National Numeracy Study

Supported by independent evidence-based research

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Preamble and Acknowledgements

This study is not the culmination but rather a point in time in our journey to produce better results for schools. It is a journey that began ten years ago in Australia and the results of this study feed from years of research, feedback, iteration and hardwork.

Both Delvene and I have worked in education all our adult lives and as former teachers, we appreciate that schools would want to have access to the most appropriate tools for their students. For years we have had the instinctive feeling that Mathletics has a positive impact on numeracy results. We've also had anecdotal evidence passed on to us via feedback from our schools. To unpack and understand this further, we wanted to dig deeper. We began examining the impact of Mathletics usage on NAPLAN results back in January 2014. This developed into a nationwide research study of numeracy results in over 8,000 schools. We then sought partnership with a university to have our findings verified and confirmed.

Dr. Tony Stokes of the Australian Catholic University in Sydney authored the final report. We would like to thank Dr. Stokes for his work on this study. His experience as a lecturer in Education and Economics and as a high school maths teacher has been invaluable to us. He has helped us better understand how Mathletics can support stronger learning outcomes.

Most importantly, we would like to thank our Mathletics community for working with us over the years. The ideas and feedback we receive on a daily basis have helped us produce enhanced and richer resources. The positive connection we have with our community is extremely important to us.

We will support schools to further increase the advantage in results that students are attaining from Mathletics. By spending as little as 30mins each week on curriculum activities, schools can gain a potential advantage of more than nine percent in NAPLAN. Working collaboratively with schools, we want to do our best to lift the performance of every Australian student. A nine percent lift per student would put us right back near the top of global performance tables.

We can do this together.

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Disclaimer: NAPLAN data sourced from the My School (www.myschool.edu.au) website, with permission from the Australian Curriculum, Assessment and Reporting Authority (ACARA). ACARA does not endorse Mathletics or the methodology used for this analysis.

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Executive Summary

This study measures the impact of using Mathletics in schools from 2007 to 2012 on the National Assessment Program Literacy and Numeracy (NAPLAN) test results. Data from 2008, 2010 and 2012 results was collected and analysed as part of this study. The data was sourced from the My School* website, with the average NAPLAN scores of approximately 8,000 schools collected. Individual student results have not been collected and analysed in this study; it focuses solely on average school results. Put simply, the study compares the average NAPLAN scores of schools that used Mathletics during the period, to schools that did not use Mathletics. While a small number of schools can be compared over the four test periods, most schools can only be measured for Primary Schools (Years 3 and 5) and Secondary Schools (Years 7 and 9).

Further analysis looked at the level of usage in Mathletics schools to ascertain if there was a correlation between higher levels of usage and better NAPLAN scores. Mathletics is made up of a variety of resource types and for the purpose of this study, usage is determined by the number of curriculum activities completed on average by schools. A curriculum activity is comprised of a set of 10 questions that are completed by students.

The comparsion of average NAPLAN scores of schools that had adopted Mathletics, and those that had not, indicates a highly significant correlation between the use of Mathletics and improved NAPLAN results. Furthermore, it is clear that higher levels of usage equate in stronger NAPLAN results.

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The impact on the use of Mathletics on schools' NAPLAN results

The adoption of Mathletics by schools, shows a significant improvement in NAPLAN results when compared to schools that did not use it (See Section 1). The advantage in NAPLAN scores to Mathletics schools is up to 9 percent. For example, the 2012 year 3 average NAPLAN score was 384 for schools without Mathletics, while schools with Mathletics received up to 35 additional marks if they completed 120 activities. The results also indicate that students achieve a significantly greater improvement in test scores when they have used Mathletics for two years instead of one.

The relationship between the average number of activities completed by students and NAPLAN results

The completion of higher numbers of activities by students in Mathletics schools further improves the NAPLAN results compared to non-Mathletics schools (Section 2). The higher results for students who complete the activities have increased over the period 2008 to 2012. While all cohorts achieve better test scores from undertaking the activities, the highest returns have occurred in Year 9 students.

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Is there an optimum number of activities that students should complete?

Overall the general trend shows that the more activities students complete, the better the NAPLAN performance of a school tends to be. The results show that in most years, the NAPLAN test scores are maximised when an average of 120 activities are completed by each student over each school year. However, once students complete more than 80 activities the benefit of completing additional activities is reduced. As a result this study concludes that an optimum level of activities, considering the time that is allocated, is around 80 (See Section 3). This equates to an average of 2 activities per week.*

Does socio-economic background and the use of Mathletics impact on the performance of users?

Students of schools from higher socio-economic backgrounds tend to perform better overall in NAPLAN tests than those from lower socio-economic backgrounds. However, the results in the 2012 NAPLAN tests indicate that students of schools from lower socio-economic backgrounds actually achieved a greater level of improvement from each additional Mathletics activity completed, compared to schools from higher socio-economic background. (See Section 4).

How does the performance vary between the states and territories?

While there is considerable difference in the performance of users of Mathletics between the states and territories, the results show that schools that use Mathletics appear in the top 10 percent of school results in NAPLAN tests, more frequently than schools that do not use Mathletics (See Section 5).

Key Findings

The results suggest that using Mathletics has a significant impact on the results of schools in NAPLAN tests. Students from all cohorts benefit from using the program and gain the greatest benefit when it is used over a number of years. The more activities students complete, the higher the NAPLAN results tend to be. The study also found that the results of schools, in which an average of 80 activities were completed (by each student), were significantly higher than those in schools that did not use Mathletics. Similarly these results were higher than those of Mathletics schools compared to schools with lower levels of completed activities.

* Global average for completing a Mathletics activity is 6.5 minutes.

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Section 1: The impact of the choice to adopt the Mathletics resource by a school

The adoption of Mathletics by a school overall does improve NAPLAN results compared to schools that do not. There have only been small changes in the mean scores achieved by all schools completing NAPLAN over the three periods of testing: 2008, 2010, 2012 (Table 1).

Table 1: Mean scores in the NAPLAN tests 2008, 2010 and 2012

Year group tested	2008	2010	2012
Year 3	397	393	392
Year 5	474	486	484
Year 7	540	543	532
Year 9	579	581	581

As shown in Table 1, the largest improvements in NAPLAN scores occur in the earlier years of education rather than the later years. For example, in 2012 the average rise in NAPLAN scores from Year 3 to Year 5 was 92 marks, compared to 49 marks for students between Year 7 and Year 9.

Table 2 compares the NAPLAN results achieved by schools that have Mathletics to those that did not. It can be seen that schools that used Mathletics outperform schools that do not.

Table 2: Mean scores for schools with and without Mathletics in the year of the NAPLAN tests 2008, 2010 and 2012

Year group tested	2008 Mathletics	2008 without Mathletics	2010 Mathletics	2010 without Mathletics	2012 Mathletics	2012 without Mathletics
Year 3	411	395	401	387	398	384
Year 5	488	472	493	480	489	477
Year 7	552	537	550	540	535	528
Year 9	590	577	585	578	583	578

The following table shows the benefit of using Mathletics compared to not. The results show the additional marks achieved by students. The table also shows the additional benefit gained for an extended period i.e two years. Note, the additional extra marks gained by having Mathletics for a second year are in addition to those extra marks gained after using Mathletics for one year.

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Table 3: Average additional marks achieved by students in schools that had Mathletics

Number of years using Mathletics	Year 3	Year 5	Year 7	Year 9
1 Years	7.6 marks	8.0 marks	10.2 marks	3.3 marks
2 Years (extra marks in addition to 1 year)	20.4 marks	18.9 marks	NA	13.0 marks

It is important to note that school results improved by a larger amount when Mathletics was used for more than one year. The benefit of using Mathletics for only one year is limited due to the fact that students only benefit from using the resource up to the time of the NAPLAN test. Students in Years 3, 5, 7 and 9 sit for the NAPLAN test in May each year. The results show that students achieved a significantly greater improvement in test scores when they used the resource for two years instead of one.

Section 2: The impact of using Mathletics for more than one year

The following tables show the benefit of using Mathletics over multiple years. Each table details the additional NAPLAN marks achieved by students in Mathletics schools for each activity completed. The analysis indicates that there are further marks gained per activity in the second year of Mathletics use. These marks are in addition to the extra marks gained in the first year of use. Therefore, schools that used Mathletics for two years in the lead up to the NAPLAN test achieved approximately double the advantage over schools that used Mathletcss for the year of the NAPLAN test only.

Table 4: Year 3 additional marks achieved on average by students per activity completed for 2008, 2010 and 2012 NAPLAN tests

Extra marks per activity	2008	2010	2012
1st Year	0.11*	0.14*	0.23*
2nd Year	0.13**	0.14*	0.26*
Combined	0.24	0.28	0.49

Statistical significance levels, *0.000, **0.01.

Table 5: Year 5 additional marks achieved on average by students per activity completed.

Extra marks per activity	2008	2010	2012
1st Year	0.12*	0.16*	0.27*
2nd Year	0.08***	0.15*	0.29*
Combined	0.20	0.31	0.56

Statistical significance levels, *0.000, **0.01.

Table 6: Year 7 additional marks achieved on average by students per activity completed.

Extra marks per activity	2008	2010	2012
1st Year	0.11*	0.20*	0.25*

Statistical significance levels, *0.000, **0.01. Second year calculations are not shown due to students in most states moving between primary and secondary school which introduces too many variables that would impact learning outcomes.

Table 7: Year 9 additional marks achieved on average by students per activity completed.

Extra marks per activity	2008	2010	2012
1st Year	0.14*	0.18*	0.32*
2nd Year	0.12***	0.24*	0.39*
Combined	0.26	0.42	0.71

Statistical significance levels, *0.000, **0.01.

Of the four NAPLAN years, Year 9 schools receive the greatest benefit per activity by using Mathletics in both the first and second year (Table 7).

Table 8 shows the average number of activities completed by students who used Mathletics over the period 2007-2012. In the early period of 2007-2008 more activities were completed in the year of the NAPLAN test than the lead up period in the year preceding it. In more recent times the average number of activities completed in the two years is similar. While there has been a decline in the average number of activities attempted during the period, the additional marks that are achieved per activitiy has increased. This could be due to the additional resources outside the core activities that have been added to Mathletics in the period 2007-2012. It is possible that use of the additional resources by students improves the efficacy of Mathletics for schools in NAPLAN.

Table 8: The average number of activities attempted per user

	2007	2008	2009	2010	2011	2012
Year 3	62	79	70	67	51	51
Year 5	61	75	70	67	50	50
Year 7	NA	58	NA	54	NA	46
Year 9	54	65	60	58	43	44

Section 3: Is there an optimum number of activities that students should complete?

Overall, the general trend shows that the more Mathletics activities schools complete the better the NAPLAN performance tends to be. Table 9 shows the additional marks that students achieved on average, compared to students from schools that did not have Mathletics. It should be noted that the sample size for schools with an average of more than 140 activities is small and statistically limited.

Table 9: Predicted scores in the NAPLAN test based on activities completed for 2012

	No Mathletics	40 activities	80 activities	120 activities	160 activities	Optimum number of activities
Year 3	384	399	416	419	401	120
Year 5	477	492	509	513	503	120
Year 7	528	543	560	568	566	140
Year 9	578	590	608	613	605	120

The calculations for Table 9 are based on a curve estimation of the NAPLAN scores and the number of activities attempted. This produces a slightly different result from measuring the average performance of the schools. The curve estimation proved to be the most significantly accurate measure to estimate the real performance of the students based on activities attempted. It shows that the gain from completing additional activities eventually plateaus.

The results show that in most years the Naplan test scores are maximised when around 120 activities are completed by each of the students. It should be noted though that the extra marks achieved from doing the extra activities does decline once students complete more than 80 activities. For example, in Year 3 increasing completions from 80 to 120 activities only improves the test score on average by 3 marks. This suggests that an optimum level of activities considering the time that is allocated is around 80.

Section 4: Does socio-economic background and the use of Mathletics impact on the performance of schools?

Students who come from higher socio-economic backgrounds tend to overall perform better in NAPLAN. The results show that, on average, students from higher socio-economic background schools achieve a mark of between 33 - 36 more than students from lower socio-economic background schools. The results for the 2012 NAPLAN tests show that students from lower socio-economic background schools actually achieved a greater level of improvement from each additional Mathletics activity (Table 10) completed, when compared to students from all schools (Tables 4-7).

Table 10: Average additional marks per activity, achieved by students from low socio-economic background schools.

Cohort	2012 only	2011 and 2012
Year 3	0.34*	0.41*
Year 5	0.33*	0.39*
Year 7	0.31*	NA
Year 9	0.35*	0.47*

Statistical significance levels, * 0.000, ** 0.01, ***0.05

The 2012 activity results demonstrate that students from low socio-economic background schools actually complete a smaller number of Mathletics activities (Table 8) compared to students from all schools, which includes students from high socio-economic backgrounds. The results suggest that performance in NAPLAN would improve for students from low socio-economic background schools if they completed at least the same number of Mathletics activities as an average student. For example a Year 9 student from a low socio-economic background school could improve their results in the 2012 NAPLAN test on average by 21 (0.47 x 44) marks if they completed the activities in 2011 and 2012, compared to a student who did not have the advantage of Mathletics.

Table 11: The average number of activities attempted by students from low socio-economic background schools for the 2011 and 2012 NAPLAN Test.

Cohort	2011	2012
Year 3	48	46
Year 5	48	45
Year 7	NA	41
Year 9	36	39

Section 5: How does the performance vary between the states and territories?

This section examines the top 10 percent of school NAPLAN scores. It compares the number of times the number of Mathletics and non Mathletics schools appear.

The results show that, while there is a considerable difference in the performance of users of Mathletics between the states and territories, the schools that use Mathletics appear more often in the top 10 percent of results compared to those that do not.

These differences could be explained by the demographic differences between the states and territories and the proportion of schools who use Mathletics. For example in 2012, the Year 9 NAPLAN test results had a top 10 percent cutoff of 645 and 642 in NSW and Victoria respectively, but only 574 in Northern Territory and 612 in Queensland. The use of Mathletics varied between the states and territories with the highest use in Victoria (64.2%), Western Australia (62.1%) and New South Wales (54.6%) and the lowest use in South Australia (38.5%) and Northern Territory (39.2%).

Except for the 2012 Year 9 NAPLAN test in Victoria, schools that had Mathletics outperformed schools that did not use Mathletics with regard to achieving results in the top 10 percent. In some states and territories, especially where a relatively small percentage of schools used Mathletics the differences were quite large. For example in ACT in the Year 7 NAPLAN test, 22.3 percent of schools using Mathletics achieved marks in the top 10 percent, compared to only 2.1 percent for those who did not use Mathletics (Table 13).

Table 12: Percentage of schools in the top 10% based on NAPLAN scores in 2012 across Australia.

Year group tested	with Mathletics	without Mathletics
Year 3	13.7 %	6.3%
Year 5	13.0 %	7.1 %
Year 7	14.7 %	7.8 %
Year 9	12.0 %	8.7 %

Table 13: Percentage of schools in the top 10% based on average NAPLAN scores in 2012 in Australian Capital Territory.

Year group tested	with Mathletics	without Mathletics
Year 3	12.6 %	7.2 %
Year 5	15.5 %	4.8 %
Year 7	22.3 %	2.1 %
Year 9	16.8 %	5.9 %

Table 14: Percentage of schools in the top 10% based on NAPLAN scores in 2012 in New South Wales.

Year group tested	with Mathletics	without Mathletics
Year 3	14.0 %	6.2 %
Year 5	12.8 %	6.5 %
Year 7	12.1 %	9.0 %
Year 9	11.4 %	8.5 %

Table 14: Percentage of schools in the top 10% based on NAPLAN scores in 2012 in Victoria.

Year group tested	with Mathletics	without Mathletics
Year 3	10.6 %	8.8 %
Year 5	11.7 %	7.8 %
Year 7	11.3 %	8.9 %
Year 9	9.8 %	11.5 %

Table 15: Percentage of schools in the Top 10% based on NAPLAN scores in 2012 in Western Australia.

Year group tested	with Mathletics	without Mathletics
Year 3	14.3 %	3.3 %
Year 5	12.5 %	5.8 %
Year 7	15.4 %	5.8 %
Year 9	12.4 %	5.1 %

Table 16. Percentage of schools in the top 10% based on NAPLAN scores in 2012 in Northern Territory.

Year group tested	with Mathletics	without Mathletics
Year 3	20.8 %	3.8 %
Year 5	21.6 %	7.1 %
Year 7	21.0 %	3.7 %
Year 9	15.9 %	4.2 %

Table 17: Percentage of schools in the top 10% based on NAPLAN scores in 2012 in Queensland.

Year group tested	with Mathletics	without Mathletics
Year 3	13.1 %	8.2 %
Year 5	14.9 %	6.7 %
Year 7	13.0%	9.1 %
Year 9	13.2%	7.5 %

Table 18: Percentage of schools in the top 10% based on NAPLAN scores in 2012 in Tasmania.

Year group tested	with Mathletics	without Mathletics
Year 3	10.4 %	9.7 %
Year 5	12.0 %	9.4 %
Year 7	16.0 %	6.3 %
Year 9	17.0 %	8.0 %

Table19. Percentage of schools in the top 10% based on NAPLAN scores in 2012 in South Australia.

Year group tested	with Mathletics	without Mathletics
Year 3	12. 7 %	8.6 %
Year 5	10.6 %	9.8 %
Year 7	11.4 %	8.7 %
Year 9	12.7 %	8.6 %

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Conclusion

The results of this study clearly indicate that using Mathletics has a highly significant impact on the average attainment of schools in the NAPLAN test. School results for all cohorts have benefited from using the program and gain the greatest benefit when they use it over a number of years. The more activities completed by students the higher the school test scores tend to be.

The results also suggest that there is an optimal amount of activities, which completed, will result in the greatest NAPLAN advantage. This is typically 80 activities on average per student, or two activities per week.

The results show there is an even greater advantage for schools from lower socio-economic backgrounds when using Mathletics. The lower socio-economic background schools on average achieved a greater improvement in their test scores, the more Mathletics activities that are completed. This is compared to Mathletics schools from higher socio-economic backgrounds, or schools that do not use Mathletics.

This study also shows that schools that use Mathletics appear in the top 10 percent of school scores more frequently than those that do not.

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About Mathletics

Mathletics is an online numeracy product for schools and students across grades K-12 and is used by over 50% of Australian schools. Mathletics provides a personalised learning environment which intelligently caters to each student. Questions are dynamically delivered according to a student's responses, which ensures the degree of difficulty reflects their understanding. This helps optimise their learning experience and enhances the value of their time spent online. To support mastering concepts, Mathletics combines three innovations:

- intelligent adaptivity to ensure questions are appropriately challenging and get progressively harder;
- animated visualisations of each question type to allow students to direct their own learning and reinforce understanding; and
- time saving tools for educators to customise courses for small groups or individuals and to set learning pathways

To learn more about Mathletics visit www.3plearning.com/mathletics

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