

The practice of using NAPLAN numeracy test results: A review of the literature

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Considered by many as a source of valuable data and a potential to improve mathematics education, a significant amount of studies have been conducted on The National Assessment Program – Literacy and Numeracy (NAPLAN) test results. This study is a systematic literature review of 86 peer-reviewed journal articles published between 2008 and 2017 to investigate how NAPLAN numeracy test results were used in those studies. Findings showed NAPLAN results were used primarily to map student progress and identify strengths and weaknesses in teaching.

The National Assessment Program – Literacy and Numeracy (NAPLAN) is an annual assessment for of Australian students in Years 3, 5, 7 and 9, undertaken since 2008. This standardised test assesses students' reading, writing, language (spelling, grammar, and punctuation) and numeracy administered by the Australian Curriculum, Assessment and Reporting Authority (ACARA). The Federal Government pushes such assessment to achieve public accountability, demonstrate transparency, and maintain public confidence in the standards of the education system throughout Australia (Klenowski & Wyatt-Smith, 2012).

The NAPLAN test plays a key role in establishing and raising standards of learning (e.g., Hardy, 2014; Polesel, Dulfer & Turnbull, 2012). It is assumed that NAPLAN test results create opportunities for thoughtful dialogue and discussion to improve teaching and learning practices. In this regard, ACARA (2017) identified various areas to use NAPLAN test results for teachers, parents, schools and government bodies. For example, NAPLAN test results could be used to help teachers to challenge higher performers and identify students needing support. For parents, the NAPLAN test results supply individual student level reports to enable parents to see their child's progress over the course of their schooling. It also provides each school aggregated data to identify strengths and weaknesses within their teaching programs (Polesel, Dulfer & Turnbull, 2012). According to ACARA (2017), the NAPLAN test results can be used to;

- Challenge higher performers and identify students needing support
- Map student progress, identify strengths and weaknesses in teaching and set goals.
- Discuss progress with teachers and compare performance against national peers.
- Support good teaching and learning, and school improvement.

The present study used a systematic literature review of 86 peer-reviewed journal articles which focused on NAPLAN numeracy test results. The four purposes of the NAPLAN test results were categorised for the systematic literature review. The study investigates how NAPLAN numeracy test results were used in the reviewed journal articles in relation to the four purposes of NAPLAN results listed by ACARA (2017). The study focuses only on the numeracy test results. As a result, the study is guided by two research questions. Firstly, which purposes for the NAPLAN results are focused on in studies? Secondly, what are the gaps in using NAPLAN numeracy test results? The contribution of this study lies in the procedures used to review the articles in particular to mathematics education research, the use of

mathematics test results to inform practice in mathematics education and identify gaps to inform future mathematics education studies.

Background

Since 2008, the NAPLAN test results are available and reported as a mean scale score compared to the national minimum standard (such as the skills and understandings students can demonstrate at their particular year of schooling, in a specific subject area or domain) (ACARA, 2017). The report is also available to be selected by gender, indigenous status, language background, geolocation, parental occupation and parental education at each year level and for each domain (reading, writing, spelling, grammar and punctuation, and numeracy) of the test (ACARA, 2017).

Results from NAPLAN test have a number of potential uses. They can be used to monitor the performance of the education system, inform classroom practice, ensure that students have met required educational standards and encourage teacher and schools for their students' performance (ACARA, 2017; Rosenkvist, 2010). The NAPLAN test results can also provide schools with data to analyse and sense trends occurring in schools that can inform planning and policy decisions (Perso, 2009). According to ACARA (2017), the NAPLAN results can be used for four purposes.

Firstly, the NAPLAN test results can be used to challenge higher performers and identify students needing support (ACARA, 2017). In this regard, there is a considerable body of research literature (e.g., Nichols and Berliner 2007; Stobart 2008; Taubman 2009; Darling-Hammond 2010) cited in (Lingard & Sellar, 2013, p.634) demonstrating the effects of standardised testing results to inform teachers' pedagogical practices and improve students learning outcomes. Therefore, individual NAPLAN results can support teachers to plan for individual student improvement (Perso, 2009).

Secondly, the NAPLAN test results provide useful information to map student progress, identify strengths and weaknesses in teaching and set future goals (ACARA, 2017). The NAPLAN test results are available in aggregated forms at the national and school level. As a result, schools can gain detailed information from NAPLAN test results about how they are performing and identify strengths and weaknesses which may lead to further attention and interventions. To identify strengths and weakness of students numeracy competency for future intervention, Hardy (2014) urged that the validity of the NAPLAN test is considered (measures of students' actual learning of mathematics) and to ensure well-understood measures of students' achievement.

Thirdly, the NAPLAN test results are good source of information to discuss students' progress and compare their performance against national peers (ACARA, 2017). This comparison and the reported outcomes of the test enable the Australian public to develop a general national perspective on student achievement and, more specifically, an understanding of how their child and schools are performing in relation to the national standards (ACARA, 2017). Such data are assumed to develop confidence in Australians that education resources are allocated to ensure that all students achieve meaningful learning during their time at school (Guenther, 2013).

Finally, at the system level, the NAPLAN test results provide education ministers with information about the success of their policies and resourcing in priority curriculum areas (ACARA, 2017). It also provides ministers with the capacity to monitor the success of policies aimed at improving the achievement of different student groups, such as indigenous students. Such data provide an additional suite of information, thus enhancing the capacity for evidence-based decision making about policy, resourcing and systemic practices at the system level (Klenowski & Wyatt-Smith, 2012).

In addition to the four purposes, the NAPLAN test results have become a powerful tool to describe education systems, assess teaching quality and determine school funding formulae (Guenther, 2013).

A significant number of studies have been conducted on NAPLAN and used NAPLAN results in their reports for various purposes. Hardy (2014) used NAPLAN numeracy results as useful data for grouping students to help improve their numeracy capabilities, and as a stimulus for teacher professional development. Burrows, Goldman, Olson, Byrne, and Coventry (2017) used NAPLAN test results to show the impact of increased consumption of sugar-sweetened beverages on numeracy test scores and suggested strategies to improve the students' numeracy competency.

This study used a systematic literature review of peer-reviewed journal articles published between 2008 and 2017 which focused on NAPLAN numeracy test results. The study investigated how NAPLAN numeracy test results were used in these studies in relation to the four purposes of NAPLAN numeracy test results.

Method

This study used a systematic literature review. The search was conducted in five scientific databases (i.e., Education Resources Information Center (ERIC), Web of Science, Scopus, Science Direct, and Academic Search Complete). The general search terms for all databases included the Boolean operators 'AND' and the wildcard (*) function. To limit the scope of the study, the review was limited to peer-reviewed articles published between 2008 and 2017, and full-text availability was required. In addition, studies focusing either only NAPLAN numeracy or both of NAPLAN literacy and numeracy were used in the review. When the studies were on both numeracy and literacy aspect, only the numeracy aspect was considered for further review.

Similar to the suggestion by Cronin, Ryan, and Coughlan (2008), this study followed the steps shown in Figure 1 to conduct the systematic review. The review passed through 5 steps from identifying the search term to categorising search results according to their focus.

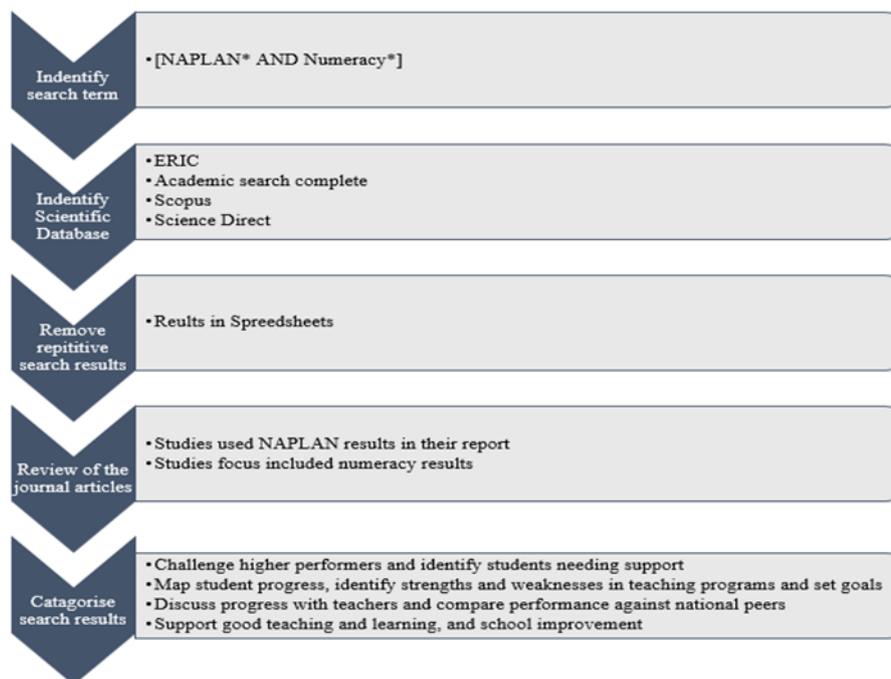


Figure 1. Database search and review process.

The initial search yielded 284 studies. However, further screening (availability of the full report, relevant to NAPLAN test results and removing repetitive search results) resulted in 160 journal articles.

Additional screening (studies used NAPLAN results in their report and studies focusing on NAPLAN numeracy test results) revealed 86 peer review journal articles. The search result across each search engine and publication year is shown in Table 1. All the studies used the quantitative NAPLAN numeracy test results (mean scores) in their reports.

In the end, these journal articles were reviewed and categorised according to the four purpose criteria (ACARA, 2017) mentioned in the background section.

Table 1

Relevant Search Results for Review

Search Source	Year published									Total
	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Scopus	0	0	1	2	5	5	5	8	8	34
Science Direct	0	0	0	2	0	5	7	7	12	33
ERIC	4	1	1	2	3	0	1	0	0	12
Academic Search complete	0	0	0	0	0	0	0	6	0	6
Web of Science	0	0	0	0	0	0	0	0	1	1
Total	4	1	2	6	8	10	13	21	21	86

In order to get a more comprehensive understanding, articles were further categorised according to year level (Years 3, 7, 9 or only primary, secondary or both or no year level focus) and type of school (government or non-government [independent, Catholic] or both or not mentioned). A spreadsheet was used to document, extract information about the categories and analyse the data.

Results and Discussion

As shown in Table 2, seven studies (8.1%) used NAPLAN numeracy test results in their report to identify higher performers and students needing support. For example, Perso (2009) analysed NAPLAN test items and indicated that students need to be taught how to deal with the literacy demands of a task if students are to become numerate.

Table 2

Purpose and Year Level

Purpose	Year published									Total
	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Map student progress, identify strengths and weaknesses in teaching and set goals	0	0	1	0	0	3	4	4	13	25 (29.1%)
Support good teaching and learning, and school improvement	0	0	0	1	1	1	5	5	3	16 (18.6%)
Discuss progress with teachers and compare performance against national peers	0	0	1	2	1	2	2	5	2	15 (17.4%)
Challenge higher performers and identify students needing support	2	0	0	0	0	1	0	2	2	7 (8.1%)
Others	2	1	0	3	6	3	2	5	1	23 (26.7%)
Total	4	1	2	6	8	10	13	21	21	86

A large number of studies (N = 25 (29.1%)) used NAPLAN test results in their report to map student progress, identify strengths and weaknesses in teaching and set goals. Using multilevel modelling to account for within-school variables, Chua, Khan, Humphry, and Hassell (2017) analysed NAPLAN test results to estimate the effect of the national partnerships on student performance. The results indicated that on average male students performed higher in the numeracy test. Vetter, O'connor, O'Dwyer, and Orr (2015) argued the importance of fitness for general numeracy competency. Similarly, Burrows et al. (2017) showed that increased consumption of sugar-sweetened beverages was associated with significantly lower test scores in numeracy. To identify students needing support for their numeracy competency, Brew, Toelle, Webb, Almqvist, and Marks (2014) used NAPLAN test results to investigate the effect of omega-3 fatty acid supplementation on subsequent numeracy performance in children. All these studies used NAPLAN test results to identify the possible reason for students' weak achievement in numeracy with little suggestion on the possible strategies to improve their numeracy competency.

The search results revealed sixteen studies (18.6%) focusing their report on supporting good teaching, learning, and school improvement. Hardy (2015, p.335)'s research showed schools that dominated with high numeracy results indicated good teaching practice and demonstrated the schools' focus on the students as 'valued capitals.' Similarly, Polesel, Dulfer, and Turnbull (2012) demonstrated that NAPLAN test results are used in schools as a source of information to plan intervention and engaging in curriculum development practices to improve teaching and learning in the school.

Fifteen (17.4%) studies focused on NAPLAN results to map student progress and compare performance against national peers. Ford (2013) analysed the inequality of achievement between indigenous and non-indigenous students in the States and Territories, with particular reference to New South Wales and the Northern Territory. In relation to comparing students against national peers, Marks (2016) used NAPLAN results to show the relative effects of socio-economic, demographic, non-cognitive and cognitive influences on student achievement in Australia. Others used NAPLAN results to compare national peers and suggest improved strategies for teachers in relation to mobile learning (Males, Bate, & Macnish, 2017), disability (Teather & Hillman, 2017), class size (Watson, Handal, & Maher, 2016) and NAPLAN scores.

There were a large number of studies (N = 23 [26.7%]), in the search result, which used NAPLAN numeracy test results in their report, with a different focus than those listed by ACARA (2017). For example, a study by Quinnell and Carter (2013) draws the reader's attention to the large variety of symbols, abbreviations, and conventions used in the NAPLAN numeracy tests. Norton (2009) provided a critique of the Year 9 NAPLAN numeracy test and how results might inform teaching mathematics. Norton (2010) used Year 9 NAPLAN numeracy test results to examine pre-service teachers' mathematics content knowledge. Rogers, Barblett, and Robinson (2016) investigated the impact of NAPLAN numeracy tests on student, parent and teacher emotional distress in independent schools. This result showed that the NAPLAN test results were not limited to the four purposes listed by ACARA (2017).

The review also considered the trends of these studies across publication year as shown in Figure 2. Studies published toward 2017 have an increased focus on supporting good teaching and learning through analysing test results.

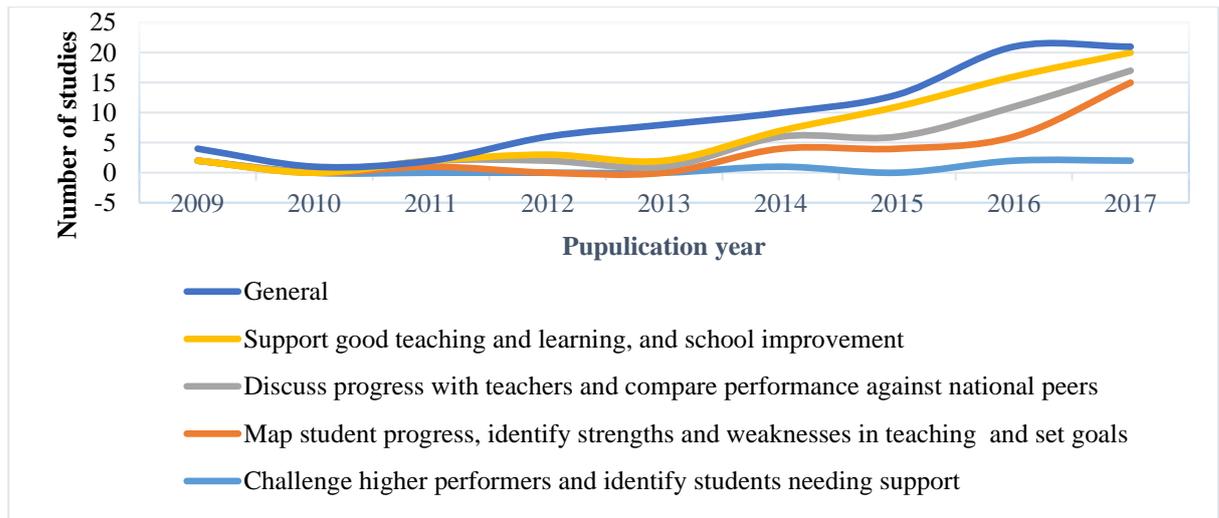


Figure 2. Trends of using NAPLAN results from 2009 to 2017.

As shown in Table 3, studies conducted at primary schools (N = 15), focused on their report to map student progress, identify strengths and weaknesses in teaching. Whereas, a significant number of studies were conducted combining both primary (Years 3 and 5) and secondary (Years 7 and 9) school NAPLAN numeracy test results (N = 37) and their primary focus was diverse (such as mathematics teachers perception on NAPLAN testing).

Table 3

Trends in the Studies Across Year Levels

Purpose	Year level							Total
	3	5	7	9	Primary	Secondary	Both	
Map student progress, identify strengths and weaknesses in teaching and set goals	5	2	2	1	4	4	8	25
Support good teaching and learning, and school improvement	3	1	0	1	4	3	4	16
Discuss progress with teachers and compare performance against national peers	2	0	0	0	1	3	9	15
Challenge higher performers and identify students needing support	1	1	0	0	4	0	1	7
Others	1	0	0	0	2	4	15	22
Total	12	4	2	2	15	14	37	86

The search result showed that most of these studies were conducted with a combination of government and non –government schools (N = 40[46.5%]). Twenty-five studies (29%) were conducted in government schools, and eight were conducted in non – government schools. The remaining studies (N = 13[15.1%]) didn't explicitly mention the type of schools included in their report.

Conclusion

The purpose of this review was to investigate how NAPLAN numeracy test results were used in the 86 peer-reviewed journal articles in relation to the four purposes of NAPLAN

results listed by ACARA (2017). From the review results, NAPLAN numeracy test results were used for various purposes in the reviewed studies. However, as this systematic review showed, a large number of studies used NAPLAN test results to map student progress, identify strengths and weaknesses in teaching. Hardy (2014) showed the importance of using NAPLAN test results as a source of evidence for grouping students to help improve their numeracy capabilities. Au (2013) examined the impact of childhood obesity on academic performance and identified children requiring support to improve their numeracy competency. Smith et al. (2014) grouped students as breakfast skippers and non-breakfast skippers impacting their NAPLAN scores on which breakfast skippers scored lower NAPLAN scores in numeracy. These studies identified possible reasons for students' performance, with limited recommendations for relevant interventions to improve students numeracy competency.

Interestingly, a significant number of studies used NAPLAN numeracy test results different from the four purposes provided by ACARA (2017). For example, Tayler et al. (2016) showed the importance of NAPLAN scores to provide evidence on how best to invest in Early Childhood Education and Care. Males, Bate and Macnish (2017) studied the impact of mobile learning on students NAPLAN scores. These studies show that the NAPLAN numeracy test results can be analysed for a wide variety of purposes, not limited to the four purposes provided by ACARA (2017). In addition, these studies (Males, Bate & Macnish, 2017; Tayler et al., 2016), used well-thought-out, valid research to evidence the impact of various interventions, (e.g., using technologies) on students' performance in numeracy.

A limited number of studies used the NAPLAN numeracy results to challenge higher performers and identify students needing support. It was the expectation of this study that majority of the reviewed articles would focus on this purpose. Polesel, Dulfer & Turnbull (2012) warn that the focus on NAPLAN test results has shifted the culture of some schools to 'teach to the test' and identify students needing support prior to sitting NAPLAN. . It is the contention of this study that studies identifying students needing support will support schools to plan interventions for students who are in most need with the intention of increasing success in their numeracy. In this regards, Hardy (2015) suggested that identifying high or low NAPLAN tests scores of students is an essential element in the provision of support and design interventions.

The authors recommend the following directions for future research on NAPLAN numeracy test results. First, even though a large number of studies used NAPLAN test results to map student progress, identify strengths and weaknesses in teaching, none of these questioned the validity of the NAPLAN tests. Future studies focusing on the validity of the NAPLAN tests are fundamental to use the results for multiple purposes. In this regard, Hardy (2014) recommended the importance of valid tests to inform future planning and intervention. Secondly, as the review results elicited, a limited number of studies used NAPLAN numeracy test results to identify students' weakness and suggest possible strategies to improve the result. Future studies could focus on identifying students' weakness in a specific mathematics branch such as algebra, measurement, geometry, probability or statistics. This could support teachers, schools, and policymakers to plan relevant interventions at national, school and individual student level. Finally, future studies should focus on assisting teachers with data analysis of NAPLAN numeracy results (such as item analysis, using item analysis report) to evaluate students' performance and plan their teaching and learning programs.

This study is limited to a review of peer-reviewed journal articles and a few search engines. Broader inclusion of publications (such as conference papers, and books) and a range of search engines could provide a more compressive picture about the use of NAPLAN numeracy test results. However, this study could be used as a starting point for similar studies.

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