The Odd Couple: The Australian NAPLAN and Singaporean PSLE

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The use of high-stakes assessment to measure students' mathematical performance has become commonplace in schools all over the world. Such assessment instruments provide national or international comparisons of student (and potentially teacher performance). Each form of assessment is specialised in nature and is characteristic of the culture and intent of the governing bodies. The purpose of this paper is to highlight differences and similarities between two national high-stakes assessments.

In 2008 the inaugural National Assessment Program—Literacy and Numeracy (NAPLAN) was introduced and administered to all students in Years 3, 5, 7 and 9 across Australia. This was amidst controversy and differing opinions amongst educators and government representatives as to the use and benefits of such data in highlighting low performing schools (Klenowski & Wyatt-Smith, 2012). In the same year Singapore was recognised and reported as the second highest achieving country in the world in the 4th Grade Trends in International Mathematics and Science Study (TIMSS) (National Centre for Education Statistics, n.d.). Singapore is also a country familiar with national high-stakes testing with the Primary School Leaving Examination (PSLE) having been implemented since 1960. Apart from the longevity of the PSLE, another fundamental difference is the function of the respective assessment instruments.

The NAPLAN is one of the assessments under Australia's National Assessment Program which measures and determines whether or not Australian students are meeting important educational benchmarks. Consequently "the results from the assessment program will be used for individual student reporting to parents, school reporting to their communities, and aggregate reporting by States and Territories against national standards" (Curriculum Cooperation, n.d., cited in Lowrie & Diezmann, 2009, p. 144). In contrast, the PSLE is used as an entry level into secondary school and is therefore undertaken by Primary 6 Singaporean students (aged 10 and 11-years) in their final year of primary school (Tan, Chow, & Goh, 2008). The results in Singapore are used as a means for allocating and apportioning students into high school with a lot more accountability being placed upon the students rather than the schools involved. The functional differences across the NAPLAN and the PSLE are reflected in the design and structure of the test items. These design differences are analysed in this investigation and are drawn from a pilot study described elsewhere in this symposium (see Logan & Ho, this symposium).

The Australian NAPLAN

The design of the numeracy component of the NAPLAN is reflective of current classroom practice and the changing philosophy of the role of mathematics in the Australian classroom. There has been a notable trend over the past few years of bridging the gap between the abstract role of mathematics to making it relevant and applicable to student's lives (Boaler, 1993). It is therefore no coincidence that the newly developed Australian mathematics curriculum echoes a similar ideology as it purports to create "confident, creative users and communicators of mathematics, able to investigate, represent and interpret situations in their personal and work lives and as active citizens"

In V. Steinle, L. Ball & C. Bardini (Eds.), Mathematics education: Yesterday, today and tomorrow (Proceedings of the 36th annual conference of the Mathematics Education Research Group of Australasia). Melbourne, VIC: MERGA.

(Australian Curriculum, Assessment and Reporting Authority [ACARA], 2012). Consequently, items such as shopping lists, timetables, graphs and maps have replaced traditional algorithms and informal use of pictures in an attempt to improve students' ability to interpret events around them. This has increased the graphical nature of mathematics and subsequently the NAPLAN (Lowrie & Diezmann, 2009).

However, it is not just the nature of graphics that has changed over the past years but also their prevalence in assessing all strands of the curriculum. Previously graphics have predominately been associated with the Measurement and Geometry strand and incorporated to assess students' abilities to read rulers, graphs, 3D and 2D shapes, similar to their current use in the PSLE (see Figure 1). Yet in Australia—an increasingly graphical society (Lowrie & Diezmann, 2009)—graphics are now being used within Statistics and Probability as well as Number and Algebra. Often these graphics are used as alternatives to word problems and contain substantial information that traditionally would have been in written form. An example of this can be seen in Figure 1 where an Australian NAPLAN item has used a 'spinner' within a probability context rather than including the written description of the scenario within the question.

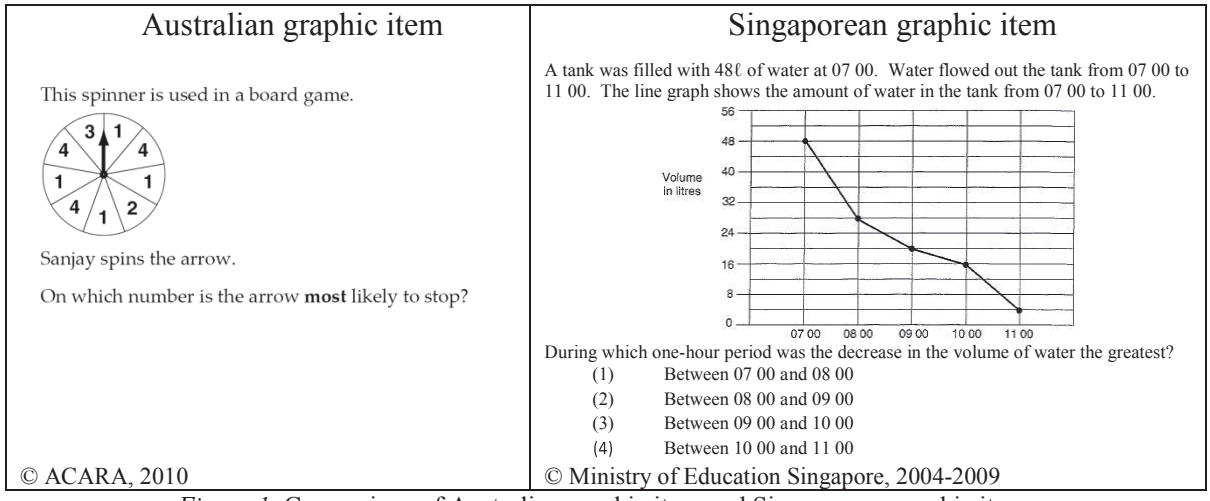

Figure 1. Comparison of Australian graphic item and Singaporean graphic item.

A repercussion of the use of such graphics has been the dramatic increase in their number within assessment. In an analysis of the Year 5 2010 NAPLAN, 31 out of the 40 items (78%) contained a graphic of some kind with only 9 items classified as 'non-graphic'. With such a high presence of graphics to scaffold thinking, "a whole new set of skills and practices is brought to the fore" (Lowrie, 2012, p. 154); in particular, the lack of opportunity to visualise and encode the data contained within an item when the graphic is already provided to decode.

The remaining 22% of the items found in the Year 5 NAPLAN resemble word problems found in many Australian textbooks. Often these problems involve a one-step mathematical procedure and are used as a means of reinforcing an algorithm. An example of this can be seen in Figure 2, where either one multiplication or division algorithm is required to determine the number of boxes needed by Lin for her cakes. Although there are items contained within the NAPLAN that resemble a non-graphic Singaporean item, they do not appear as often when compared to the PSLE.

The types of graphic and non-graphic items used within Australian assessment illustrate what is considered important in assessing a child's numeracy and has resulted in a

Lin is packing 34 cakes into boxes. Each full box holds 5 cakes. What is the smallest number of boxes Lin needs to pack all the cakes? © ACARA, 2010 *Australian non-graphic item*	There are some marbles in a tin. The marbles can be put into bags of 6 or 8 with no marbles leftover. When the marbles are put into bags of 10, there are 2 marbles leftover. What is the **smallest** possible number of marbles in the tin? © Ministry of Education Singapore, 2004-2009 *Singaporean non-graphic item*

Figure 2. Comparison of Australian non-graphic item and Singaporean non-graphic item.

high proportion of graphical and contextual items. Although the PSLE also uses graphic and non-graphic items they are considerably different due to the purpose and expectations behind it.

The Singaporean PSLE

It is noted that Singapore "has a world-class mathematics system in which all elements focus on students mastering concepts in order to solve challenging mathematics problems" (Ginsburg, Leinwand, Anstrom, & Pollack, 2005, p. 155) . There has been particular emphasis since the early 1990s on students developing strategies and models of problem solving to promote "independent, critical, and creative thinking" (Fan & Zhu, 2007, p. 491). In this way a stronger emphasis is placed on encoding the information within a task and applying appropriate mathematical strategies or problem-solving techniques (either visual or non-visual). It is also noted that Singapore's textbooks build "deep understanding of mathematical concepts through multistep problems and concrete illustrations that demonstrate how abstract mathematical concepts are used to solve problems from different perspectives" (Ginsburg, et al., 2005, p. xii).

This teaching philosophy is mirrored within Singaporean national assessment with a significantly larger proportion of non-graphic items found in the PSLE compared to the NAPLAN. In Lowrie's (2012) analysis of the two national tests (see Figure 3) it was found that Singaporean assessment presented a more balanced approach to using graphics in assessment items (nearly 50%).This difference can be explained by the use of graphics within the PSLE generally within the Measurement and Geometry strand (see Figure 1). Although there are some instances of the use of graphics in items within the Number strand of the PSLE, these are less frequent than in the NAPLAN. Consequently, there are few instances of graphics used as a substitute for word problems or in an effort to create a context.

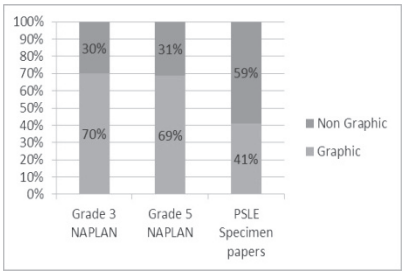

Figure 3. Proportion of graphic and non-graphic items in Australian (2009-2010) and Singaporean (2006-2010) national mathematics assessments (Lowrie, 2012, p. 96).

The structure of non-graphic items are also markedly different between the two tests with the PSLE reinforcing one of the primary aims of mathematics education in Singapore schools—to "develop the mathematical thinking and problem solving skills and apply these skills to formulate and solve problems" (Ministry of Education, 2006, p. 5) .

Consequently, a majority of the problems represented in the PSLE require more than one mathematical procedure or step and students are assessed on their ability to apply appropriate problem solving heuristics (see Figure 2).

Conclusion

The items used for this analysis were drawn from an instrument developed to analyse cross-cultural differences between Australian and Singaporean students (see Logan & Ho, this symposium). This paper has highlighted how the purpose and scope of the mathematics curriculum guiding both countries and the use of assessment and has direct implications on the types of items used. It is for this reason that the notion of the "odd couple" was incorporated into the title of this paper. Similar to the characters involved in the popular American television series, the NAPLAN and the PSLE have different characteristics and unique attributes but still co-exist under the same roof of national assessment. In the Australian context, the NAPLAN is used as a measure of school performance to increase the accountability of schools and teachers with a strong trend towards the use of graphics and real-world contexts (Lowrie & Diezmann, 2009). In Singapore, the accountability is placed upon the individual child as to their placement in a secondary school with an intentional push towards mathematical thinking and problem solving often within a 'non-graphic' context (Ginsburg, Leinwand, Anstrom, & Pollack, 2005). This analysis of the curriculum does not just reveal differences in assessment but obvious differences in the philosophy and content of mathematics education in both countries. Implications of this will be explored further in other papers included within the symposium (see Ho & Logan; Logan & Ho, this symposium).

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