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Snapshots issue 4: Boys, girls and mathematics

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SNAPSHOTS

Global Assessment // Local Impact

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Boys, girls and mathematics

The most recent OECD Programme for International Assessment (PISA) survey enables educators, policy makers and the wider community to compare Australian students with each other, as well as their counterparts across the world.

PISA measures the extent to which 15-year-old students near the end of compulsory education have acquired the knowledge and skills that young adults need to meet the challenges of the future.

This issue of Snapshots looks to the data from PISA on similarities and differences in student performance by sex to inform education policies, improve educational outcomes and equity.

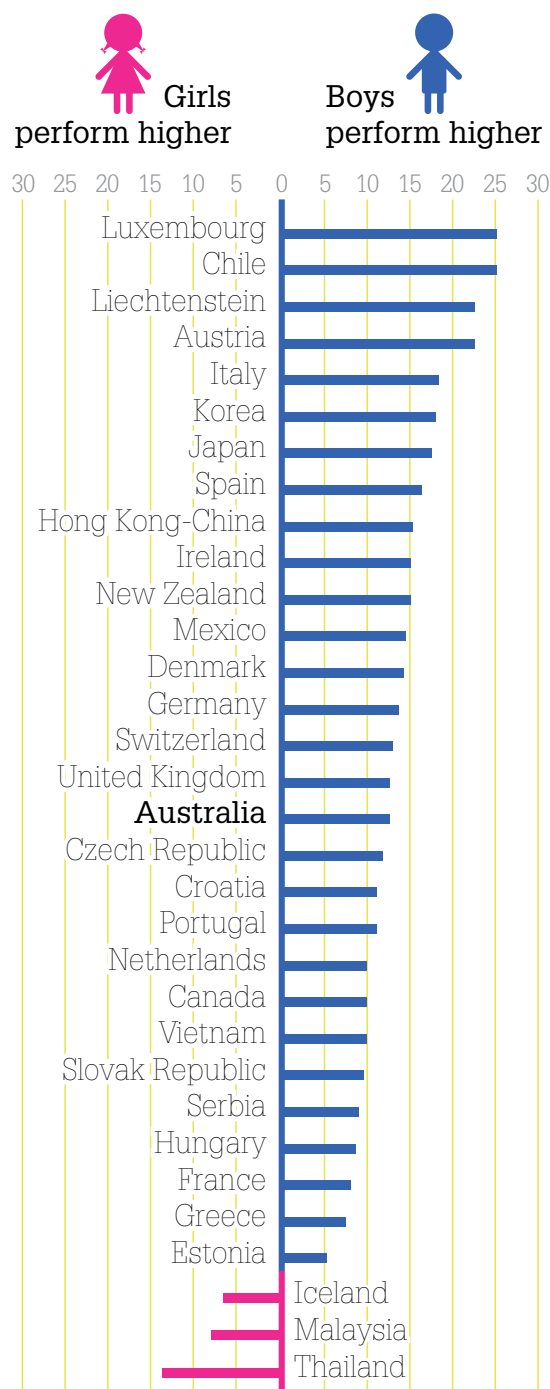
- ▶ Australian boys outperformed Australian girls in mathematics by the equivalent of about one-third of a school year.
- ▶ Sex differences in mathematics are largest in the area of space and shape, and in the process of formulating situations mathematically.
- ▶ Seventeen per cent of boys and 12 per cent of girls are high performers in mathematics.
- ▶ In terms of self-efficacy, boys reported being more confident than girls in tasks such as finding distances using a map and calculating petrol consumption rate, while in terms of mathematics anxiety, girls reported being more worried about getting poor grades in mathematics and mathematics classes being difficult than did boys.
- ▶ Regardless of sex, increasing students' mathematics self-efficacy and decreasing students' mathematics anxiety tend to improve mathematics performance.

Performance in mathematics

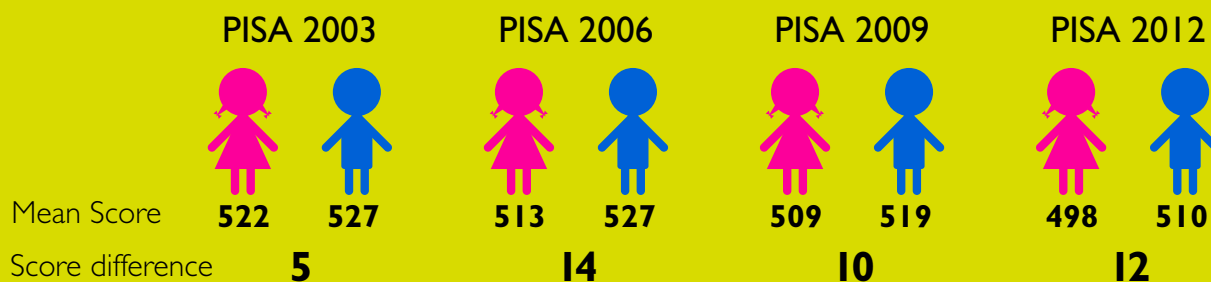
Results from the PISA 2012 mathematics assessment showed an overall sex difference in favour of boys by an average of 10 score points. Twenty-nine countries or economies were found to have significant sex differences in favour of boys, while in three countries girls significantly outscored the boys.

In Australia, boys performed significantly higher than girls by 12 score points, representing about one-third of a school year. Significant sex differences were also found in 2006 and 2009, but not in 2003.

Average sex differences in student mathematics performance by country



Average student mathematics performance by sex and average sex differences across PISA cycles



More details about students' knowledge and abilities in mathematics were collected in PISA 2012.

Boys outscored girls in all content and process areas, with larger differences found in the space and shape area, and in the mathematical process of formulating situations – that is, transforming the problem in context into a mathematical problem.

Boys perform higher than girls by:



Content subscales



Change and relationships



Space and shape subscale



Quantity



Uncertainty and data



Process subscales



Formulating situations mathematically



Employing mathematical concepts, facts, procedures and reasoning



Interpreting, applying and evaluating mathematical outcomes

High and low performers across different groups

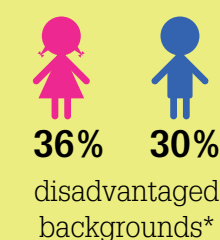
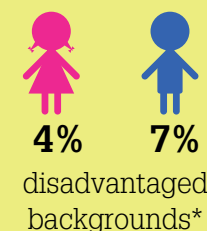
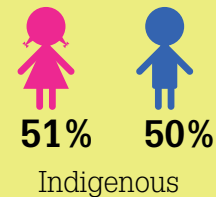
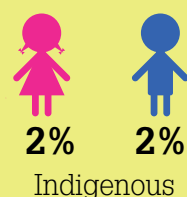
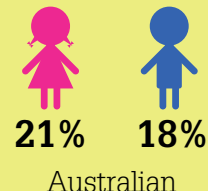
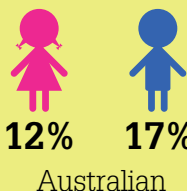
A high performer is a student who is highly proficient in a subject area, for example, they can successfully complete tasks that require the handling of complex information. In PISA, high performers are defined as reaching the two highest proficiency levels – Level 5 and 6.

A low performer is a student who lacks the competencies to actively participate in life situations, for example, they can only apply their knowledge to a few familiar situations. In PISA, low performers are defined as being below an international baseline proficiency level – Level 2.

Proportion of high and low performers for different students groups

High performers

Low performers



* Students in the lowest quartile of PISA's socioeconomic background measure (ESCS).

DID YOU KNOW?

Over a nine-year period, the proportion of high-performing girls and boys has decreased – by six per cent for girls and five per cent for boys – and the proportion of low-performing girls and boys has increased – by six per cent for girls and four per cent for boys.

Why do boys and girls perform differently? What influence does motivations and beliefs have on mathematics performance?

PISA 2012 collected information about students' motivations and beliefs by asking why they chose to pursue mathematics, their beliefs about their mathematical ability and how competent they felt in mathematics. Two of the concepts, mathematics self-efficacy and mathematics anxiety are presented in this issue of *Snapshots* to show the influence they have on mathematics performance.



Self-efficacy

The relationship between self-efficacy and average mathematics performance are stronger than the relationship between other concepts and average mathematics performance.

The relationship between self-efficacy and mathematics performance shows that students in higher self-efficacy quartiles scored higher average levels of mathematics than students in lower self-efficacy quartiles, and that girls' and boys' average mathematics performance is similar in each of the quartiles of self-efficacy. The difference in average mathematics score between one quartile of self-efficacy and the next is the equivalent of about one-and-a-half years of schooling.

Although girls' and boys' average mathematics performance is similar in each of the quartiles of self-efficacy, differences by sex are found when taking a closer look at the item level.

Self-efficacy in PISA was measured by asking students how confident they would feel completing a number of mathematics tasks. From the list of tasks presented to students, boys indicated they were more confident than girls in tasks that involved finding the distances using a map and calculating petrol consumption rate, while girls and boys showed similar levels of confidence solving equations.



Percentage of students who report they are 'confident' or 'very confident' about having to do the following tasks			Difference
Solving an equation like $3x + 5 = 17$	86	88	2
Solving an equation like $2(x + 3) = (x + 3)(x - 3)$	71	75	4
Using a train timetable to work out how long it would take to get from one place to another	84	89	5
Understanding graphs presented in newspapers	82	88	6
Calculating how much cheaper a TV would be after a 30% discount	69	83	14
Calculating how many square metres of tiles you need to cover a floor	65	80	15
Finding the actual distance between two places on a map with a 1:10 000 scale	43	68	25
Calculating the petrol consumption rate of a car	41	66	25

Mathematics anxiety

While the relationship between self-efficacy and average mathematics performance was positive, the relationship between mathematics anxiety and mathematics performance was negative, that is students who were less anxious about mathematics tended to perform better on the PISA mathematics assessment.

The relationship between mathematics anxiety and mathematics performance shows that as students' mathematics anxiety increases, their mathematics performance decreases. The difference in average mathematics score between one quartile of self-efficacy and the next is the equivalent of about one year of schooling.

Mathematics anxiety was measured using five statements about the worry and tension they felt when confronted with mathematics tasks. Girls were more likely to agree or strongly agree with these statements than boys. The proportion of girls who reported worrying about getting poor grades in mathematics and worrying that mathematics classes will be difficult was about 15 per cent higher than for boys.

Percentage of students who report they are 'agree' or 'strongly agree' with the following statements			Difference
I get very tense when I have to do mathematics homework	40	34	6
I feel helpless when doing a mathematics problem	30	20	10
I get very nervous doing mathematics problems	35	23	12
I worry that I will get poor grades in mathematics	69	55	14
I often worry that it will be difficult for me in mathematics classes	67	52	15



ASK YOURSELF

- ▶ Are you aware of any differences in performance between boys and girls in your mathematics classes?
- ▶ What can you do to further extend students who are high performers?
- ▶ What can you do to improve the achievement of low performers?
- ▶ How can you foster students' confidence in mathematics?

The data presented here are drawn from the Programme for International Student Assessment (PISA), which together with the Progress in International Reading Literacy Study (PIRLS) and the Trends in International Mathematics and Science Study (TIMSS) form the suite of international comparative education studies in which Australian students participate as part of Australia's National Assessment Program. Further information about Australia's participation in PISA can be found at www.acer.edu.au/ozpisa.