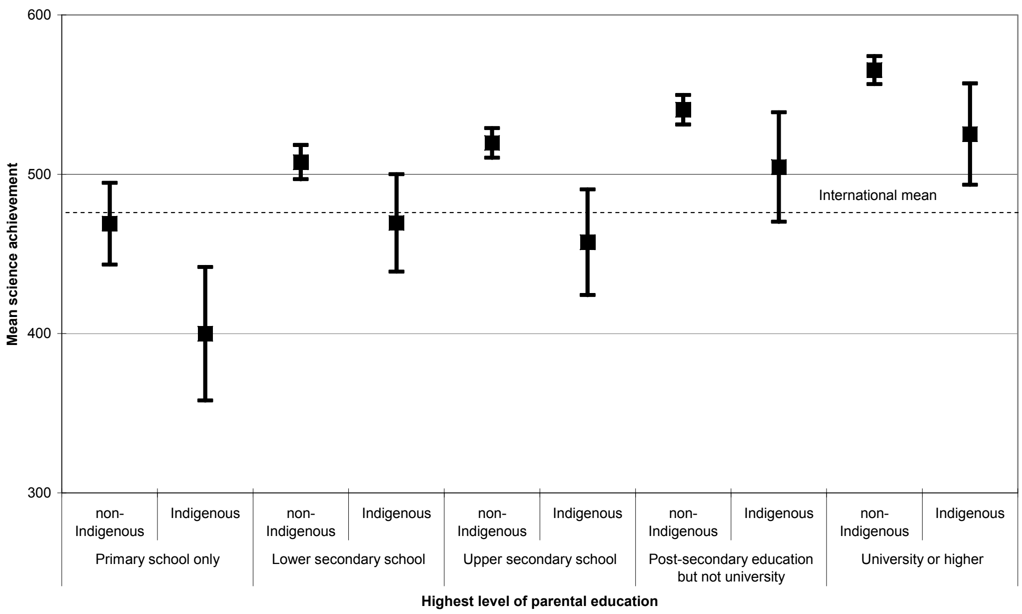

Figure 21 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by parents' highest education level

The science performance of those Indigenous students whose parents did not complete secondary school was significantly below the national Indigenous average for science achievement. The average score of these students in science was 400, a figure similar to the average science achievement of students in Saudi Arabia, Morocco and Lebanon. However, for those Indigenous students whose parents completed some form of post-secondary education, science achievement exceeded the international average and was not significantly different to either the non-Indigenous students in the same level of parental education or the national average.

STUDENT ATTITUDES TOWARDS LEARNING

A series of statements were posed to students in the TIMSS student questionnaire about how they felt about learning mathematics and science. These questions were orientated towards the students' self-confidence and valuing learning mathematics and science. Purdie, Tripcony, Boulton-Lewis, Fanshawe and Gunstone (2000) argued that positive self-identity as a *student* (beyond being an *Indigenous* person) is likely to be associated with success at school. Factors such as feeling a sense of belonging to a school, having warm, supportive and encouraging teachers, a relevant curriculum and support and encouragement from family, friends and the community are all associated with perceiving value in schooling. Unfortunately, research has demonstrated that Indigenous students have a lower sense of academic self-efficacy (the belief that one has the necessary capabilities for academic achievement and success; DeBortoli & Cresswell, 2004) and poorer self-concepts (Scott, 1992) than non-Indigenous students. Despite these findings, reports and inquiries examining Indigenous education and training often fail to examine Indigenous students' actual attitudes and confidence towards their own learning (DEST, 2005; MCEETYA, 2000).

Self confidence in learning mathematics

The TIMSS survey asked students to respond to four statements regarding their self-confidence in mathematics and science. Table 16 lists the statements with respect to their correlation with mathematics achievement for Indigenous and non-Indigenous students. This table shows that for both Indigenous and non-Indigenous students similar patterns of correlations with self-confidence statements in terms of direction but not necessarily strength are evident for both Indigenous and non-Indigenous students.

All statements are positively correlated at a moderate level with achievement (r ranging from ±.39 to .47) for non-Indigenous students. All of the statements are also correlated with Indigenous student achievement; however these correlations are a little weaker (r ranging from ± .23 to .31). Only the statement 'mathematics is more difficult / harder for me than for my classmates' is correlated at a strength that is similar for both groups of students.

Table 16 Correlations of Indigenous and non-Indigenous student self-confidence with mathematics achievement

Statement about Mathematics	Indigenous	Non-Indigenous
Self-Confidence in learning mathematics		
I usually do well in mathematics	0.25*	0.42*
Mathematics is more difficult / harder for me than for my classmates	-0.31*	-0.39*
Mathematics is not one of my strengths / I am just not good a mathematics	-0.24*	-0.47*
I learn things quickly in mathematics	0.23*	0.42*

Note: * indicates a significant correlation ($p<.05$)

Responses to these statements can be formed into an index of students' self-confidence in learning mathematics and this index has been used over a number of TIMSS cycles. Students who agreed either a little or a lot with all four statements were assigned to the high level of the index, whereas students who disagreed either a little or a lot with all four statements were assigned to the low level. The medium level includes all other possible combinations of responses. Figure 22 illustrates the percentage of Indigenous and non-Indigenous students who report a low, medium and high level of self-confidence in learning mathematics by gender.

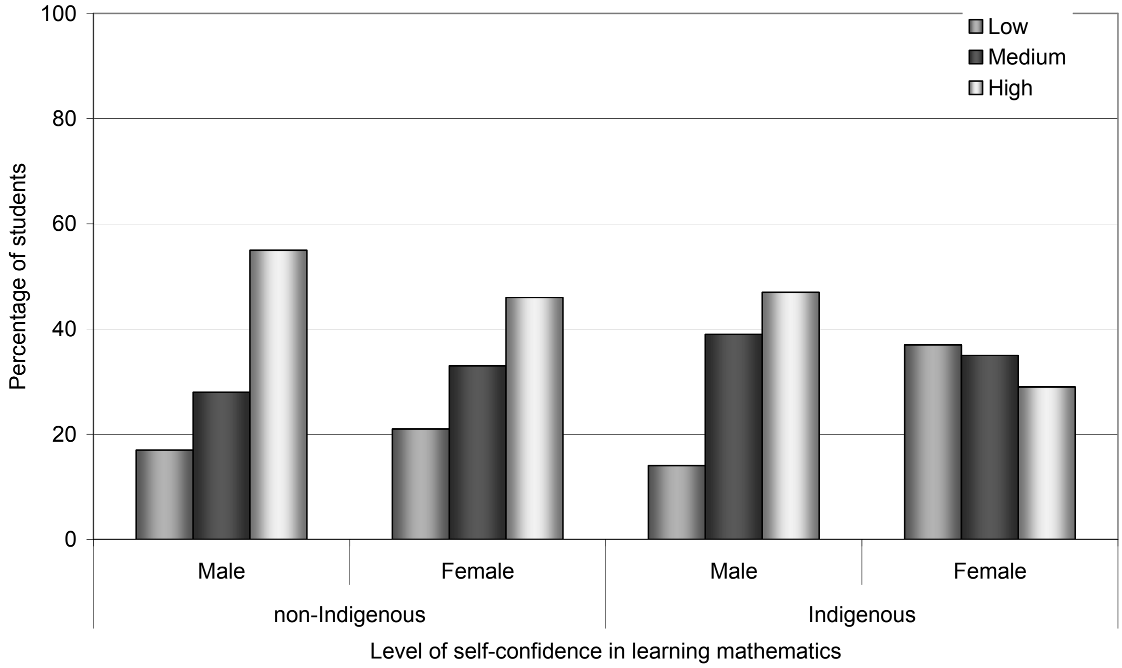

Figure 22 Percentage of Indigenous and non-Indigenous students reporting a low, medium and high level of self-confidence in learning mathematics by gender

Together, around half of all non-Indigenous (both male and female) and Indigenous male students reported high self-confidence in learning mathematics, with approximately 20 per cent reporting low self-confidence. In contrast, close to 40 per cent of Indigenous female students report low self-confidence in learning mathematics and less than 30 per cent report high self-confidence.

Figure 23 illustrates the relationship between self-confidence and achievement in mathematics. For all groups, the higher the level of self-confidence, the higher the level of achievement. For this analysis, students in the low to medium categories of self-confidence were grouped and compared to those students with high levels of self-confidence. The figure shows that Indigenous female students with low mathematics self-confidence performed at a level that was significantly below the international average. Those Indigenous female students who report high self-confidence, on the other hand, achieved at a level not significantly different to the international average in mathematics. The ‘booster’ effect of self-confidence with achievement can be seen clearly for non-Indigenous students in particular, where there is quite a large jump in scores from those with low-medium levels of self-confidence to those with high self-confidence.

Whilst it is not known whether low self-confidence is a result of poor academic achievement, or whether low self-confidence leads to low mathematics achievement, these figures certainly suggest that addressing the self-confidence of Indigenous females in particular in mathematics should be a major aim for educators.

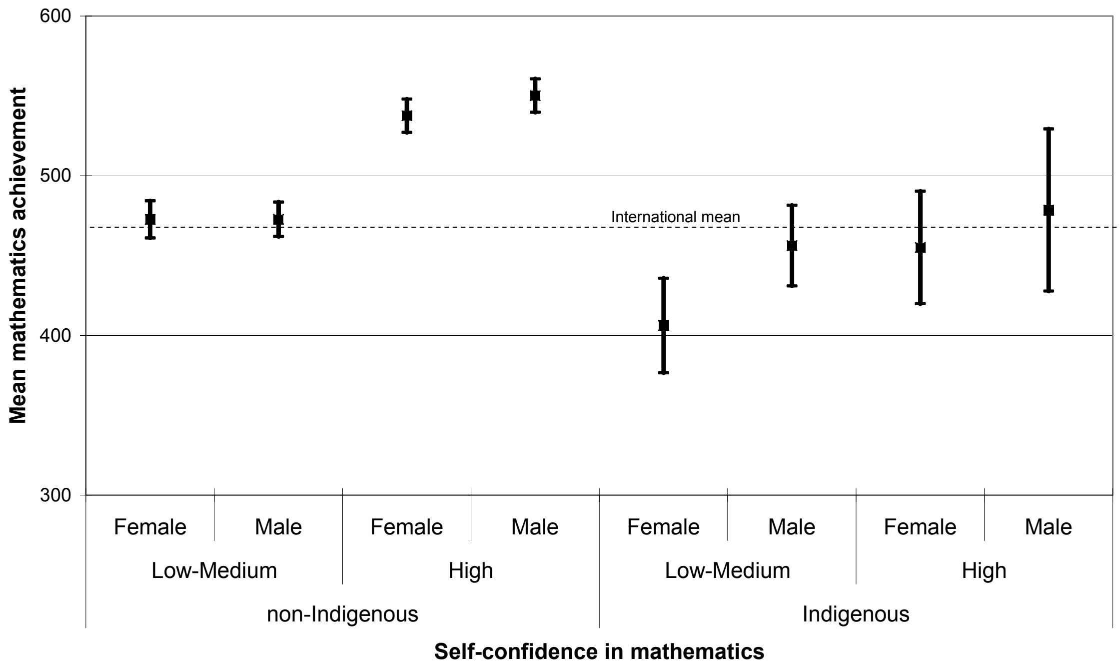

Figure 23 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by level of self-confidence in learning mathematics and gender

Self-confidence in learning science

As already discussed, four statements regarding self-confidence in science were also presented to students. Table 17 lists the statements and their correlation with science achievement for Indigenous and non-Indigenous students. All statements are positively correlated at a fairly low level with non-Indigenous student achievement (*r* ranging from ±.26 to .29). Although a number of the statements are also correlated with Indigenous science achievement, these correlations are somewhat weaker (*r* ranging from ± .05 to .22). Similar to the findings for mathematics, only the statement 'science is more difficult / harder for me than for my classmates' is correlated at a strength that is similar (*r* = -.22) to the non-Indigenous correlations.

Table 17 Correlations of Indigenous and non-Indigenous student self-confidence with science achievement

Statement about Science	Indigenous	Non-Indigenous
Self-confidence in learning science		
I usually do well in science	0.05	0.29*
Science is more difficult / harder for me than for my classmates	-0.22*	-0.26*
Science is not one of my strengths / I am just not good a science	-0.13*	-0.29*
I learn things quickly in science	0.12*	0.26*

Note: * indicates a significant correlation (p<.05)

No relationship existed between Indigenous science achievement and responses to the statement 'I usually do well in science'. There were, however, significant correlations between the other three self-confidence statements and science achievement for these students, and all four significant correlations between these statements and achievement for non-Indigenous students. These statements form an index of students' self-confidence in learning science that has also been used over a number of TIMSS cycles. Students who agreed a little or agreed a lot with all four statements were assigned to the high level of the index, whereas students who disagreed a little or disagreed a lot with all four statements were assigned to the low level. The medium level includes all other possible combinations of responses.

Figure 24 illustrates the percentage of Indigenous and non-Indigenous students who report low, medium and high levels of self-confidence in learning science. As with results in mathematics, these results have been disaggregated by gender.

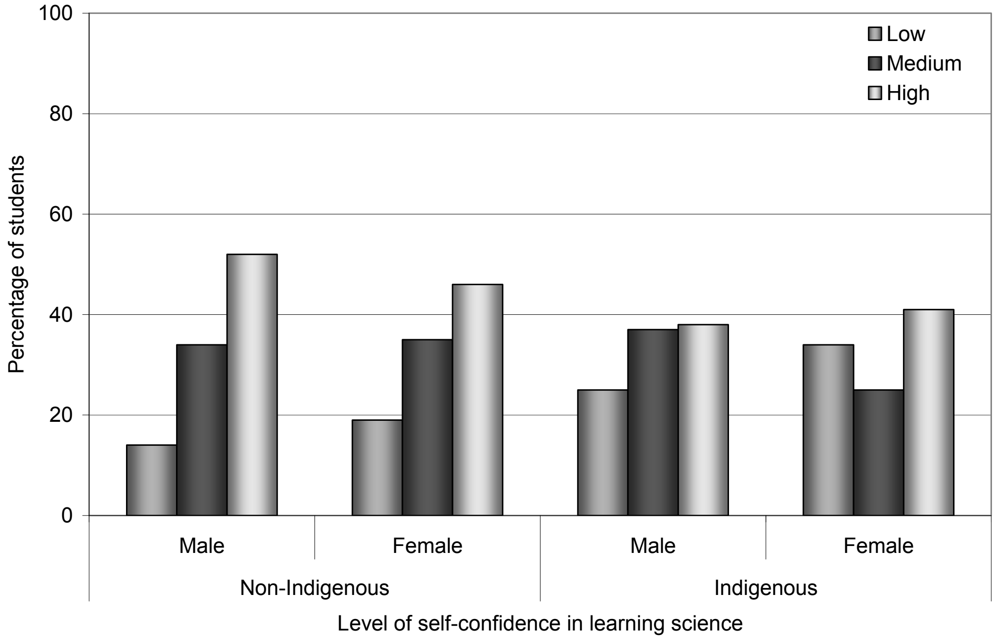

Figure 24 Percentage of Indigenous and non-Indigenous students reporting a low, medium and high level of self-confidence in learning science by gender

A little more than 40 per cent of female Indigenous students reported high self-confidence in learning science, with a similar figure (38%) found for male Indigenous students. Although at least two-thirds of all Indigenous students report having either a medium to high level of self-confidence in learning mathematics, there are still a large number of Indigenous students (both male and female) who indicate low self-confidence in undertaking science study. One-third of the female Indigenous students report low levels of self-confidence in learning science. For the male Indigenous students, this figure is around one-quarter. In contrast, less than one-fifth of non-Indigenous students indicate a similar low level of self-confidence in learning science.

Although the direction of the relationship between a student's self-confidence towards science study and actual science achievement cannot be inferred from these results, attempting to raise Indigenous self-confidence towards learning science should be an important goal in its own right for those involved with Indigenous education. As shown in Table 18, although non-Indigenous students' self-confidence appears to increase with science achievement, the confidence intervals for the Indigenous students are so wide that we cannot say with any certainty that any such relationship exists.

Table 18 Mean science achievement for Indigenous and non-Indigenous students by level of self-confidence in learning science and gender

		Level of self-confidence in science			
		Low-Medium		High	
	Gender	Science achievement	se	Science achievement	se
Non-Indigenous	Female	503	5.0	541	5.1
	Male	515	5.2	562	4.8
Indigenous	Female	437	14.6	479	17.7
	Male	485	16.0	511	15.2

Indigenous female students with low levels of self-confidence performed at a level significantly lower than the international mean (474). This was not the case for Indigenous males. Irrespective of level of self-confidence, they performed, on average, at a level not significantly different to the international mean.

Valuing mathematics and science

Students' motivation to learn mathematics and science can also be affected by whether they find the subject enjoyable, place value on the subject and consider it to be important to future success in school and for further career aspirations. In addition, developing positive attitudes towards mathematics and science among students is an important goal of education in its own right. The TIMSS survey asked students to respond on a four-point Likert scale, with responses ranging from agree a lot to disagree a lot, to seven statements regarding their valuing of mathematics and science. Table 19 lists the statements and their correlation with mathematics achievement for Indigenous and non-Indigenous students. This table shows that different patterns of correlations exist between the Indigenous and non-Indigenous students for the valuing of mathematics statements.

Table 19 Correlations of Indigenous and non-Indigenous student valuing of mathematics with mathematics achievement

Statement about Mathematics	Indigenous	Non-Indigenous
Valuing mathematics		
I would like to take / do more mathematics at school	-0.10*	0.16*
I enjoy learning mathematics	-0.05*	0.23*
I think learning mathematics will help me in my daily life	0.03	0.05*
I need mathematics to learn other school subjects	-0.12*	0.07*
I need to do well in mathematics to get into the post-school course of my choice	-0.05	0.12*
I would like a job that involved using mathematics	0.03	0.20*
I need to do well in mathematics to get the job I want	-0.12*	0.05*

For non-Indigenous students, enjoying mathematics, wanting to do more of it in school and seeing a possible career involving mathematics were all found to be significantly positively correlated with mathematics achievement. In contrast, only negative relationships were found for Indigenous students. Indigenous students' enjoyment of mathematics was actually very weakly negatively correlated with mathematics achievement. Indigenous students also reported a very weak but significant negative correlation between wanting to do more mathematics at school and actual mathematics achievement. In this instance, wanting to do more mathematics is related to lower Indigenous student achievement, indicating perhaps that lower achieving students may feel the need to catch up to their more successful peers, and may require additional remedial classes to do so. Indigenous students also report a significant negative correlation (as opposed to a positive correlation for non-Indigenous students) between needing mathematics to get a desired job and student achievement. In this case, vocations that require mathematics may not be those that are particularly desired by Indigenous students.

Before looking at the results for the combined 'valuing mathematics' index, the individual statement about enjoyment of mathematics will be examined, as the promotion of students' enjoyment in mathematics and science has for a number of years now been the focus of a great deal of professional development with teachers as a way of boosting students' participation in the subjects.

Students were asked in the TIMSS surveys whether they enjoyed learning mathematics, with responses as previously described. For the analyses following, the two 'agree' categories were collapsed and the two 'disagree' categories similarly collapsed. The percentage of students agreeing or disagreeing to the statement 'I enjoy learning mathematics', along with their scores in mathematics is provided in Table 20. Overall, this table shows that while more students enjoy learning mathematics than do not, female students, both Indigenous and non-Indigenous, are more likely to exhibit negative attitudes towards enjoyment of mathematics than males.

Table 20 Indigenous and non-Indigenous students' responses to the statement 'I enjoy learning mathematics' by gender, with mathematics achievement scores

			Disagree		Agree	
		% agree (se)	Mathematics achievement	se	Mathematics achievement	se
Non-Indigenous	Male	61 (1.8)	494	6.1	529	6.3
	Female	55 (1.8)	487	6.4	515	5.7
Indigenous	Male	61 (7.4)	453	15.0	446	17.3
	Female	56 (4.3)	416	15.2	417	12.2

For non-Indigenous students, there is a clear association between higher levels of enjoyment of mathematics and mathematics achievement. This pattern is not apparent for Indigenous students. Rather, Indigenous students have a similar level of achievement in mathematics irrespective of their enjoyment of the subject. The effect of this is a widening of the gap between the performance of Indigenous and non-Indigenous students: from 41 score points between male students who do not enjoy mathematics to 83 score points between male students who do, and from 71 score points for female students who do not enjoy mathematics to 98 score points for female students who do.

The index of students' valuing mathematics is based on the responses to all of the items listed in Table 19. An average is then calculated across the seven items based on the four-point scale, and students assigned to the high level if they agree a little or a lot on average, to the low level if they disagree a lot or a little on average, and to the middle level in all other cases.

The relationship between Indigenous students' valuing of mathematics as shown in Figure 25 (measured by the index as described) and mathematics achievement is unclear. For non-Indigenous students a clear linear relationship is evident: the higher the level of valuing mathematics, the higher the level of achievement. For Indigenous students a possible conclusion is that placing a value on mathematics seems to be more important for girls than boys – females with low levels on the valuing mathematics index had significantly lower levels of achievement than boys with the same level of valuing mathematics.

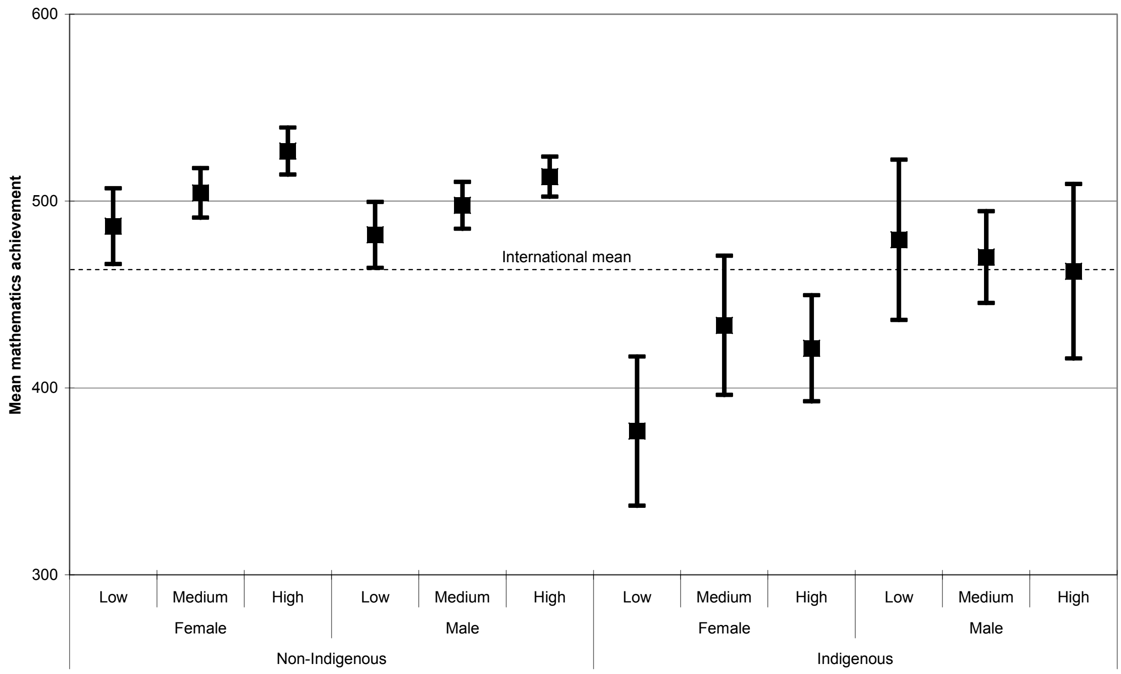

Figure 25 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by students' level of valuing mathematics and gender

Table 20 and Figure 25 illustrate that higher enjoyment and value in learning mathematics is not necessarily associated with higher mathematics achievement for Indigenous students. This is in contrast to the positive association between these variables for non-Indigenous students, and the positive association between self-confidence and mathematics achievement for both Indigenous and non-Indigenous students.

Table 21 provides the proportion of Indigenous and non-Indigenous males and females who responded 'agree' or 'strongly agree' to the statement 'I enjoy learning science', and the science achievement scores of students in each of the two categories – agree or disagree. It would seem that science is a more enjoyable subject than mathematics for those in the sample, with a greater percentage of students in each group indicating that this was the case.

Table 21 Indigenous and non-Indigenous students' responses to the statement 'I enjoy learning science by gender, with science achievement scores

			Disagree		Agree	
		% agree (se)	Science achievement	se	Science achievement	se
Non-Indigenous	Male	72 (1.5)	518	5.1	550	4.8
	Female	63 (1.8)	508	5.2	528	2.1
Indigenous	Male	65 (6.1)	498	14.3	473	12.7
	Female	63 (5.2)	453	14.8	442	14.3

The data in Table 21 also show the differences in the way agreement with this statement relates to science achievement between Indigenous and non-Indigenous students. The positive association between greater enjoyment in learning science and higher science achievement is evident for non-Indigenous students; however the relationship is not clear for Indigenous students. The effect of this is, as with mathematics, a widening of the gap between the performance of Indigenous and non-Indigenous students: from around 20 score points between male students who do not enjoy science to 77 score points between male students who do, and from 55 score points for female students who do not enjoy science to 86 score points for female students who do.

Table 22 shows the statements about valuing science that were included in the TIMSS survey and their correlation with science achievement for Indigenous and non-Indigenous students. For non-Indigenous students the correlations are all moderate but significant, and in the direction that is expected. Students who like science, want to do more of it and can see a long-term purpose to studying it, do better on the achievement test than those who do not.

For Indigenous students the correlations are more tenuous, however the only two significant (but weak) correlations indicate that those Indigenous students who can see a long-term goal in science, either in education or work, do better on the science assessment.

Table 22 Correlations of Indigenous and non-Indigenous student valuing of science with science achievement

Statement about Science	Indigenous	Non-Indigenous
Valuing science		
I would like to take / do more science at school	-0.03	0.20*
I enjoy learning science	-0.02	0.19*
I think learning science will help me in my daily life	-0.02	0.22*
I need science to learn other school subjects	-0.05	0.19*
I need to do well in science to get into the post-school course of my choice	0.07*	0.20*
I would like a job that involved using science	0.08*	0.26*
I need to do well in science to get the job I want	0.07*	0.20*

The index of students' valuing science is based on the responses to all of the items listed in Table 22. An average is then calculated across the seven items based on the four-point scale, and students assigned to the high level if they agree a little or a lot on average, to the low level if they disagree a lot or a little on average, and to the middle level in all other cases.

The achievement levels of both female and male Indigenous students remains reasonably constant when examined on the valuing of science index – as the confidence intervals all overlap there is no significant difference in achievement levels. For non-Indigenous students there is a 'booster' effect for placing high value on science – those who placed a high value on science had significantly higher achievement in science, particularly for males. A positive correlation was evident between male students' valuing of science and science achievement for both Indigenous and non-Indigenous males (r = .31, r = .27 respectively). These relationships are illustrated in Figure 26.

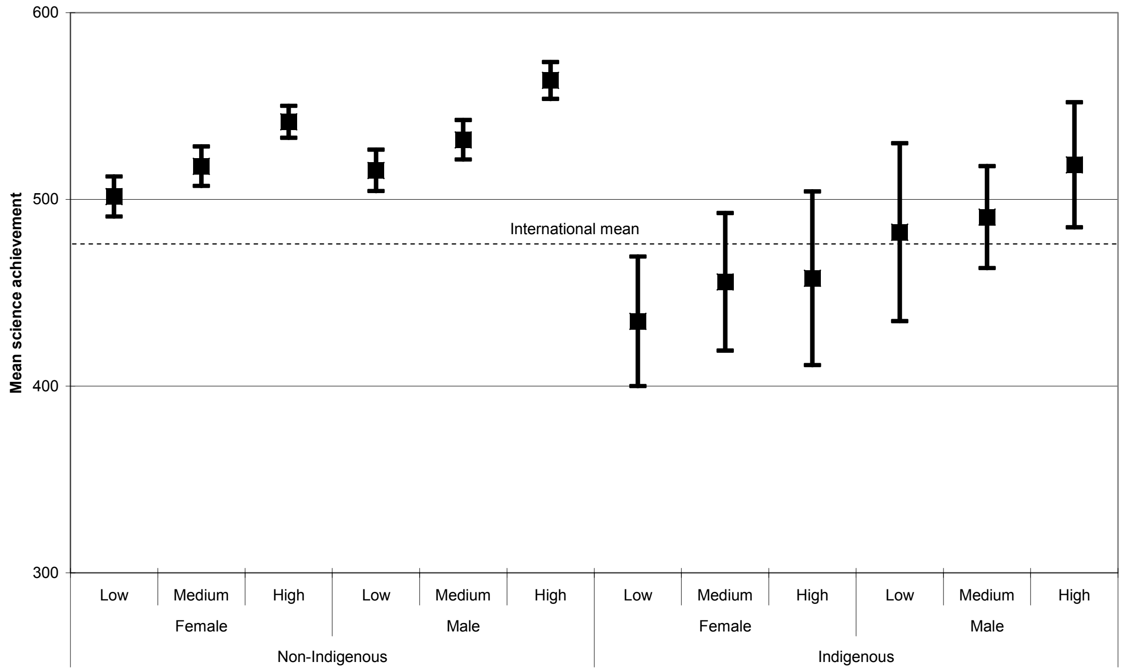

Figure 26 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by level of valuing science and gender

These data show that those Indigenous students who express a high level of self-confidence in learning mathematics and science also generally demonstrate higher levels achievement in these subjects. This is similar to a finding reported by McInerney, Roche, McInerney and Marsh (1997) in reference to self-esteem and English and mathematics achievement. In addition, the higher a male Indigenous student valued science, the more likely it is they achieved at a level that was similar to the non-Indigenous national average for science achievement. Unfortunately, for the female Indigenous students, none of the examined attitude variables (self-confidence, enjoyment and value in learning mathematics or science) appeared to improve female mathematics and science achievement to a level similar to the non-Indigenous national average.

It may be that external and situational factors (rather than a student's own self-confidence and self-efficacy) have a greater impact upon Indigenous (than in comparison to non-Indigenous) achievement in mathematics and science. Such a suggestion is supported by the results of Scott (1992), who found that Indigenous students had a more external locus of control, and believed that factors outside their own control dictated their lives. Perceiving an external locus of control as the agent that influences events surrounding the individual can then lead a person to believe they are unable to instigate change or influence their own success.

Educational aspirations

Examining the relationship between Indigenous students' performance and their educational and vocational aspirations is another way to investigate the factors which relate to mathematics and science achievement. Internationally it was found that students who had aspirations to finish university had substantially higher average science and mathematics achievement than those without such aspirations. The educational and vocational aspirations of Indigenous students, like all students, are shaped by external forces as well as the student's own desires and talents, such as parental and community expectations. For example, even though McInerney *et al.* (1997) found that self-esteem was a significant predictor of academic achievement for English and mathematics achievement, self-esteem did not significantly predict the desired occupations of Indigenous students. Because many Indigenous students felt that high-unemployment was a reality, these authors felt that for Indigenous students self-esteem was irrelevant to their expectations of career development (McInerney *et al.*, 1997).

Table 23 shows the percentage of Indigenous and non-Indigenous students (by gender) according to a number of educational aspirations. This indicates that at least 63 per cent of the Australian students who participated in TIMSS 2003 (both Indigenous and non-Indigenous) wished to finish secondary college, TAFE, a bachelors degree or a postgraduate qualification. In light of recent data suggesting the retention rates for Indigenous full-time students have continued to rise over the last five years up until 2005 (Australian Bureau of Statistics [ABS], 2006), the proportion of Indigenous students in the present study wishing to complete or continue with their education appears promising. However, marked differences between Indigenous and non-Indigenous students in their educational aspirations can be seen in the results presented in Table 23. In particular, the proportion of Indigenous female students (32%) who don't know or who do not have any educational aspiration is of concern.

Table 23 Educational aspirations of Indigenous and non-Indigenous students, by gender (%)

	Not finish secondary college	Finish secondary college	Finish TAFE	Finish Bachelors Degree	Beyond Bachelors Degree	I don't know
Indigenous						
Male	8	23	25	9	22	13
Female	5	10	31	10	12	32
non-Indigenous						
Male	3	18	25	15	22	17
Female	2	14	30	21	19	14

It is encouraging to see almost one-third of Indigenous female and one-quarter of Indigenous male students wishing to complete TAFE. These are the same as the proportions of non-Indigenous females and male students with the same educational aspirations. However, the number of Indigenous students who wish to undertake tertiary studies and complete a bachelors degree (approximately 10%) is around half of the proportion of non-Indigenous students (approximately 18%) with similar aspirations.

Indigenous and non-Indigenous students' mathematics achievement according to students' educational aspirations is shown in Figure 27. For these analyses, aspirations were grouped into those who wanted to complete secondary school at most, those who aimed for some sort of vocational qualifications, and those who aimed for tertiary qualifications. Those Indigenous students with aspirations to further education, be it TAFE, undergraduate or postgraduate, achieved at a level significantly higher than Indigenous students with no such aspirations, and at a level that is not significantly different to the international mean. However the achievement levels in mathematics for Indigenous students are significantly lower than for the similar group of non-Indigenous students. This could flag problems that these students will have – as they are lower achievers they are likely to struggle in their chosen course without significant academic support. In order that as a country we continue to encourage participation of this marginalised group of students, such support is essential.

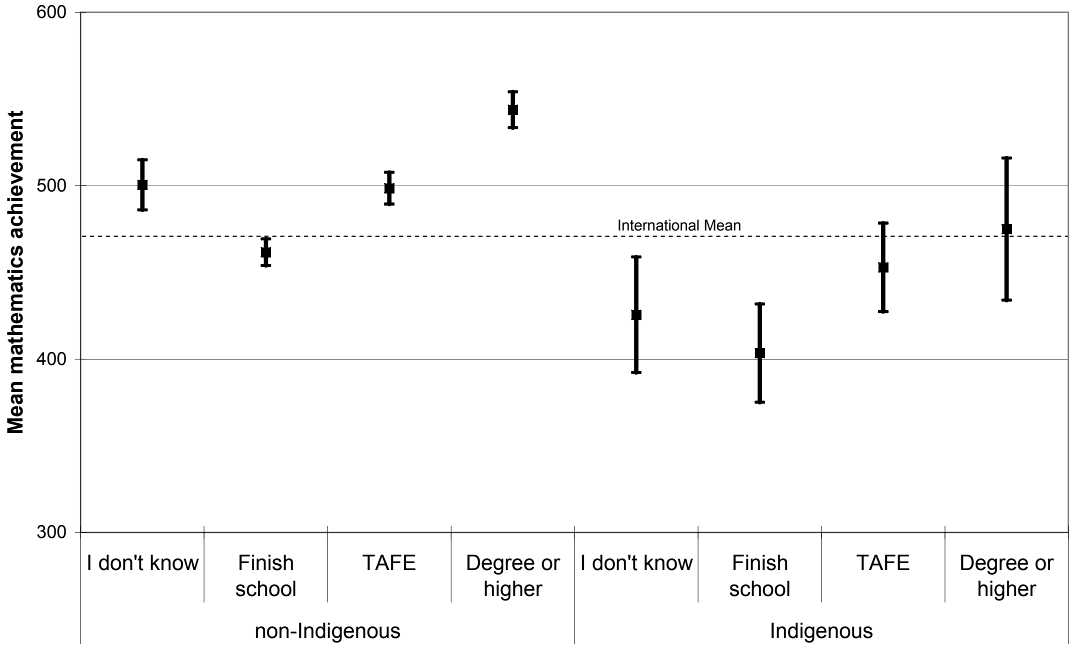

Figure 27 Mean mathematics achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by students' educational aspirations

A similar relationship exists between aspirations and science achievement, shown in Figure 28. The level of science achievement for Indigenous students who wish to undertake further study was statistically similar to the international mean, but as for mathematics, was significantly lower than the achievement levels for their non-Indigenous counterparts, meaning that extra support will be needed if these students are to achieve their aspirations.

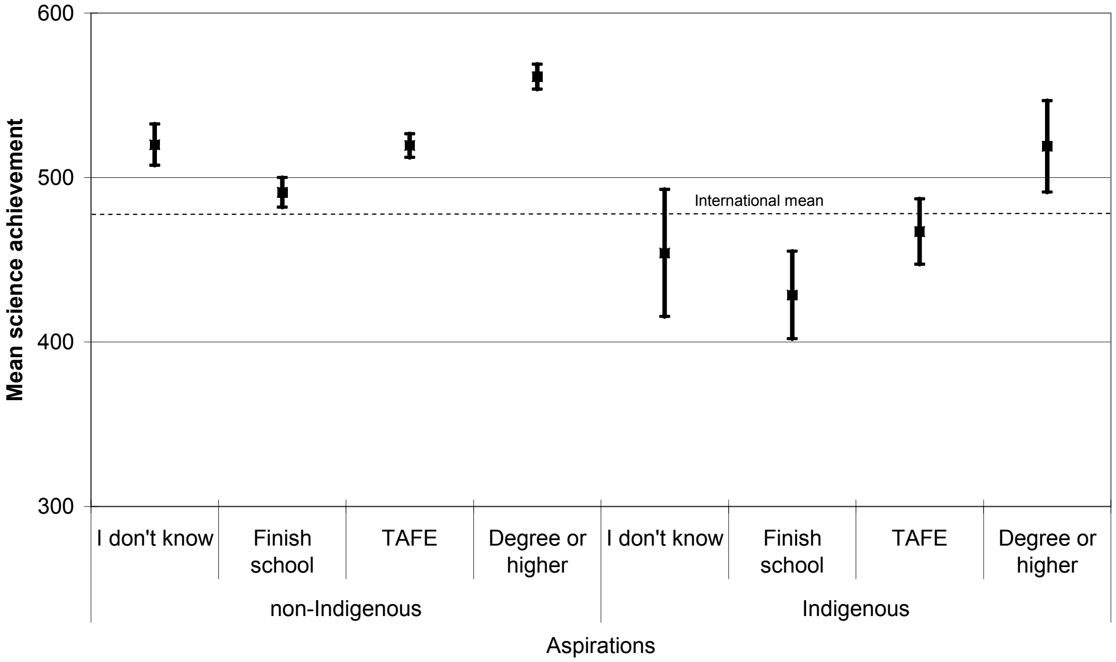

Figure 28 Mean science achievement (and 95% confidence intervals) for Indigenous and non-Indigenous students by students' educational aspirations

There are a substantial proportion of students who express no aspirations. These students are not necessarily those who are poor performers academically. For those involved in Indigenous education, ensuring that students develop realistic and achievable educational goals should be of major concern. To have a large number of Indigenous students with relatively strong mathematics and science achievement and unclear educational aspirations may mean that these students may one day sell themselves short in terms of future educational and vocational choices. This finding underlines the importance of strong vocational and career guidance information being provided to all students.

In the next chapter of this report, school-based factors which are thought to have an impact on Indigenous learning are explored for the TIMSS data.

4. SCHOOL-BASED FACTORS

School characteristics play an important role in influencing the quality of student learning and achievement (Mullis, Martin, Ruddock, O'Sullivan, Arora, Erberer, 2005). For a better understanding of the meaning of student results in TIMSS 2003, it is important to understand the context in which Australia's Indigenous and non-Indigenous students learn (Mullis et al., 2005). In particular, the school plays a vital role in ensuring the goals of the curriculum are implemented. Data was collected in TIMSS on a number of school-based factors. These include the socioeconomic composition of the student body and the frequency of absenteeism within schools. Both of these factors have been found to relate to Indigenous student achievement (Mellor & Corrigan, 2004).

SCHOOL'S SOCIOECONOMIC COMPOSITION

There is likely to be a relationship found between the average socioeconomic level of the students in a school and the level of resources available to students at that school. Schools in which there is a high proportion of students from disadvantaged backgrounds do not have a call on funding or other resources from parents. When a high proportion of family finances goes towards essentials, there is necessarily less to provide extra income to schools. Many such schools have difficulty even obtaining even the lowest financial contribution from families. In comparison, schools with a low proportion of families from economically disadvantaged homes often collect all non-compulsory or compulsory fees, and obtain substantial extra support from parents in terms of contributions of voluntary parental time supporting the school in its programs and activities.

To obtain some measure of the overall socioeconomic level of schools, the TIMSS school questionnaire asked principals to approximate the socioeconomic composition of their school. Principals were asked to report the percentage of their students who came from economically disadvantaged homes, with selections ranging from 0-10, 11-25, 26-50 and greater than 50 per cent of students. A summary of the responses to this question for Australian schools is shown in Figure 29.

One third of non-Indigenous students attended a school in which fewer than 10 per cent of students were from an economically disadvantaged background; almost 70 per cent attended schools with less than 25 per cent of socially disadvantaged students. In stark contrast, only 16 per cent of Indigenous students attended schools with fewer than 10 percent disadvantaged students and 42 per cent attended schools with less than 25 per cent disadvantaged students.

Australia's Indigenous students are instead far more likely than non-Indigenous students to be attending schools in which there are a high proportion of students living in poverty. Almost 60 per cent of Indigenous students attended schools where more than a quarter of students came from socioeconomically disadvantaged backgrounds, a figure that is double the proportion of non-Indigenous students attending such schools.

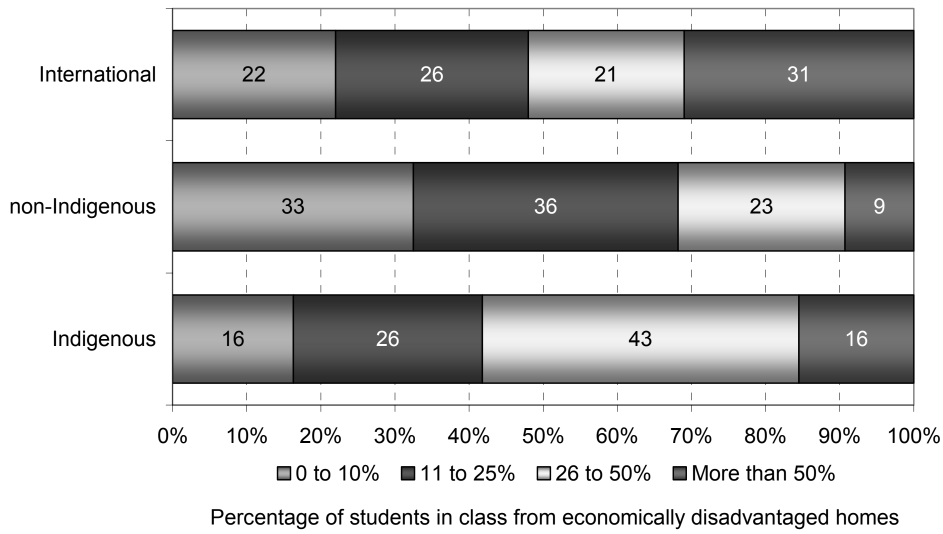

Figure 29 Percentage of students within TIMSS-participating schools from economically disadvantaged homes by Indigenous status

Mathematics and science achievement

Table 24 provides data to examine the relationship between levels of disadvantage in schools and average performance. The achievement levels of non-Indigenous students in both mathematics and science are highest in schools with the lowest proportion of students from economically disadvantaged backgrounds. Non-Indigenous students who attend schools with up to 25 per cent of disadvantaged students also achieve at a similar level to non-Indigenous students attending schools with only up to 10 per cent of disadvantaged students. However, past that point, the achievement levels of non-Indigenous students declines.

The highest performances in mathematics for Indigenous students occur in schools with fewer than 10 per cent of students from economically disadvantaged backgrounds. Indigenous students in such schools achieve on average at a level slightly higher than the international mean and not significantly different to the non-Indigenous mean. However, the achievement levels of Indigenous students attending schools with more than 10 per cent and up to 50 per cent of students from such backgrounds are markedly lower.

Interestingly, Indigenous students appear to perform better in schools where more than 50 per cent of students are from disadvantaged backgrounds than in schools with more than 10 per cent and fewer than 50 per cent of disadvantaged students (although the differences in scores are not statistically significant because of the large standard errors). It may be that schools with higher proportions of disadvantaged students also have higher proportions of Indigenous students. If this is the case, these schools may receive more assistance targeted to the needs of Indigenous students and/or they may be able to apply the assistance they receive more effectively. This may explain the apparent better performance of Indigenous students in these schools than in seemingly less disadvantaged schools.

Table 24 Mathematics and science achievement for Indigenous and non-Indigenous student, by level of disadvantage of school

		Mean mathematics achievement		**Mean science achievement**	
Indigenous status	**Percentage of students from economically disadvantaged backgrounds in class**	Mean	se	Mean	se
Non-Indigenous	0 to 10%	522	8.4	545	6.9
	11 to 25%	520	10.0	541	7.2
	26 to 50%	492	10.4	512	8.5
	More than 50%	475	10.2	498	9.3
Indigenous	0 to 10%	477	21.7	503	23.1
	11 to 25%	438	19.2	477	16.3
	26 to 50%	425	11.1	449	8.7
	More than 50%	452	20.1	486	23.6

For further examination of the differences the data were collapsed into two categories: less than one-quarter of students from disadvantaged homes, and more than one-quarter of students from disadvantaged homes. This is shown in Figure 30, and shows the differences quite clearly. Non-Indigenous students, even those in highly disadvantaged schools, still achieved at a significantly higher level than the international mean. Those Indigenous students in less disadvantaged schools also achieved at a level similar to the international mean, while those in the highly disadvantaged schools achieved at a level significantly lower than this.

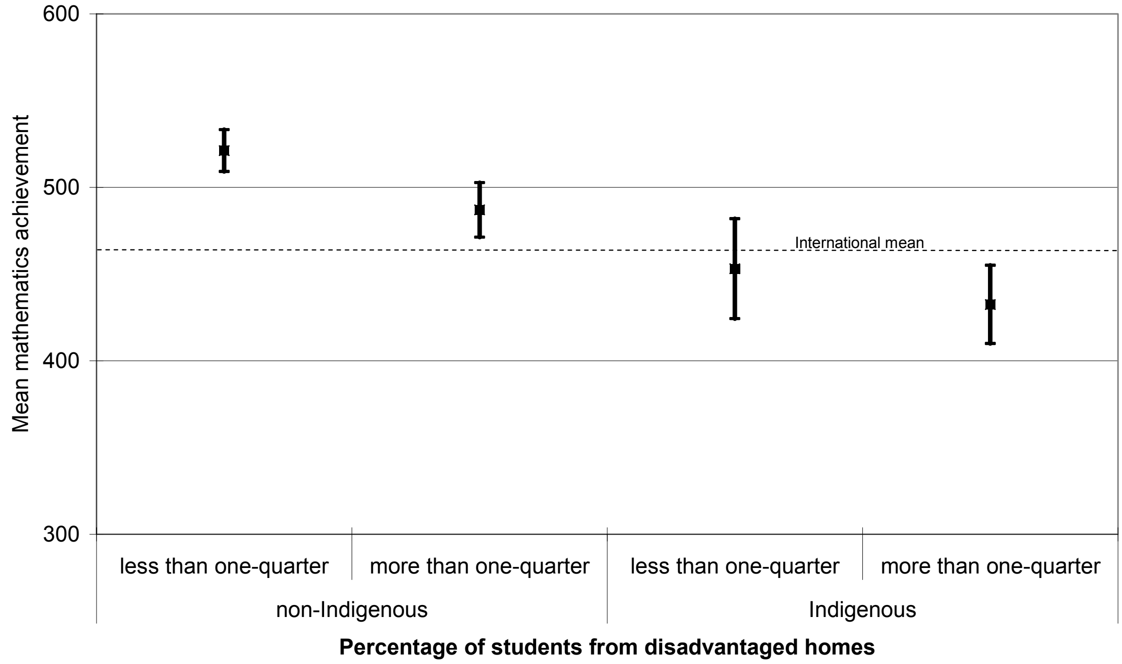

Figure 30 Mean mathematics achievement for Indigenous and non-Indigenous students by the percentage of students in the school from economically disadvantaged homes

FREQUENCY OF STUDENT ABSENTEEISM

Student absenteeism can create problems associated with instructional continuity and a reduction in the student's learning time (Collins, 1999; Thomson & Fleming, 2004a, 2004b). Research has demonstrated that greater student absenteeism is related to lower academic achievement and reflects a less serious attitude towards school (Martin *et al*., 2004; Mullis, *et al*., 2004). In mathematics and science in particular, the cumulative pattern to learning is irrevocably broken by absences (Groome & Hamilton, 1995). Recent research indicates not only that Indigenous children consistently attend school less frequently on average than their non-Indigenous counterparts (DEST, 2002), but that Indigenous outcomes suffer from this high absenteeism (Frigo *et al*., 2003; Bourke, Rigby & Burden, 2000).

To examine this issue, principals were asked in the TIMSS school questionnaire to rate the severity of student absenteeism in their school. Figure 31 displays the proportion of students in schools categorised in this way.

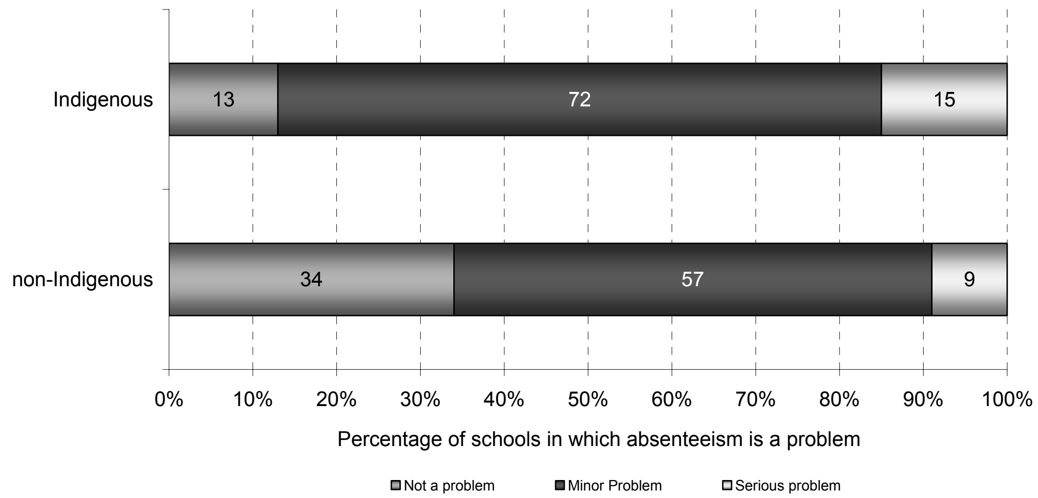

Figure 31 Severity of absenteeism problem in schools

There appears to be a relationship between absenteeism and achievement in mathematics, as shown in Figure 32; however the number of students in each of the extreme ends of the distribution is small and therefore standard errors are large. As a result, all the confidence intervals for non-Indigenous students overlap, and all those for Indigenous students overlap, meaning we are unable to say that any statistically significant differences exist in achievement within either group.

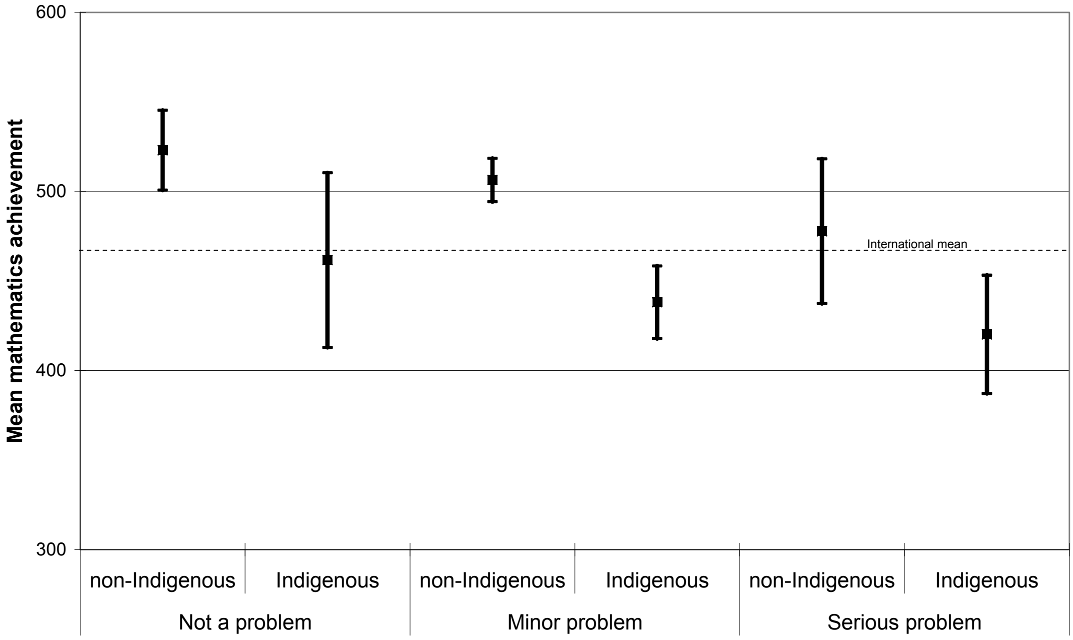

Figure 32 Mathematics achievement and severity of problem of student absenteeism, for Indigenous and non-Indigenous students

Further research could examine any differences in the background factors between Indigenous students with regular school attendance, and those Indigenous students with poor school attendance.

A PROFILE OF INDIGENOUS STUDENTS IN THE TOP BENCHMARKS

There are a very small number of Indigenous students who could be deemed to be 'successful' in terms of the TIMSS test.

Sixteen Indigenous students achieved either the advanced or the high benchmarks in mathematics. While not wishing to make any broad generalisations, it is of some interest to attempt to derive some characterisations of the high achieving Indigenous students compared to their lower-achieving Indigenous counterparts. In summary

- They are more likely to be male;
- They are more likely to have high levels of home educational resources;
- They value mathematics more highly;
- They have higher levels of self-confidence in mathematics; and
- They are more likely than high performing non-Indigenous students to be in schools with low levels of student absenteeism and with low proportions of disadvantaged students.

CONCLUSIONS

This report has examined the performance of Australia's Indigenous students at Year 8 level in TIMSS 2003.

The results from this study show that Indigenous students consistently perform at a significantly lower level than not only their non-Indigenous Australian counterparts, but also the International average. Few Indigenous students achieve at the highest benchmarks, and a much greater proportion of them fail to achieve the lowest benchmarks, compared to non-Indigenous students. These findings are generally consistent in mathematics and science, and within each of the content and cognitive areas in both subjects. Mathematics achievement levels of Indigenous students have not changed since the TIMSS 1994/95 study.

While there were no statistically significant gender differences in mathematics or science for Indigenous students, substantially fewer females than males reached the advanced benchmarks, and higher proportions of females than males failed to achieve the lowest international benchmarks in both mathematics and science.

Indigenous students scored at a significantly lower level than non-Indigenous students in all geographic locations, in both mathematics and science. In mathematics, Indigenous students did not achieve the international mean in any geographic location – in science, students in metropolitan and provincial areas did achieve the international mean.

Indigenous students, particularly females, had lower levels of self-confidence in mathematics and science, and self-confidence was found to be positively related for all students to achievement in both subject areas. Female Indigenous students were found to be more likely than male Indigenous students to not enjoy mathematics and science.

Indigenous students were more likely than non-Indigenous students to be unsure of or have no further educational aspirations after leaving school. This combined with lower levels of home educational resources, including computers at home, parental educational background and books in the home, and higher proportions of Indigenous students attending schools with high proportions of students from economically disadvantaged homes, means that many Indigenous students are not achieving their full potential. One way of trying to address this could be to provide career guidance and mentoring for Indigenous students who come from families who may have limited connections with or knowledge of further education and employment options.

In practical terms, these results reveal a high proportion of Indigenous students who do not recognise basic facts about life sciences and physical sciences, who have limited knowledge of the human body and who have serious difficulties interpreting pictorial diagrams. Furthermore, these results indicate that a high proportion of Indigenous students (and in particular, Indigenous females) are unable to perform basic computations and has little or no basic mathematical knowledge. Taken together, these results suggest that many Indigenous students may leave school without the basic knowledge and skills to participate successfully in further education or in more than low-skilled employment.

Whilst it is recognised that the Australian education system is a form of Western education that is arguably ill-suited to the social and cultural needs of Indigenous people, successful completion of secondary school is a necessary precursor to accessing the full range of further education, training and employment opportunities (Purdie *et al.*, 2000). Education may well be a tool for assimilation, and for those who successfully negotiate its pathways, it provides a key to self-determination and active and equal participation in society (Mellor & Corrigan, 2004).

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APPENDIX A: SUPPLEMENTARY TABLES

Table A1

Geographic location	Urban	(se)	Regional	(se)	Remote	(se)
non-Indigenous	64	4	34	4	2	0.4
Indigenous	50	8.2	32	6.2	19	9.9

Table A2

Maths	Year	Mean	se
Indigenous	1995	439	7.1
	2003	429	7.6
Non-Indigenous	1995	513	3.8
	2003	508	4.5

Table A3

Science	Year	Mean	se
Indigenous	1995	444	7.1
	2003	458	7.0
Non-Indigenous	1995	514	3.7
	2003	530	3.7

Table A4

2002	Advanced	(se)	High	(se)	Intermediate	(se)	Low	(se)	Below Low	(se)
Indigenous	1	0.5	15	2.1	25	2.8	32	2.6	26	4.0
non-Indigenous	7	0.8	28	1.1	33	1.1	21	0.9	11	1.0

Table A5

	Advanced	(se)	High	(se)	Intermediate	(se)	Low	(se)	Below Low	(se)
1994										
Indigenous	0	0.0	12	2.4	22	3.2	36	3.5	30	3.8
non-Indigenous	7	0.9	29	1.2	33	1.1	21	1.0	10	0.9
2002										
Indigenous	1	0.5	15	2.1	25	2.8	32	2.6	26	4.0
non-Indigenous	7	0.8	28	1.1	33	1.1	21	0.9	11	1.0

Table A6

2002	Advanced	(se)	High	(se)	Intermediate	(se)	Low	(se)	Below Low	(se)
Indigenous	1	0.5	15	2.1	25	2.8	32	2.6	26	4.0
non-Indigenous	7	0.8	28	1.1	33	1.1	21	0.9	11	1.0

Table A7

	Advanced	(se)	High	(se)	Intermediate	(se)	Low	(se)	Below Low	(se)
1994										
Indigenous	1	0.6	12	2.3	23	3.3	35	3.6	29	3.7
Non-Indigenous	8	1.0	29	1.1	34	1.1	21	1.0	9	0.9
2002										
Indigenous	2	0.9	15	2.8	25	3.1	32	3.0	25	3.1
Non-Indigenous	9	1.1	33	1.5	35	1.3	17	1.2	5	0.8

Table A8

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
Number	502	9.0	426	15.0
Algebra	502	8.5	424	14.1
Measurement	513	8.5	445	14.4
Geometry	494	9.2	426	18.3
Data	534	7.5	462	16.3

Table A9

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
Life Science	535	7.1	463	14.2
Chemistry	509	7.4	436	15.9
Physics	534	8.2	463	15.8
Earth Science	534	8.2	463	15.8
Environmental Science	538	6.5	478	13.1

Table A10

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
Knowing	500	4.0	444	7.1
Applying	512	4.8	443	9.1
Reasoning	519	4.0	452	9.7

Table A11

	Non-Indigenous				Indigenous			
	Female		Male		Female		Male	
	%	se	%	se	%	se	%	se
Advanced	5	0.9	9	2.1	0	0.0	1	0.4
High	25	2.4	27	2.1	7	2.2	15	4.0
Intermediate	34	2.2	33	1.9	14	3.7	24	4.8
Low	26	1.9	22	1.8	34	4.6	32	4.4
Not reaching Low	10	1.7	9	1.2	45	6.6	29	4.7

Table A12

	Non-Indigenous				Indigenous			
	Female		Male		Female		Male	
	%	se	%	se	%	se	%	se
Advanced	6	0.9	13	1.8	0	0.2	4	1.9
High	32	2.0	34	1.7	12	3.3	19	4.3
Intermediate	37	1.8	34	1.7	20	4.0	31	4.7
Low	20	1.7	15	1.2	36	3.8	28	4.5
Not reaching Low	6	1.0	4	0.9	31	4.9	19	3.7

Table A13

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
Metropolitan	512	6.8	435	13.1
Provincial	503	8.2	431	12.2
Remote	475	9.3	410	7.8

Table A14

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
Metropolitan	530	5.3	468	9.8
Provincial	530	6.5	460	12.1
Remote	514	5.3	430	8.0

Table A15

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
English spoken at home	506	8.0	432	4.1
English rarely spoken at home	538	18.2	406	14.3

Table A16

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
English spoken at home	531	3.6	464	7.8
English rarely spoken at home	524	12.2	416	13.7

Table A17

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
0-100 books	492	5.9	415	8.5
More than 100 books	522	4.3	464	13.1

Table A18

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
0-100 books	508	4.7	442	4.9
More than 100 books	549	3.3	497	16.3

Table A19

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
University or higher	544	5.4	489	14.1
Post-secondary education but not university	517	5.9	466	15.3
Upper secondary school	495	6.4	436	18.2
Lower secondary school	483	5.4	456	12.6
Primary school only	437	14.4	357	14.9

Table A20

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
University or higher	565	4.5	525	16.2
Post-secondary education but not university	540	4.7	505	17.5
Upper secondary school	520	4.7	457	16.9
Lower secondary school	508	5.5	469	15.6
Primary school only	469	13.1	400	21.4

Table A21

	Non-Indigenous				Indigenous			
	Male		Female		Male		Female	
	%	se	%	se	%	se	%	se
High	55	2.0	46	2.2	47	7.6	29	5.4
Medium	28	1.4	33	1.3	39	6.2	35	4.7
Low	17	1.4	21	1.6	14	4.9	37	5.1

Table A22

	Non-Indigenous				Indigenous			
	Female		Male		Female		Male	
	mean	se	mean	se	mean	se	mean	se
High	538	5.3	550	5.3	455	18.0	479	25.9
Low - Medium	473	5.9	473	5.5	406	15.1	456	12.9

Table A23

	Non-Indigenous				Indigenous			
	Male		Female		Male		Female	
	%	se	%	se	%	se	%	se
High	52	2	46	1.6	38	7.7	41	6.1
Medium	34	1.6	35	1.1	37	6.5	25	6.7
Low	14	1.2	19	1.3	25	7.1	35	5.2

Table A24

	Non-Indigenous				Indigenous			
	Male		Female		Male		Female	
	mean	se	mean	se	mean	se	mean	se
High	527	6.4	513	5.5	462	23.8	421	14.5
Medium	504	6.7	498	6.4	470	12.5	433	19.0
Low	487	10.3	482	9.0	479	21.9	377	20.4

Table A25

	Non-Indigenous				Indigenous			
	Male		Female		Male		Female	
	mean	se	mean	se	mean	se	mean	se
High	548	5.3	524	4.8	497	15.0	451	14.5
Medium	534	5.6	520	5.3	499	17.1	454	20.1
Low	526	8.7	511	6.8	502	22.4	420	26.2

Table A26

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
I don't know	500	7.4	426	17.0
Finish school	458	4.6	398	13.8
TAFE	499	4.7	453	13.0
Degree or higher	544	5.3	475	20.9

Table A27

	Non-Indigenous		Indigenous	
	Mean	se	Mean	se
I don't know	520	6.4	454	19.7
Finish school	491	4.6	429	13.6
TAFE	519	3.7	467	10.1
Degree or higher	561	3.9	519	14.2

Table A28

	Non-Indigenous		Indigenous	
	%	se	%	se
0-10%	33	4.7	16	6.2
11-25%	36	4.3	26	7.4
26-50%	23	3.2	43	13.6
More than 50%	9	2.3	16	5.5

Table A29

	Non-Indigenous		Indigenous	
	%	se	%	se
Less than one-quarter	521	6.1	453	14.7
More than one-quarter	487	8.0	432	11.5

Table A30

	Non-Indigenous		Indigenous	
	%	se	%	se
Not a problem	34	5.1	13	4.4
Minor problem	57	5.1	72	6.2
Serious problem	9	2.5	15	4.9