REFERENCES AND NOTES

Student performance

1. The OECD Programme for International Student Assessment (PISA) conducts surveys every three years to assess the competencies of 15-year-olds in reading, mathematics and science. Each cycle has a focus on one of these domains. Once a domain has been the focus of a PISA cycle, results for that year can be compared with results for later cycles. Comparisons depend on common items being used in the successive cycles. Mathematics was the focus of PISA 2003, so trends in mathematical literacy can be observed from 2003 onwards. There was a statistically significant decline in Australia's performance in mathematics between 2003 and 2015. The countries that outperformed Australia in mathematics in 2015 were Singapore, Hong Kong-China, Macao-China, Chinese Taipei, Japan, Beijing- Shanghai- Jiangsu- and Guangdong-China (B-S-J-G China), Korea, Switzerland, Estonia, Canada, the Netherlands, Denmark, Finland, Slovenia, Belgium, Germany, Poland, Ireland and Norway. Five countries that outperformed Australia in 2015 (Singapore, Chinese Taipei, B-S-J-G China, Estonia and Slovenia) did not participate in 2003. Science was first the focus of PISA in 2006, so scientific literacy comparisons can be made from that time on. Australia showed a significant decline in scientific literacy performance between 2006 and 2015. The countries that outperformed Australia in science in 2015 were Singapore, Japan, Estonia, Chinese Taipei, Finland, Macao-China, Canada, Vietnam, and Hong Kong-China. Two countries that outperformed Australia in 2015 (Singapore and Vietnam) did not participate in 2006. Thomson, S., De Bortoli, L., and Underwood, C. 2017. *PISA 2015: Reporting Australia's results*. Australian Council for Educational Research, pp 15 and 151.
2. The Trends in International Mathematics and Science Study (TIMSS) assesses Year 4 and Year 8 students every four years. It is directed by the International Association for the Evaluation of Educational Achievement, an independent cooperative of national research institutions and government agencies from around the world. In 2015 the top five countries in mathematics were Singapore, Korea, Chinese Taipei, Hong Kong, and Japan. Of the 39 participating countries, Australia was significantly outperformed by 12 countries. Australia's 2015 Year 8 mathematics and science scores are not significantly different from the corresponding score in 1995. Thomson S., Wernet, N., O'Grady, E., and Rodrigues, S. 2017. *TIMSS 2015: reporting Australia's results*. Australian Council for Educational Research, pp. 46 and 49. In 2015 the top five countries in science were Singapore, Japan, Chinese Taipei, Korea and Slovenia. Of the 39 participating countries, Australia was significantly outperformed by 14. Thomson *et al*. 2017. *TIMSS 2015: reporting Australia's results*, pp. 111, 117 and 120.
3. Thomson *et al*. 2017. *PISA 2015: Reporting Australia's results*, pp. 38 and 170.
4. In PISA 2015 males achieved a mean score of 497 score points in mathematics, which was not significantly different to the mean score of 491 score points for females. There was also no significant difference in the mean scores of male and female students in PISA 2003. In PISA 2015 males achieved a mean score of 511 score points in science, while females had a mean score of 509. This difference of two score points is not statistically significantly different. For both mathematics and science 13 per cent of Australian males and 10 per cent of Australian females performed at the highest levels. Thomson *et al*. 2017. *PISA 2015: Reporting Australia's results*, pp. 63 and 195-197.
5. In PISA 2015 Indigenous students achieved a mean score of 427 points in mathematics, significantly lower than the average score of 497 points for non-Indigenous students. The difference equates to about one proficiency level or around two-and-a-third years of schooling. In science, Indigenous students achieved a mean score of 437 points, compared to a mean score of 513 points for non-Indigenous students. The difference equates to one proficiency level or about two-and-a-half years of schooling. Thomson *et al*. 2017. *PISA 2015: Reporting Australia's results*, pp. 48 and 180.
6. In PISA 2015 students attending metropolitan schools achieved a mean score of 502 in mathematics, which was significantly higher than the mean score of 473 for students attending provincial schools, which was not significantly different to the mean score of 460 for students attending remote schools. The mean score difference between students attending metropolitan schools and students attending remote schools was 42 score points on average, the equivalent of around one-and-a-half years of schooling.

In science, students attending metropolitan schools achieved a mean score of 517, while students in provincial and remote schools achieved average scores of 491 and 473 respectively. The mean score difference between students attending metropolitan schools and students attending remote schools was 44 score points on average, the equivalent of more than one-and-a-half years of schooling. Thomson *et al*. 2017. *PISA 2015: Reporting Australia's results*, pp. 51 and 183.

7. In PISA 2015 students in the highest socioeconomic quartile achieved a mean score of 541 points in mathematics, which was significantly higher than the mean score for students in the lowest socioeconomic quartile of 455 points. This difference of 86 score points equates to over one proficiency level or around three years of schooling. In science, students in the highest socioeconomic quartile achieved a mean score of 559 points, which was significantly higher than the mean score for students in the lowest socioeconomic quartile of 468 points. This difference of 91 score points equates to over one proficiency level or around three years of schooling. Thomson *et al*. 2017. *PISA 2015: Reporting Australia's results*, pp. 54 and 186.

Student participation

A. In 2012 there were 30,800 more students in Year 12 than in 1992, but 8,000 fewer physics students; 4,000 fewer chemistry students, and 12,000 fewer biology students than two decades previously. Kennedy, J., Lyons, T., Quinn, F. 2014. The continuing decline of mathematics and science in Australian high schools. *Teaching Science*, vol. 60, 2, pp 34-46.

B. Students were scored according to the degree of their agreement with five statements such as 'I enjoy learning science,' 'Science is boring' (reverse coded), and 'I learn many interesting things in science'. Students in the very much like learning science category 'agreed a lot' with three of the five statements and 'agreed a little' with the other two, on average. Thomson *et al*. 2017. *TIMSS 2015: reporting Australia's results*, pp. 206-207 and 210-211.

Teacher supply

A. Teachers are assumed to be 'notionally qualified' in an area if they have studied the area for at least one semester at second year tertiary level or have trained at tertiary level in teaching methodology in the area concerned. 'Out-of-field' means that these qualification requirements have not been met. Weldon P., McMillan J., Rowley G., McKenzie, P. 2014. *Profiles of Teachers in Selected Curriculum Areas: Further Analyses of the Staff in Australia's Schools 2013 Survey*, Australian Council for Educational Research, p 26.

B. These results summarise school principals' reports from the TIMSS 2011 Year 8 assessment about difficulties in filling vacancies for mathematics and science teachers. Mullis, I., Martin, M., Foy, P., and Arora, A. 2012. *TIMSS 2011 International Results in Mathematics*. International Association for the Evaluation of Educational Achievement, p 263; and Martin, M., Mullis, I., Foy, P., and Stanco, G. 2012. *TIMSS 2011 International Results in Science*. International Association for the Evaluation of Educational Achievement, p 232.