

Mathematics learning: What TIMSS and PISA can tell us about what counts for all Australian students

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PISA, TIMSS - why?

- There are two different ways this is asked:
 - “WHY do we have to do it”,
 - and
 - “Why do WE have to do it?”



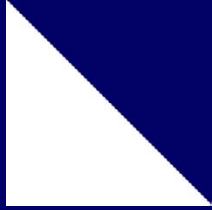
national goals for schooling

- The National Goals aim to provide Australian students with high quality schooling to provide them with the necessary knowledge, understanding, skills and values for a productive and rewarding life.



assessing the goals

- The *Measurement Framework for National Key Performance Measures* (MCEETYA, 2008) sets out the *National Assessment Program* as a basis for reporting ongoing progress towards the goals by drawing on agreed definitions of Key Performance Measures



so... WHY do we have to do it?

- The National Assessment Program
- The NAP consists of all tests endorsed by MCEETYA, such as the national literacy and numeracy tests (NAPLAN), the three-yearly sample assessments in science literacy, civics and citizenship, and ICT literacy, and Australia's participation in the international assessments PISA and TIMSS



aims

- We are assessing not only students' progress against the goals, but also the progress of the Australian education system against the goals.
- It's important to do this nationally, but it's also important to do this internationally, against internationally defined standards.



so why do we need NAPLAN *and* PISA and TIMSS?

- The answers lie in who are assessed, how the assessments are constructed and the additional information gained from the international assessments



WHO is assessed?

- In NAPLAN all students are tested in literacy and numeracy, and the data provide results at the student level.
- In the international sample assessments, a light sample of schools is selected, and then, depending on the assessment, either a random sample of students or a random sample of students is selected from these schools.



why do WE have to do it?

- The light sample is a nationally representative random sample, which includes schools in all states and territories, government, Catholic and independent schools, and metropolitan, regional and rural schools.



Australian schools

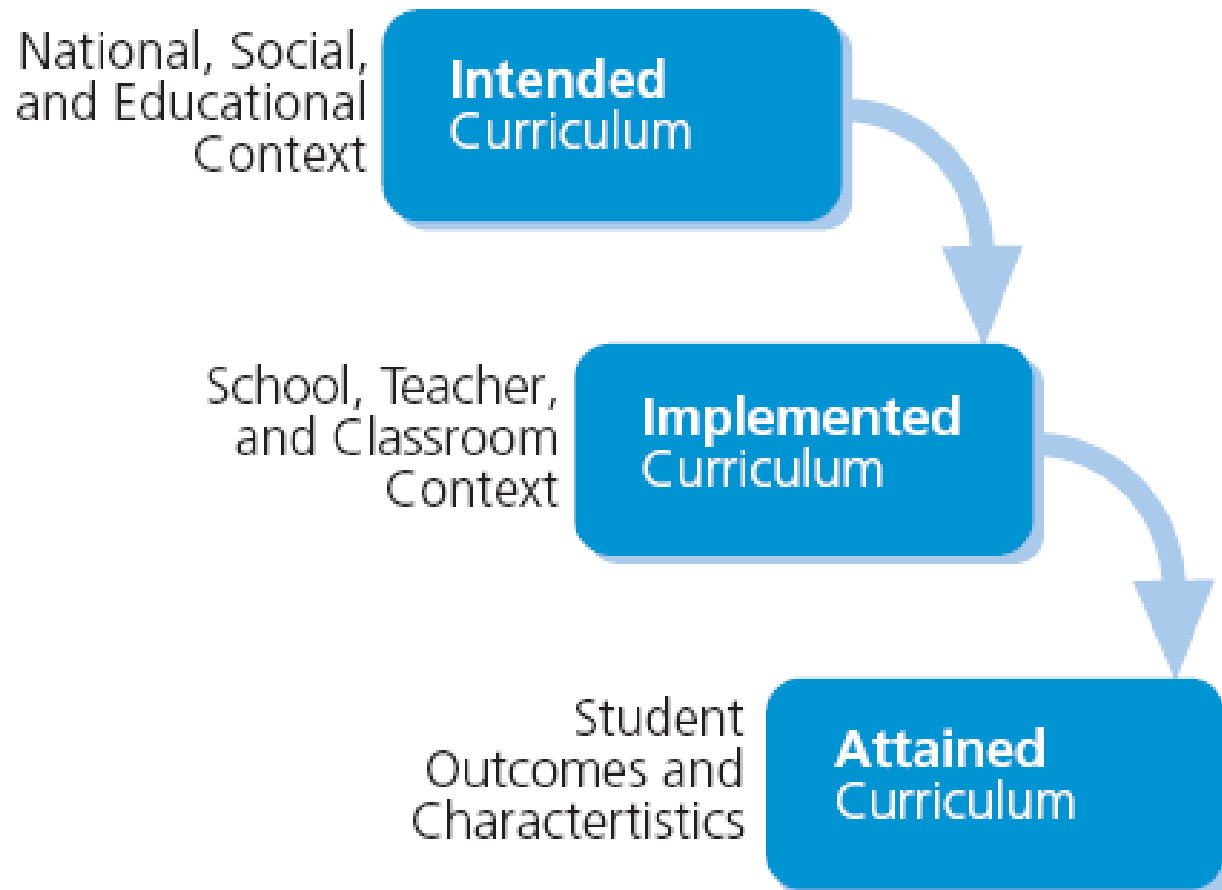


WHAT is assessed?

- the NAPLAN tests are informed by the National Statements of learning in English and Mathematics which underpin the current state and territory learning frameworks
- the TIMSS and PISA assessments are developed against frameworks developed at an international level. However there are not just subject specific frameworks but both studies are embedded in school effectiveness theory and so have contextual frameworks.

TIMSS

TIMSS Curriculum Model





PISA

- PISA is concerned with how well 15 year old students can make use of knowledge acquired from school and from other sources, in situations in everyday life that involve mathematics



what can we learn?

- Of course we can find out numerical results – not for individual students (see NAPLAN) but for groups of students, systems and countries.
- We can also use the contextual information gathered to examine the background for learning – what works and what doesn't work...



reporting results

- In both PISA and TIMSS, results are reported in terms of mean achievement levels and also in terms of ‘proficiency levels’ in PISA or ‘benchmarks’ in TIMSS
- Both represent a continuum of mathematics achievement



standards

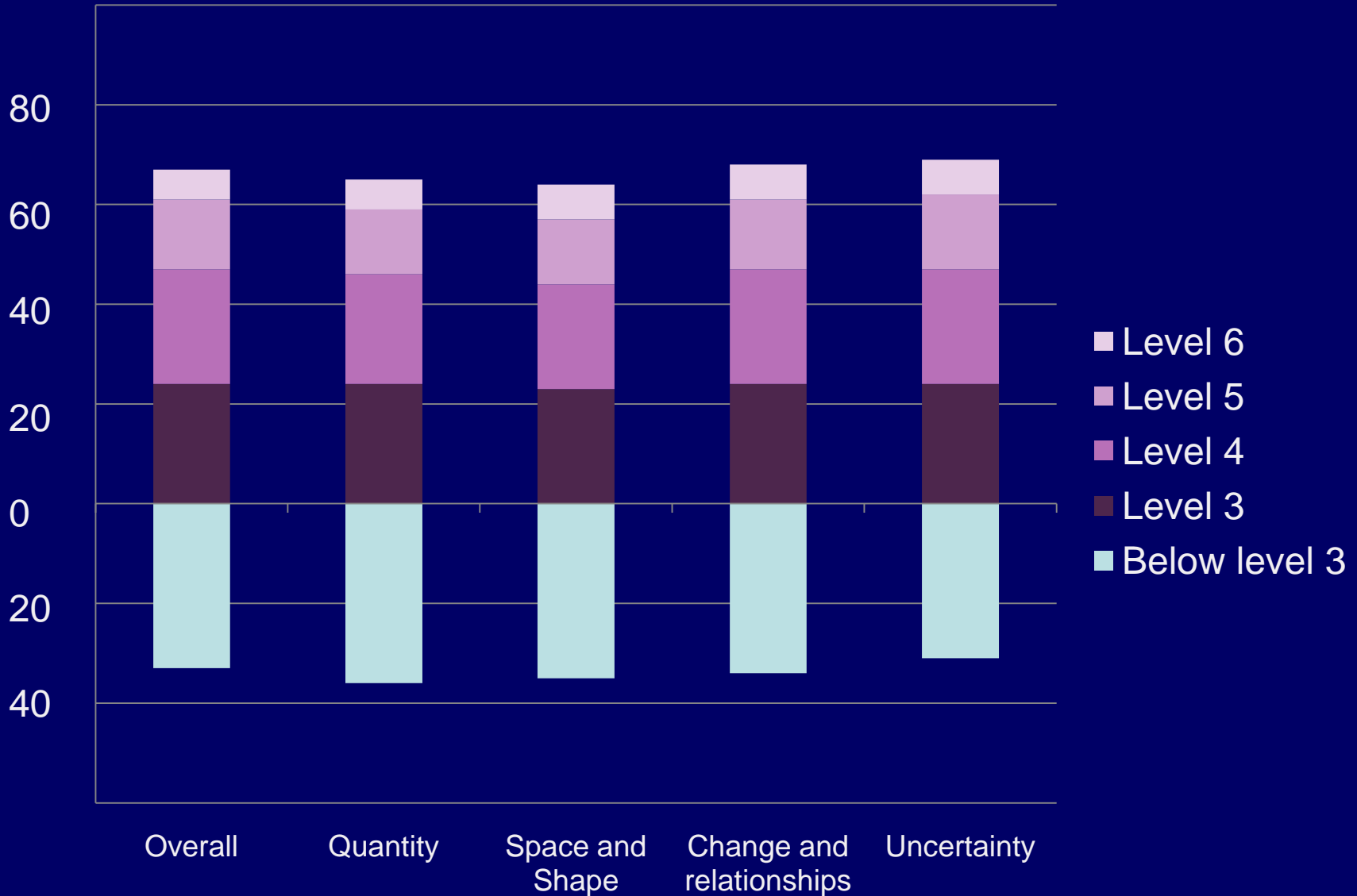
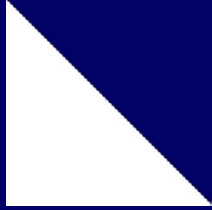
- PISA – 6 proficiency levels, MCEETYA have set proficiency level 3 as the minimum standard for Australian students.
- TIMSS – 4 benchmarks – no minimum standard set yet



content

- On average in PISA Australian students are achieving at a level significantly higher than the OECD mean.
- Are there areas in which we do relatively better and worse in, internationally?

generally, no

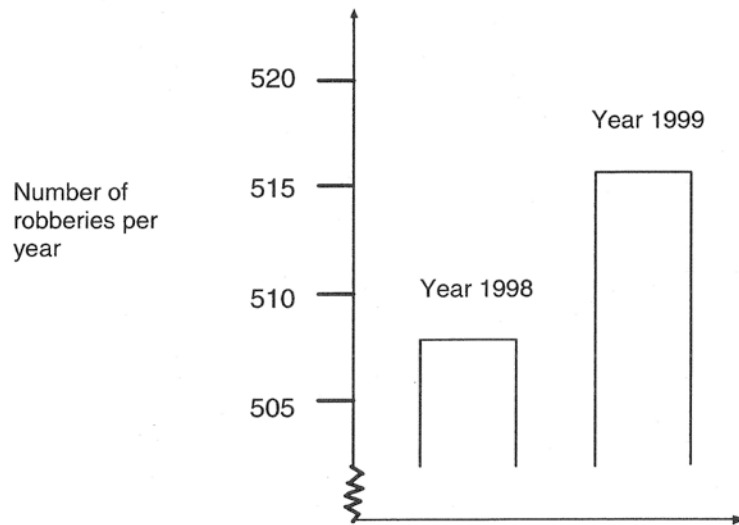


Robberies

ROBBERIES

A TV reporter showed this graph and said:

“The graph shows that there is a huge increase in the number of robberies from 1998 to 1999.”



Do you consider the reporter's statement to be a reasonable interpretation of the graph? Give an explanation to support your answer.

This item was in the *uncertainty* subscale, and was worth 2 points. The full credit response illustrated a Proficiency Level 6, the partial credit Level 4.

I don't think that it is a reasonable interpretation as the robberies have only increased by 9 robberies which is only a total of a 1.7% increase.

- Full credit - 22% of Australian students
- Partial credit - 36% of Australian students
- 33% did not achieve any score at all.



and in TIMSS?

- At Year 8 Australian students = international average in maths overall
- In data and chance Australian students performed at a level significantly **HIGHER** than the international average...
- **BUT** in algebra and geometry Australian students performed at a level significantly **LOWER** than the international average



Year 4

- Overall, Australian students performed at a level significantly HIGHER than the international mean
- They performed significantly HIGHER than the international average in data and chance, and in geometry...
- But significantly LOWER in number

for example

$$\begin{array}{r} 942 \\ -5\blacksquare7 \\ \hline 415 \end{array}$$

Adam did the subtraction problem above for homework but spilled some of his drink on it. One digit could not be read. His answer of 415 was correct. What is the missing digit?

Answer: 2

- 88% of students in Chinese Taipei answered correctly
- The international average was 42%
- In US 41% of students answered correctly
- In Australia 20% of students answered correctly



equity

- Mathematics is a fundamental literacy requirement for the 21st century.
- It is important that every student has the opportunity to learn what is assessed.
- Can we use PISA and TIMSS to identify subgroups of students who are not achieving as well as can be expected, and what can we learn about these students from the contextual data?

gender

- PISA 2003:
 - Males > females in 28/41 countries
 - 1 country females > males
 - Australia – NSD overall
 - BUT males significantly outscored females in *space and shape* and *uncertainty*

TIMSS shows different patterns

- At Year 4
 - males > females in 12/37 countries
 - females > males in 8/37 countries
 - Australia NSD overall
- AND
- Males > females in *number*
 - Females > males in *data display*



And at Year 8

- Males > females in 8/49 countries – Australia is one (along with Algeria, Lebanon, Syria, El Salvador, Tunisia, Ghana, Columbia)
- Females > males in 16/49 countries
- TIMSS 2003 found no gender differences in Australia – so what's happened?
- The average score for males has stayed the same, but the average for girls has declined significantly.




and

- Internationally, females performed significantly better than males in all domains other than *number*, but in Australia, males scored at significantly higher levels than females in both *data and chance*, and *number*



why these differences?


- In PISA and TIMSS
 - Females lower levels on
 - Instrumental motivation
 - Self-concept in maths
 - Self-efficacy
 - Interest in maths
 - Self-confidence
 - And higher levels of
 - Maths anxiety



And even when comparing students achieving at the same proficiency level, males had higher average levels of self-concept, self-efficacy and interest in maths, and lower levels of maths anxiety...

questions for teachers and researchers

- Why are there still gender differences in favour of males in all areas of mathematical literacy (PISA) while a more curriculum based assessment (TIMSS) finds gender differences in favour of males in some countries and females in others?

- 
- Why are boys more self-confident , have higher levels of self-concept and lower levels of maths anxiety in maths, even when females outperform them?
 - Conversely, why do girls still doubt their abilities, even when they are clearly achieving at a high level?




Indigenous students

- 70% of Indigenous students, compared to 32% of non-Indigenous students, were not achieving at the MCEETYA standard of Level 3 in PISA.
- TIMSS produced similar findings – Indigenous students were much lower on each of the subscales at both Year 4 and Year 8. Differences were greater at Year 4 than Year 8.

attitudes...

- Amongst Indigenous students there were NO significant gender differences in *interest*, *instrumental motivation* and *maths anxiety*, and no significant differences between Indigenous and non-Indigenous averages

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- And in TIMSS, similar proportions of male and female Indigenous students reported high levels of *valuing maths* and also *self-confidence*

factors influencing achievement

- More detailed analysis found that while the effect of socioeconomic background is substantial, the effects of strong, positive attitudes and beliefs is significant, and can be encouraged through school programs.



however ...

- Also significant was found to be irregular attendance at school – negative effects for being late on a regular basis, missing consecutive months of schooling and changing schools several times – and Indigenous students were more likely to score higher on all of these.



concluding ...

- The students we are educating today will compete in a global market, and we need to make sure that they are attaining the skills level they need in order for us to be competitive.
- Also, we get a huge amount of contextual information that shows differences, and shows some reasons those differences may occur.