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 change in Australia's performance in mathematics between 2003 and 2012. The countries that outperformed Australia in mathematics in 2012 were Shanghai-China, Singapore, Hong Kong-China, Chinese Taipei, Korea, Macao-China, Japan, Liechtenstein, Switzerland, Netherlands, Estonia, Finland, Canada, Poland, Belgium and Germany. Four countries that outperformed Australia in 2012 (Chinese Taipei, Estonia, Shanghai-China and Singapore) 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. There was a no statistically significant change in Australia's performance in science between 2006 and 2012. The countries that outperformed Australia in science in 2012 were Shanghai-China, Hong Kong-China, Singapore, Japan, Finland, Estonia and Korea. Two countries that outperformed Australia in 2012 (Shanghai-China and Singapore) did not participate in 2006. Thomson, S., De Bortoli, L., and Buckley, S. 2013. *PISA 2012: How Australia measures up*. Australian Council for Educational Research, pp 41 and 150.
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 2011 the top five countries in mathematics were: Chinese Taipei, Singapore, South Korea, Hong Kong and Japan. Australia was ranked 8th of 42 countries. 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 114. In science, Australia was ranked 10th of 42 countries. The top five countries were: Singapore, Chinese Taipei, South Korea, Japan and Russia. 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 114.
3. Thomson, et al. 2013. *PISA 2012: How Australia measures up*, pp 29 and 139.
4. In PISA 2012 males achieved a mean score of 510 score points in mathematics, which was significantly higher than the mean score of 498 score points for females. This difference of 12 score points equates to around one-fifth of a proficiency level or the equivalent of about one-third of a year of schooling. Seventeen per cent of males and 12 per cent of females performed at the highest levels. There was no significant difference in the mean scores of male and female students in PISA 2003. In PISA 2012 males achieved a mean score of 519 score points in science, while females had a mean score of 524. This difference of five score points is not statistically significantly different. Thomson, et al. 2013. *PISA 2012: How Australia measures up*, pp 27, 29 and 139.
5. In PISA 2012 Indigenous students achieved a mean score of 417 points in mathematics, significantly lower than the average score of 507 points for non-Indigenous students. The difference equates to almost one-and-a-half proficiency levels or more than two-and-a-half years of schooling. In science, Indigenous students achieved a mean score of 440 points, compared to a mean score of 524 points for non-Indigenous students. The difference equates to more than one proficiency level or about two-and-a-half years of schooling. Thomson, et al. 2013. *PISA 2012: How Australia measures up*, pp 37 and 48 and 146.
6. In PISA 2012 students attending metropolitan schools achieved a mean score of 511 in mathematics, which was significantly higher than the mean score of 486 for students attending provincial schools, which in turn was significantly higher than the mean score of 444 for students attending remote schools. The mean score difference between students attending metropolitan schools and students attending rural schools was 67 score points on average, the equivalent of almost two years of schooling.

In science, students attending metropolitan schools achieved a mean score of 527, which was significantly higher than the mean score of 509 for students attending provincial schools, which in turn was significantly higher than the mean score of 470 for students attending remote schools. The mean score difference between students attending metropolitan schools and students attending rural schools was 57 score points on average, the equivalent of more than one-and-a-half years of schooling. Thomson, et al. 2013. PISA 2012: How Australia measures up, pp 35, 36 and 145.

7. In PISA 2012 students in the highest socioeconomic quartile achieved a mean score of 550 points in mathematics, which was significantly higher than the mean score for students in the lowest socioeconomic quartile of 463 points. This difference of 87 score points equates to almost one-and-a-half proficiency levels or around two-and-a-half years of schooling. In science, students in the highest socioeconomic quartile achieved a mean score of 567 points, which was significantly higher than the mean score for students in the lowest socioeconomic quartile of 479 points. This difference of 88 score points equates to over one proficiency level or around two-and-a-half years of schooling. Thomson, et al. 2013. PISA 2012: How Australia measures up, pp 38, 39, 147 and 148.

Student participation

A. In 2012 there were 30800 more students in Year 12 than in 1992, but 8000 fewer physics students; 4000 fewer chemistry students, and 12000 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 Like Learning Science category 'agreed a lot' with three of the five statements and 'agreed a little' with the other two, on average. Martin, et al. 2012. *TIMSS 2011 International Results in Science*, pp 331-2 and 335, and Mullis, et al. 2012. *TIMSS 2011 International Results in Mathematics*, pp 330 and 332.

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, et al. 2012. *TIMSS 2011 International Results in Mathematics*, p 263, and Martin, et al. 2012. *TIMSS 2011 International Results in Science*, p 232.