Annual Numeracy Program Report 2013

The SiMERR National Research Centre
The University of New England
ARMIDALE NSW

quicksmart

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Acknowledgements

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1 *QuickSmart* in 2013

In 2013, the *QuickSmart* team at the University of New England received data from 7803 students who participated in *QuickSmart* Numeracy lessons and 2033 average-achieving comparison peers. These students were drawn from schools from 28 regions around Australia. Further data were also submitted for independent analysis to the Northern Territory (NT) Department of Education and Training by NT schools.

The analyses presented in this report provide information about students' performance on the Cognitive Aptitude Assessment System, Australian version (OZCAAS) and on standardised test measures, specifically the Progressive Achievement Tests in Mathematics (ACER, 2005). Some schools provided data for other independent tests, however there was insufficient use of these tests for inclusion in this report. Further investigation of the data provided in this report examines the results in terms of gender and for the participating Indigenous students.

2 Background

2.1 Purpose of *QuickSmart*

The prime purpose of the *QuickSmart* program is to reverse the trend of ongoing poor academic performance for students who have been struggling at school and who are caught in a cycle of continued failure. These targeted students experience significant and sustained difficulties in basic mathematics and/or literacy, and have a profile of low progress despite attempts to overcome their learning problems. Many such students have not drawn lasting benefits from other in-class and withdrawal instructional activities.

The *QuickSmart* professional learning program is designed for classroom teachers, special needs support teachers, and paraprofessionals to learn how to work with, and significantly improve, the learning outcomes in basic mathematics and literacy of under-achieving middle school students. The program features professional learning and support for working in a small class instructional setting with two students, using a specially constructed teaching program supported by extensive material and computer-based resources.

2.2 *QuickSmart* program description

The *QuickSmart* Numeracy and Literacy interventions were developed through the National Centre of Science, Information and Communication Technology and Mathematics Education for Rural and Regional Australia (SiMERR) at the University of New England, Armidale. The *QuickSmart* programs have been under development and continuous improvement since 2001.

The intervention is called *QuickSmart* to encourage students to become *quick* in their response speed and *smart* in their understanding and strategy use. In *QuickSmart*, the aim is to improve students' information retrieval times to levels that free working-memory capacity from an excessive focus on mundane or routine tasks. In this way, students are able to engage meaningfully with more demanding cognitive activities. In these interventions, automaticity is fostered; time, accuracy and understanding are incorporated as key dimensions of learning; and an emphasis is placed on ensuring maximum student on-task time. *QuickSmart* lessons develop learners' abilities to monitor their academic learning and set realistic goals for themselves.

3 Overall *QuickSmart* results

Two major sets of analyses quantify the benefits of the *QuickSmart* program. The first analysis examines data from speed and accuracy OZCAAS measures related to arithmetic operations collected at the beginning and end of the *QuickSmart* program. These results are a direct measure of the work of *QuickSmart* instructors and reflect the primary focus of the *QuickSmart* lessons.

The second set of analyses concern the results of independent tests in mathematics. Most schools have utilised the PATM (Progressive Achievement Test Mathematics) assessment. This is a standardised test developed by the Australian Council for Education Research (ACER). The PATM is an independent test taken prior to commencement of *QuickSmart* and at the completion of the program. Students' PATM results provide information about how the knowledge, skills and attitudes developed in *QuickSmart* are used and how they transfer to other broad areas of mathematics.

The results from these analyses are reported below in separate sections and include further analyses of the data by gender and for participating Indigenous students.

3.1 Results on the OZCAAS assessments

Six tests measured students' speed and accuracy both before *QuickSmart* began and at the end of the program. The tests were: (1) Addition to 20 facts; (2) Addition facts; (3) Subtraction to 20 facts; (4) Subtraction facts; (5) Multiplication facts; and (6) Division facts. To assist with interpretation of these results, the tests are shown below in reverse order as often the most revealing results are shown in the operations which are at first weakest, in this case division. A detailed analysis of division is also provided. It is important to note that interpretation of results in some other operations (e.g., addition to 20) can be impacted by a 'ceiling effect' as many students record strong results at pre-test which do not leave much room for improvement. The OZCAAS results recorded for average-achieving comparison students should also be interpreted with the knowledge that many of these students' results were constrained by a ceiling effect.

For all tests in this study (OZCAAS and PATM) the comparison group represents average-achieving students selected from the same class as *QuickSmart* students. The comparison students did the pre-intervention and post-intervention tests but did not receive any *QuickSmart* small class instruction. It is important to note that the comparison students do not represent a 'true' control group because they do not share the same starting points with the *QuickSmart* students. The former were average-achieving students, the latter were low-achieving students. This point is demonstrated in all tables of results in this report with comparison students achieving better average pre-intervention scores than students in the *QuickSmart* group.

As is often the case in educational studies of this nature, to obtain a 'true' control group would be ethically problematic since this would deprive a selected group of low-achieving students of the educational benefits that other low-achieving students in the same class would receive. Thus, even though the results in this report consistently show that the *QuickSmart* students improve more than the comparison students, it has to be borne in mind that, if the comparison group consisted of low-achieving students, it is highly likely that the *QuickSmart* students would show an even greater margin of improvement relative to that group of comparison students.

Additionally, as *QuickSmart* programs become established in schools, sometimes even within the first year of operation, it becomes increasingly difficult to establish even a true 'comparison' group. This occurs as more and more *QuickSmart* practitioners are sharing *QuickSmart* resources and activities throughout their schools. Our information from school reports is that a majority of Principals begin this school wide implementation of *QuickSmart* in their schools within the first two years. While this attests to the impact that *QuickSmart* is having in schools, it does not allow a straightforward interpretation of results. Specifically, in many schools average-achieving comparison students are receiving some experience with *QuickSmart* activities, resources and approaches in their classrooms, and consequently their scores are higher at post-test because of this exposure.

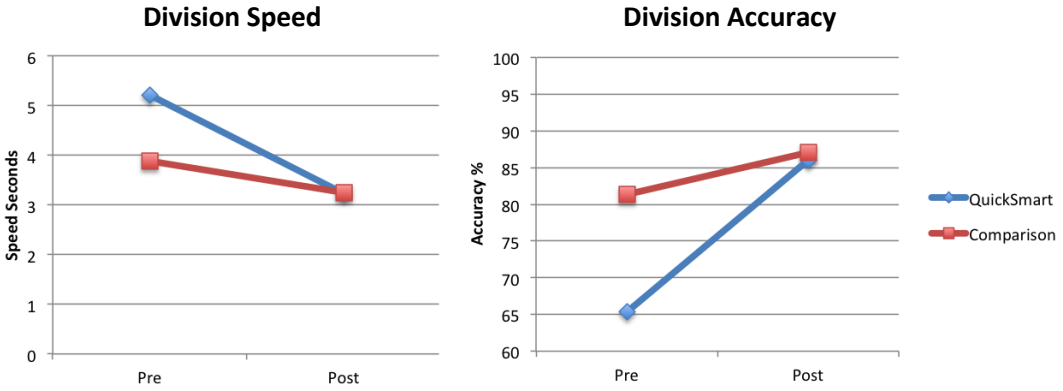
It should also be noted that in order to obtain the difference between the improvement of *QuickSmart* students and comparison students we analysed the data using paired-samples *t*-tests. To protect against the cascading Type I error associated with multiple *t*-tests we lowered the significance level from the customary 0.05 to 0.01. (The reason for this is to adjust for the situation where *t*-tests are repeated many times. This repetition means that, on average, the decision that the means of two groups are significantly different would be incorrect one time in every one hundred replications.) This means that in our analysis for any two means to be judged significantly different from each other, there has to be a less than 1% chance that the result was obtained by chance. This is the case for the results of our analyses presented in Tables 1 to 6 below. A detailed discussion of Table 1 is provided for clarification purposes and as a model for understanding the results provided in Tables 2 to 6.

3.1.1 Combined OZCAAS Analysis

3.1.1.1 Division

Table 1: OZCAAS division - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Division QS (speed secs)	5732	5.221	2.711	3.232	2.097	-1.989	<0.001*	-0.821
Division COMP (speed secs)	1661	3.885	2.204	3.251	1.802	-0.634	<0.001*	-0.315
Division QS (accuracy %)	5732	65.333	25.856	86.012	17.973	20.678	<0.001*	0.929
Division COMP (accuracy %)	1661	81.357	19.073	87.09	15.142	5.733	<0.001*	0.333



On the division test, there were paired data for 5732 *QuickSmart* students and 1661 comparison students. The desired criterion for response speed on the OZCAAS assessments is between 1 and 2 seconds as an indication of automaticity. The decrease in time for *QuickSmart* students is 1.989 seconds, which is a strong result. The effect size for this result is -0.821, which indicates substantial improvement. (Note the negative number means that the post-test time is lower than the pre-test time which is the desired pattern of improvement).

Effect size statistics can be understood based on the work of Hattie (Hattie, J. 2009. *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement.* London: Routledge) such that:

- Effect sizes below 0.2 are considered poor, with an appropriate range of growth over an academic year for a student cohort established as within the range of 0.2 to 0.4;
- Effect size scores of 0.4 to 0.6 are considered strong;
- Effect sizes between 0.6 and 0.8 are considered very strong; and
- Effect size scores above 0.8 represent substantial improvement of the order of approximately three years' growth.

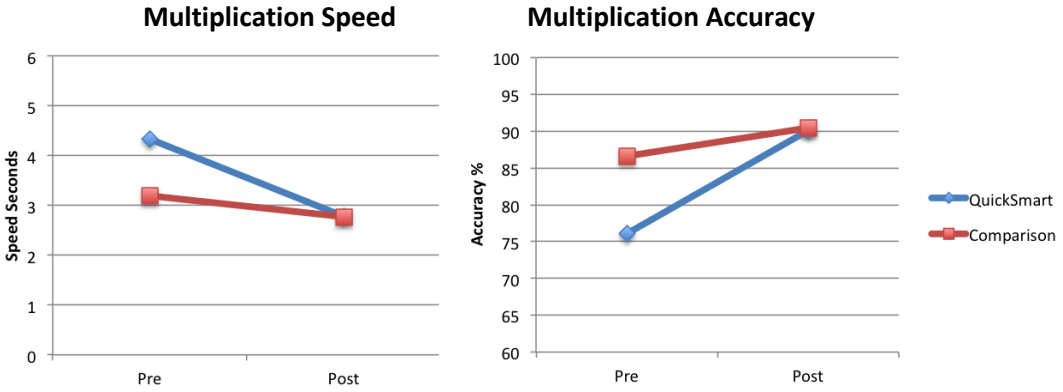
In terms of accuracy, the *QuickSmart* students' average scores have improved by over 20 percentage points, which is a very strong result. The effect size for this result is 0.929, which again indicates substantial improvement for the *QuickSmart* group.

Table 1 shows that when compared to the scores of the comparison students *QuickSmart* students' scores indicate substantial improvement in terms of speed and accuracy in division. The diagrams illustrate the *QuickSmart* students closing the initial gap between them and their average-achieving peers.

3.1.1.2 Multiplication

Table 2: OZCAAS multiplication - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Multiplication QS (speed secs)	6317	4.339	2.386	2.782	1.869	-1.557	<0.001*	-0.726
Multiplication COMP (speed secs)	1738	3.202	1.952	2.773	1.629	-0.429	<0.001*	-0.238
Multiplication QS (accuracy %)	6317	76.088	19.859	90.103	14.135	14.015	<0.001*	0.813
Multiplication COMP (acc %)	1738	86.63	14.917	90.488	12.012	3.858	<0.001*	0.285

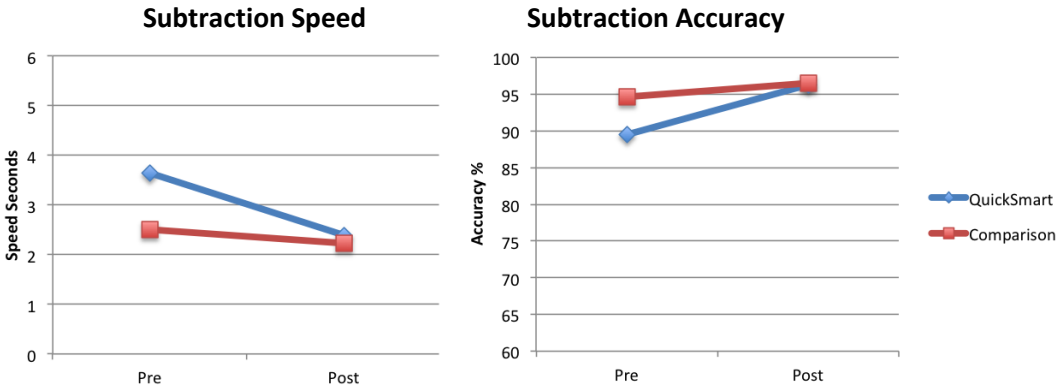


The results for multiplication indicate a significant improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

3.1.1.3 Subtraction

Table 3: OZCAAS subtraction - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Subtraction QS (speed secs)	4853	3.638	1.911	2.394	1.389	-1.244	<0.001*	-0.745
Subtraction COMP (speed secs)	1261	2.511	1.235	2.23	1.097	-0.281	<0.001*	-0.24
Subtraction QS (accuracy %)	4853	89.503	11.604	96.281	6.703	6.779	<0.001*	0.715
Subtraction COMP (accuracy %)	1261	94.649	7.825	96.505	6.114	1.856	<0.001*	0.264

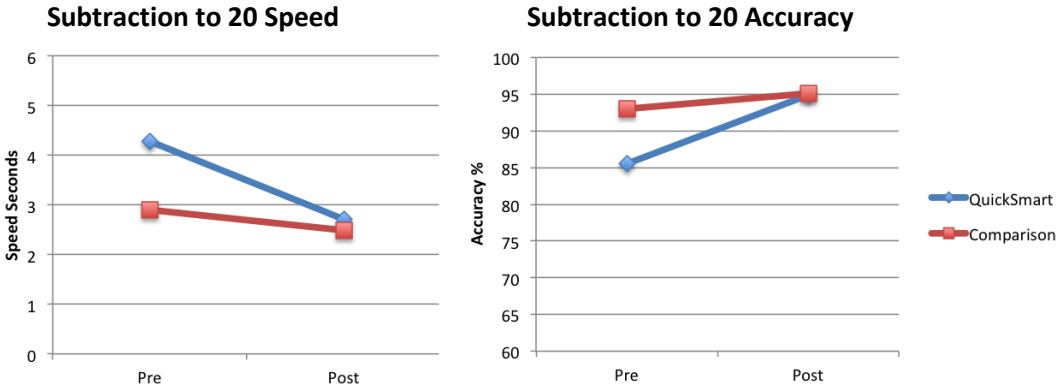


The results for subtraction indicate a very strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

3.1.1.4 Subtraction to 20

Table 4: OZCAAS subtraction to 20 - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Subtraction to 20 *QS* (speed secs)	4253	4.279	2.364	2.706	1.594	-1.573	<0.001*	-0.78
Subtraction to 20 COMP (speed secs)	1178	2.896	1.53	2.491	1.335	-0.404	<0.001*	-0.282
Subtraction to 20 *QS* (accuracy %)	4253	85.541	15.078	94.858	8.697	9.317	<0.001*	0.757
Subtraction to 20 COMP (acc %)	1178	93.004	9.603	95.167	8.009	2.163	<0.001*	0.245

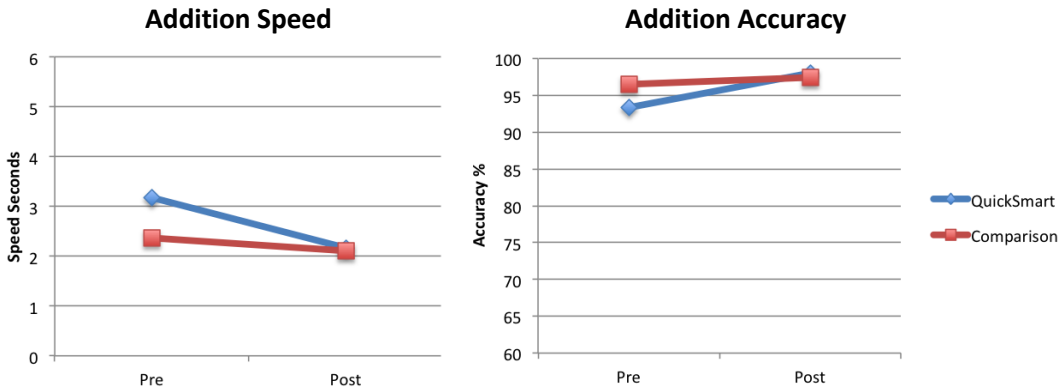


The results for subtraction to 20 indicate a significant improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students as a result of the *QuickSmart* intervention.

3.1.1.5 Addition

Table 5: OZCAAS addition - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Addition *QS* (speed secs)	5085	3.173	1.498	2.169	1.057	-1.004	<0.001*	-0.775
Addition COMP (speed secs)	1294	2.371	1.132	2.105	0.917	-0.266	<0.001*	-0.258
Addition *QS* (accuracy %)	5085	93.355	9.087	97.983	4.458	4.628	<0.001*	0.647
Addition COMP (accuracy %)	1294	96.467	5.602	97.486	4.605	1.02	<0.001*	0.199

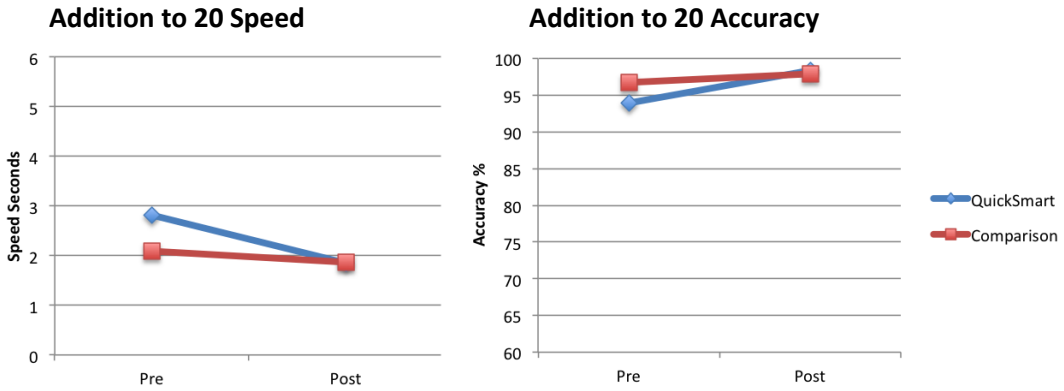


The results for addition indicate a strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students. In accuracy, both *QuickSmart* and comparison students exhibit a strong ceiling effect.

3.1.1.6 Addition to 20

Table 6: OZCAAS add to 20 results - all students 2013

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Addition to 20 *QS* (speed secs)	4358	2.823	1.455	1.847	0.869	-0.975	<0.001*	-0.814
Addition to 20 COMP (speed secs)	1183	2.099	0.94	1.868	0.842	-0.232	<0.001*	-0.259
Addition to 20 *QS* (accuracy %)	4358	93.948	9.298	98.398	3.778	4.45	<0.001*	0.627
Addition to 20 COMP (accuracy %)	1183	96.689	5.787	97.881	4.274	1.192	<0.001*	0.234



The results for addition to 20 indicate a strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students. In accuracy, both *QuickSmart* and comparison students exhibit a strong ceiling effect.

3.1.2 OZCAAS By Demographics

3.1.2.1 Division by Gender

The following tables show an analysis of OZCAAS results for each operation by gender (Tables 7, 8, 9, 10, 11, 12) and for Indigenous students (Table 13).

Table 7: OZCAAS division results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2677	5.059	2.597	3.153	2.035	-1.907	<0.001*	-0.817
Male COMP (speed)	812	3.659	2.038	3.142	1.756	-0.517	<0.001*	-0.272
Female QS (speed)	3055	5.363	2.8	3.301	2.147	-2.061	<0.001*	-0.826
Female COMP (speed)	849	4.101	2.333	3.355	1.839	-0.746	<0.001*	-0.355
Male QS (accuracy)	2677	66.454	25.231	86.075	17.582	19.621	<0.001*	0.902
Male COMP (accuracy)	812	82.049	18.772	87.565	15.015	5.516	<0.001*	0.325
Female QS (accuracy)	3055	64.351	26.357	85.956	18.311	21.605	<0.001*	0.952
Female COMP (accuracy)	849	80.696	19.344	86.636	15.258	5.94	<0.001*	0.341

The results of *QuickSmart* students show that in both speed and accuracy the females have improved slightly more than males.

3.1.2.2 Multiplication by Gender

Table 8: OZCAAS multiplication results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2928	4.27	2.336	2.762	1.857	-1.507	<0.001*	-0.714
Male COMP (speed)	842	3.057	1.779	2.658	1.514	-0.398	<0.001*	-0.241
Female QS (speed)	3389	4.399	2.427	2.799	1.88	-1.6	<0.001*	-0.737
Female COMP (speed)	896	3.338	2.093	2.881	1.725	-0.457	<0.001*	-0.238
Male QS (accuracy)	2928	76.367	19.432	90.18	14.081	13.813	<0.001*	0.814
Male COMP (accuracy)	842	87.077	14.406	90.917	12.105	3.839	<0.001*	0.289
Female QS (accuracy)	3389	75.847	20.221	90.037	14.184	14.19	<0.001*	0.812
Female COMP (accuracy)	896	86.21	15.379	90.085	11.916	3.875	<0.001*	0.282

The results of *QuickSmart* students show that in both speed and accuracy the females have improved slightly more than males.

3.1.2.3 Subtraction by Gender

Table 9: OZCAAS subtraction results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2266	3.419	1.834	2.278	1.324	-1.141	<0.001*	-0.713
Male COMP (speed)	612	2.342	1.154	2.078	1.057	-0.264	<0.001*	-0.239
Female QS (speed)	2587	3.83	1.956	2.495	1.436	-1.335	<0.001*	-0.778
Female COMP (speed)	649	2.67	1.288	2.373	1.115	-0.297	<0.001*	-0.246
Male QS (accuracy)	2266	89.742	11.49	96.216	6.756	6.474	<0.001*	0.687
Male COMP (accuracy)	612	94.865	8.217	96.74	5.896	1.875	<0.001*	0.262
Female QS (accuracy)	2587	89.293	11.702	96.338	6.657	7.045	<0.001*	0.74
Female COMP (accuracy)	649	94.446	7.437	96.283	6.309	1.837	<0.001*	0.266

The results of *QuickSmart* students show that in both speed and accuracy the females have improved slightly more than males.

3.1.2.4 Subtraction to 20 by Gender

Table 10: OZCAAS subtraction to 20 results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	1986	3.957	2.202	2.545	1.546	-1.412	<0.001*	-0.742
Male COMP (speed)	571	2.59	1.334	2.259	1.144	-0.331	<0.001*	-0.266
Female QS (speed)	2267	4.561	2.464	2.846	1.623	-1.714	<0.001*	-0.822
Female COMP (speed)	607	3.183	1.645	2.71	1.46	-0.473	<0.001*	-0.304
Male QS (accuracy)	1986	86.397	14.599	95.304	8.55	8.907	<0.001*	0.745
Male COMP (accuracy)	571	93.612	9.56	95.383	8.332	1.771	<0.001*	0.197
Female QS (accuracy)	2267	84.791	15.45	94.468	8.807	9.677	<0.001*	0.77
Female COMP (accuracy)	607	92.432	9.616	94.963	7.695	2.531	<0.001*	0.291

The results of *QuickSmart* students show that in both speed and accuracy the females have improved slightly more than males.

3.1.2.5 Addition by Gender

Table 11: OZCAAS addition results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2367	3.134	1.505	2.12	1.053	-1.014	<0.001*	-0.781
Male COMP (speed)	626	2.248	1.133	2.018	0.964	-0.23	<0.001*	-0.218
Female QS (speed)	2718	3.207	1.491	2.212	1.059	-0.996	<0.001*	-0.77
Female COMP (speed)	668	2.486	1.119	2.186	0.863	-0.3	<0.001*	-0.3
Male QS (accuracy)	2367	92.959	9.264	98.011	4.337	5.052	<0.001*	0.699
Male COMP (accuracy)	626	96.619	5.496	97.71	4.55	1.091	<0.001*	0.216
Female QS (accuracy)	2718	93.7	8.918	97.958	4.561	4.258	<0.001*	0.601
Female COMP (accuracy)	668	96.324	5.7	97.277	4.65	0.953	<0.001*	0.183

The results of *QuickSmart* students show that in both speed and accuracy the males have improved slightly more than females.

3.1.2.6 Addition to 20 by Gender

Table 12: OZCAAS addition to 20 results – all students by gender 2013

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2044	2.757	1.459	1.825	0.905	-0.932	<0.001*	-0.768
Male COMP (speed)	578	1.958	0.872	1.767	0.821	-0.191	<0.001*	-0.225
Female QS (speed)	2314	2.881	1.449	1.867	0.835	-1.013	<0.001*	-0.857
Female COMP (speed)	605	2.234	0.982	1.964	0.852	-0.27	<0.001*	-0.294
Male QS (accuracy)	2044	93.794	9.531	98.413	3.815	4.62	<0.001*	0.636
Male COMP (accuracy)	578	96.908	5.546	97.961	4.497	1.053	<0.001*	0.209
Female QS (accuracy)	2314	94.084	9.088	98.385	3.747	4.301	<0.001*	0.619
Female COMP (accuracy)	605	96.479	6.006	97.805	4.053	1.325	<0.001*	0.259

The results show that in speed, females slightly outperformed males, but in accuracy the males had a slightly higher gain than the females.

3.1.2.7 Indigenous students

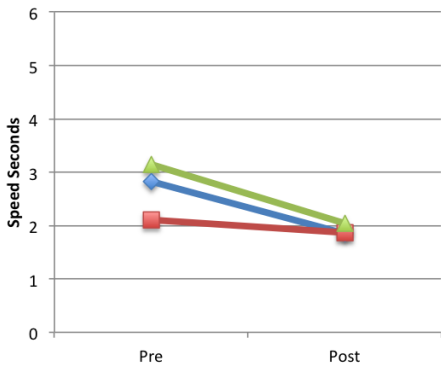
Table 13: OZCAAS results - Indigenous students 2013

Test	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Add to 20 QS (spd)	499	3.139	1.944	2.042	1.095	-1.097	<0.001*	-0.696
Add to 20 QS (acc)	499	93.22	11.323	98.324	4.277	5.104	<0.001*	0.596
Addition QS (speed)	565	3.273	1.685	2.278	1.154	-0.995	<0.001*	-0.689
Addition QS (acc)	565	93.495	10.177	97.812	4.521	4.316	<0.001*	0.548
Sub to 20 QS (spd)	463	4.671	2.688	2.923	1.799	-1.748	<0.001*	-0.764
Sub to 20 QS (acc)	463	85.929	15.244	94.912	8.952	8.982	<0.001*	0.719
Sub QS (speed)	529	3.845	2.173	2.521	1.592	-1.324	<0.001*	-0.695
Sub QS (accuracy)	529	89.981	11.253	96.126	7.303	6.145	<0.001*	0.648
Mult QS (speed)	617	4.438	2.541	3.09	2.08	-1.348	<0.001*	-0.581
Mult QS (accuracy)	617	75.939	21.03	89.206	15.927	13.268	<0.001*	0.711
Division QS (speed)	556	5.366	2.886	3.56	2.405	-1.806	<0.001*	-0.68
Division QS (acc)	556	65.204	27.528	84.299	20.903	19.095	<0.001*	0.781

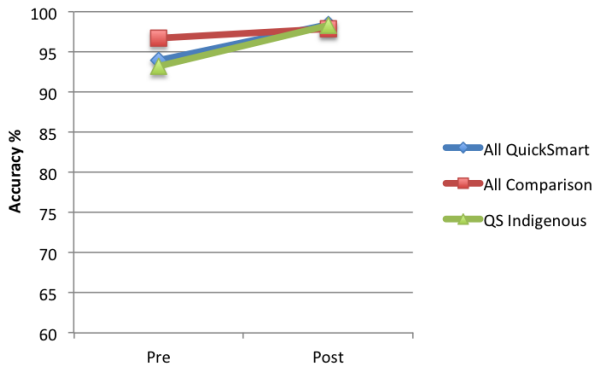
These results indicate that in most instances for both the pre-intervention and post-intervention the Indigenous students' mean scores were slightly lower than those of the overall *QuickSmart* group. In other words, these students had lower starting and finishing points. However, their improvement was very similar to that of the overall *QuickSmart* group, and sometimes better. This is particularly so for addition and subtraction. For addition, the accuracy results exhibit the ceiling effect (the pre-intervention scores were so high that the students did not have much room for further improvement).

The following graphs illustrate how the Indigenous students (green) have performed in each operation compared to the whole *QuickSmart* group (blue) as well as the comparison students (red).

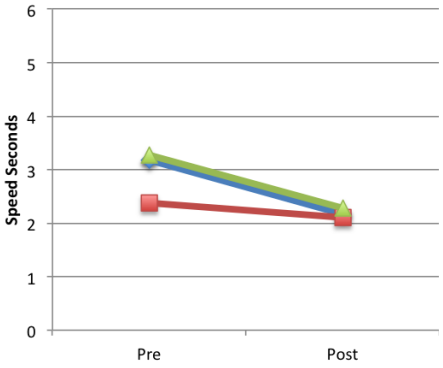
Addition to 20 Speed



Addition to 20 Accuracy



Addition Speed



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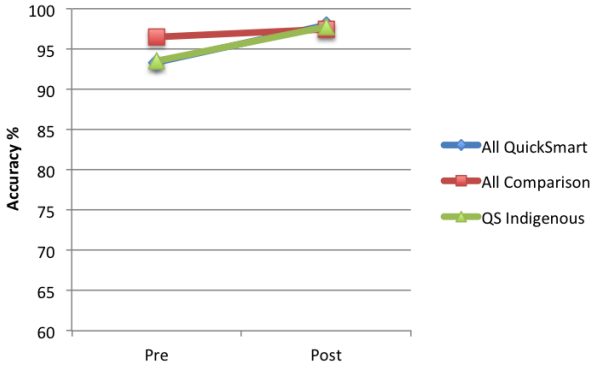
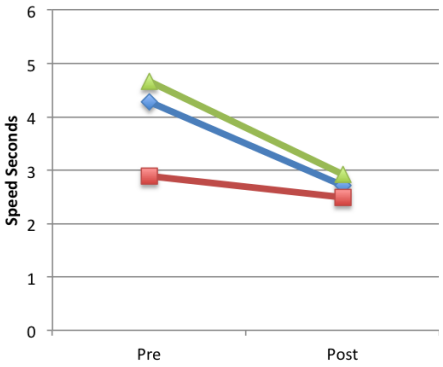
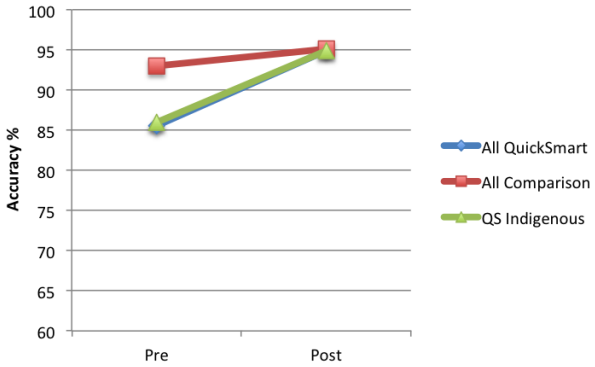


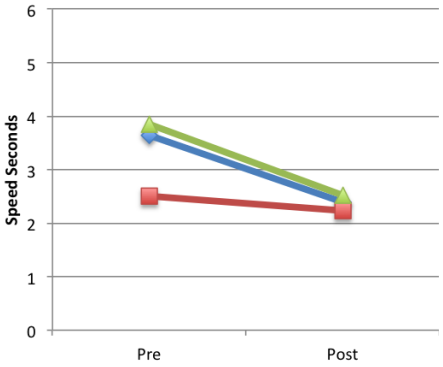
Subtraction to 20 Speed



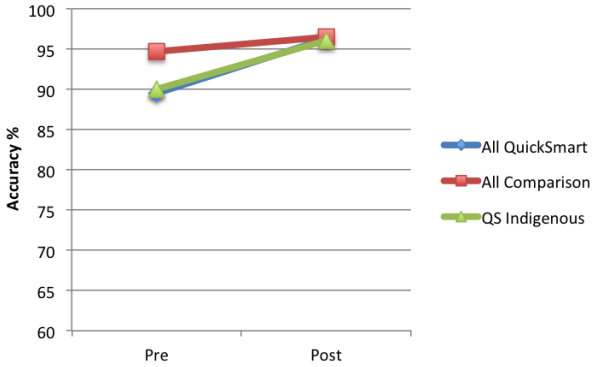
Subtraction to 20 Accuracy



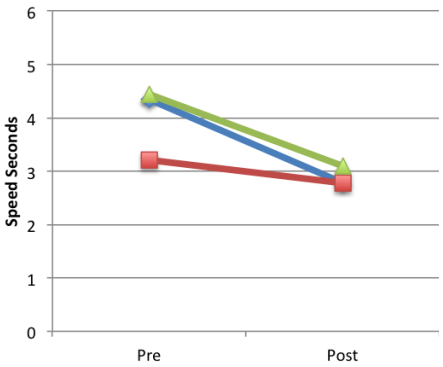
Subtraction Speed



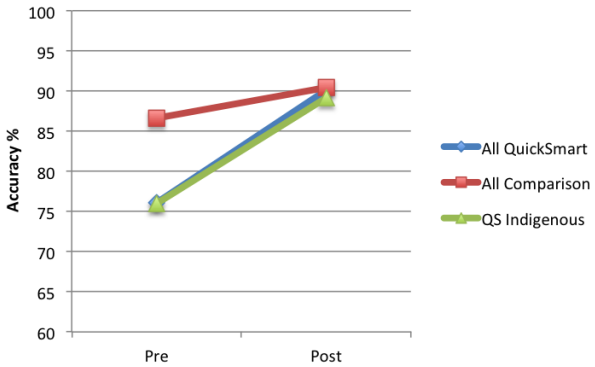
Subtraction Accuracy



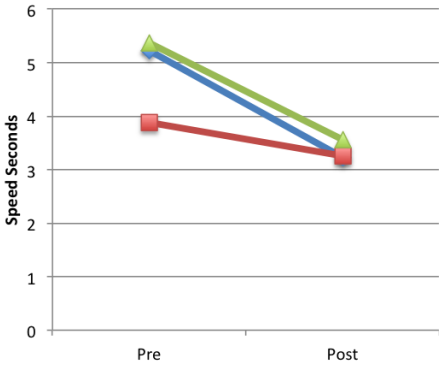
Multiplication Speed



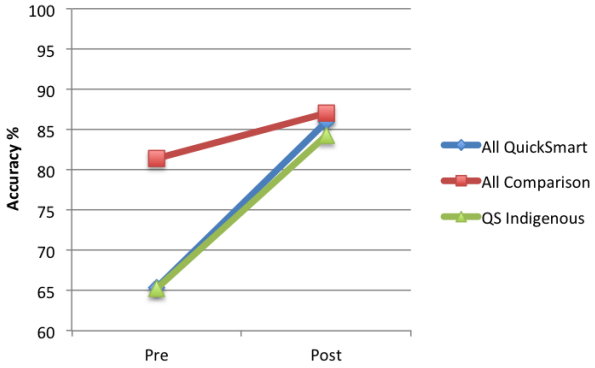
Multiplication Accuracy



Division Speed



Division Accuracy



3.1.3 Students who were unable to complete the pre-intervention test

To complete this section on OZCAAS results, it is important to note that there were students who the instructors confirmed were not able to complete all the OZCAAS pre-tests. In such cases Instructors were advised not to continue collecting data as doing so would have confronted these students dramatically with their weaknesses at the beginning of the program. A mark of the success of *QuickSmart* is that many of these students were able to complete all OZCAAS assessments at the end of the program. These students' results could not be included in the previous analyses and are presented in Table 14 below.

Table 14: OZCAAS results where no pre-test data was available - 2013

	N	Mean	Std. Deviation
Addition to 20 Speed	50	1.855	0.898
Addition to 20 Accuracy	50	97.814	5.262
Addition Speed	192	2.32	1.211
Addition Accuracy	192	96.72	5.572
Subtraction to 20 Speed	102	2.725	1.97
Subtraction to 20 Accuracy	102	95.135	9.78
Subtraction Speed	249	2.637	1.577
Subtraction Accuracy	249	93.939	8.806
Multiplication Speed	175	4.28	2.846
Multiplication Accuracy	175	78.25	21.583
Division Speed	359	4.148	2.531
Division Accuracy	359	77.162	22.639

The results in Table 14 are impressive given that these students did not have the skills or confidence to complete the OZCAAS pre-tests initially. In addition and subtraction, the average response rates were below 3 seconds and above 93.9% accuracy. Even though some of these students may not have progressed to multiplication and division during *QuickSmart* lessons, their results are encouraging. In multiplication and division the average response speeds were below 4.5 seconds and accuracy over 77% at post-test. It is likely that part of this improvement may be due to the fact that: (1) there has been some mutually beneficial development of the common areas of the brain that process the four operations; (2) students have increased their ability to benefit from classroom instruction; and (3) students' overall improved levels of confidence may have led to a 'have a go attitude' that was not present at the beginning of the *QuickSmart* program.

3.1.4 Conclusion on OZCAAS Testing

Overall, the *QuickSmart* students showed very strong growth in their understanding and use of number facts. In all four mathematical operations, they either closed the gap between them and the comparison group of average-achieving peers or narrowed this gap to a very small margin. Such growth is critical for these students as number facts are a vital skill underpinning mathematics functioning in general. This improvement provides the foundation for students to improve in other areas of mathematics that are not specifically taught in *QuickSmart*.

Some small differences between male and female students were observed. Females performed slightly better in most operations. These differences, however, are too small to warrant further investigation.

It is acknowledged that Indigenous students had lower starting and finishing points in most operations but their overall improvement is very strong to significant.

3.2 Independent Assessments

3.2.1 Why they are used

The *QuickSmart* pre and post assessments include use of independent tests in order to demonstrate whether the students are able to take the basic facts and problem-solving strategies taught in *QuickSmart* and apply these to higher-level mathematical concepts.

3.2.2 Results on the PATM Assessments

Table 15 reports the paired-samples *t*-tests analysis of the PATM data for all students for whom paired data were available. PATM analyses for individual clusters are provided in an Appendix to this report. (Note: Students who were absent at the end of the year were not included in the analysis).

The PATM (2005) Norm Tables were used to convert raw scores from various forms of the PATM to consistent Scale scores, which were used for all subsequent calculations. Two analyses are reported in Table 15. The first analysis presents a calculation of a standard gain score and the significance of this result. The second analysis is an Effect Size calculated from the Means and Standard Deviations on PATM scores for each group. Effect Size statistics indicate the magnitude of the change in academic achievement for the *QuickSmart* and comparison students.

Table 15: PATM results - (Scale scores) 2013

	Students with paired data	Average Gain score	Significance	Effect size
All *QuickSmart*	**5846**	**7.209**	**<0.001***	**0.697**
All comparison	**1591**	**4.832**	**<0.001***	**0.444**

The results indicate a very strong improvement for *QuickSmart* students. This improvement is greater than those recorded for the comparison group of their average-achieving peers. The gain recorded here for the *QuickSmart* group is also well in excess of the expected yearly growth of students' scores as measured on the PATM assessment of 5 scale score points.

Table 16 reports the same information as Table 15 but shows a comparison of males and females included in the *QuickSmart* program.

Table 16: PATM results - By Gender (Scale scores) 2013

Gender	Students with paired data	Average Gain score	Significance	Effect size
Male QS Students	2711	7.544	<0.001*	0.717
Male Comp Students	769	5.059	<0.001*	0.457
Female QS Students	3135	6.919	<0.001*	0.68
Female Comp Students	822	4.62	<0.001*	0.433

The results indicate that the males improved slightly more than the females.

Table 17 reports the same information as Table 15 but does so for the scores of Indigenous students included in the *QuickSmart* program.

Table 17: PATM results - Indigenous (Scale scores) 2013

Indigenous students	Students with paired data	Average Gain score	Significance	Effect size
Indigenous *QuickSmart*	602	6.807	<0.001*	0.587

Once again these results show substantial improvement for the Indigenous students who participated in *QuickSmart*. Even though this improvement is not as high as that of the overall *QuickSmart* group, these students were able to report a rate of growth in excess of that achieved by the comparison group. Their improvement is also in excess of the expected yearly growth of students' scores as measured on the PATM assessment of 5 scale score points.

The following table shows the percentage of *QuickSmart* students that achieved a gain on the PATM results

Table 18: Percentage students with PAT Gain

Student Type	N with gain	N with PATM	Percentage with Gain
QuickSmart	4699	5846	80.4
Comparison	1333	1922	69.4

These results show that in the *QuickSmart* group, a greater percentage of students achieved gain in PAT than in the comparison group of their average-achieving peers.

4 Conclusion to Report

The support provided by the Schools and Clusters has been critical in making more positive the hopes and aspirations of students participating in the *QuickSmart* program. This report has focused on the quantitative aspects of the program. In all analyses, the data report a narrowing of the achievement gap between *QuickSmart* students and their average-performing comparison group peers. Impressive Effect Sizes have been reported as well as highly significant gains on the part of individual students who, in some cases, could not complete the full suite of pre-test assessments.

Additionally, substantial qualitative data (reported in school presentations during professional workshops 2 and 3) indicate that *QuickSmart* students gained a new confidence in the area of mathematics. Many stories within the corpus of qualitative data document improvements for *QuickSmart* students not only in relation to their performance in class, but also with regard to students' attitudes to school, their attendance rates and levels of academic confidence both inside and outside the classroom.

The data collected to date from thousands of *QuickSmar*t students indicate that the narrowing of the achievement gap between *QuickSmart* and comparison students results in low-achieving students proceeding with their studies more successfully by learning to 'trust their heads' in the same ways that effective learners do. Importantly, previous *QuickSmart* studies (references at http://www.une.edu.au/simerr/quicksmart/pages/qsresearchpublications.php) demonstrate that *QuickSmart* students can maintain the gains made during the program for years after they completed the program. Analyses have consistently identified impressive statistically significant end-of-program and longitudinal gains in terms of probability measures and effect sizes that mirror the qualitative improvements reported by teachers, paraprofessionals, parents and *QuickSmart* students.

If you have any questions concerning this report or *QuickSmart* please contact us at the SiMERR National Centre at UNE on (02) 67735065.

Professor John Pegg

Associate Professor Lorraine Graham

5 APPENDIX – Independent Assessment Results

5.1 PAT results by Region (Scale scores) 2013

School Region		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
ACT QS Students	40	32.668	9.881	46.708	11.034	14.04	<0.001*	1.341
Adelaide QS Students	813	38.366	10.564	45.508	10.416	7.142	<0.001*	0.681
Ballarat QS Students	343	42.423	10.047	50.205	10.124	7.782	<0.001*	0.772
Eyre Peninsula QS Students	112	35.903	8.895	43.309	8.131	7.406	<0.001*	0.869
Gawler QS Students	103	34.66	9.218	41.611	7.947	6.95	<0.001*	0.808
Horsham QS Students	156	44.087	7.724	51.194	9.151	7.107	<0.001*	0.839
Hunter QS Students	413	40.621	9.462	47.572	10.926	6.951	<0.001*	0.68
Limestone Coast QS Students	90	40.027	9.413	46.578	9.528	6.551	<0.001*	0.692
Melbourne QS Students	343	43.105	9.447	52.203	10.955	9.098	<0.001*	0.889
Mid West QS Students	208	43.96	8.121	49.109	8.769	5.15	<0.001*	0.609
Murray/Mallee QS Students	96	36.608	9.598	40.566	8.608	3.957	<0.001*	0.434
New England QS Students	56	40.52	7.587	50.636	10.486	10.116	<0.001*	1.105
North Coast QS Students	954	41.138	9.771	48.874	11.271	7.736	<0.001*	0.733
North Tas QS Students	121	44.136	8.078	48.913	8.964	4.777	<0.001*	0.56
North West QS Students	136	41.476	7.404	47.019	8.695	5.543	<0.001*	0.686
Northern Territory QS Students	17	45.006	3.087	47.047	4.858	2.041	0.025	0.502
Perth QS Students	58	36.953	11.441	48.145	10.803	11.191	<0.001*	1.006
Port Augusta QS Students	81	34.53	18.012	48.448	9.016	13.919	<0.001*	0.977
Port Pirie QS Students	75	41.4	8.485	51.505	9.204	10.105	<0.001*	1.142
Queensland QS Students	23	36.461	17.893	51.643	13.13	15.183	<0.001*	0.967
Riverina QS Students	70	50.116	7.882	54.996	8.605	4.88	<0.001*	0.591
South Tas QS Students	37	39.659	6.28	45.846	7.316	6.186	<0.001*	0.907
Southern Sydney QS Students	67	41.063	9.22	47.04	9.011	5.978	<0.001*	0.656
Sydney QS Students	1148	42.917	9.592	49.578	9.885	6.662	<0.001*	0.684
Western QS Students	163	45.933	11.115	51.713	12.114	5.78	<0.001*	0.497
Western Syd QS Students	32	34.094	7.26	41.528	5.988	7.434	<0.001*	1.117
Yorke Peninsula/Mid North QS Students	91	36.551	8.913	41.227	10.189	4.677	<0.001*	0.489

Note 1: only students who did both 'pre' and 'post' test are included in the table.

5.2 PAT results by demographic (Scale scores) 2013

Demographic		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
All QS Students	**5846**	**41.119**	**10.14**	**48.329**	**10.532**	**7.209**	**<0.001***	**0.697**
All comparison students	**1591**	**52.186**	**10.784**	**57.018**	**10.961**	**4.832**	**<0.001***	**0.444**
Indigenous QS Students	602	39.344	11.902	46.151	11.298	6.807	<0.001*	0.587
Male QS Students	2711	41.034	10.452	48.578	10.601	7.544	<0.001*	0.717
Male comparison students	769	52.59	10.973	57.65	11.15	5.059	<0.001*	0.457
Female QS Students	3135	41.194	9.864	48.113	10.469	6.919	<0.001*	0.68
Female comparison Students	822	51.807	10.597	56.427	10.754	4.62	<0.001*	0.433
Male Indigenous QS Students	256	38.768	12.758	46.425	11.243	7.657	<0.001*	0.637
Female Indigenous QS Students	346	39.77	11.227	45.948	11.35	6.178	<0.001*	0.547

Note: only students who did both 'pre' and 'post' test are included in the table.

5.3 PAT results by State

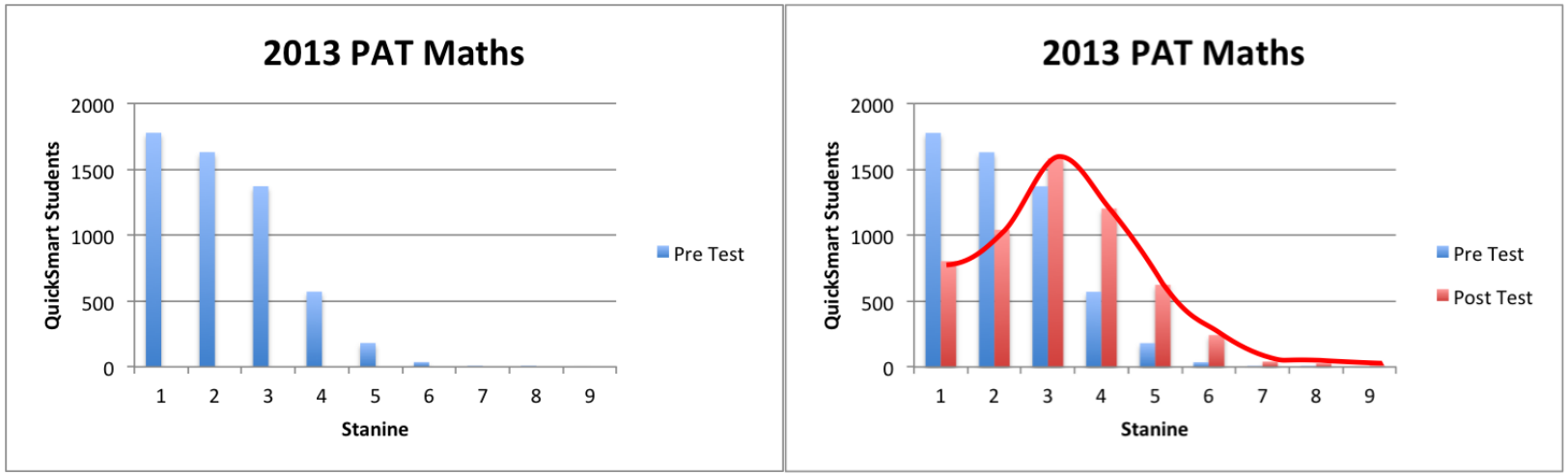
School		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
All QS Students	**5846**	**41.119**	**10.14**	**48.329**	**10.532**	**7.209**	**<0.001***	**0.697**
All comparison students	**1591**	**52.186**	**10.784**	**57.018**	**10.961**	**4.832**	**<0.001***	**0.444**
ACT QS students	40	32.668	9.881	46.708	11.034	14.04	<0.001*	1.341
ACT Ind QS	1	15.7	.	42.2	.	26.5		
ACT COMP students	9	45.122	6.943	53.3	8.815	8.178	0.006*	1.031
NSW QS students	3247	42.249	9.639	49.089	10.495	6.841	<0.001*	0.679
NSW Ind QS	420	41.927	9.847	47.807	11.351	5.879	<0.001*	0.553
NSW COMP students	572	53.873	9.837	59.185	10.349	5.312	<0.001*	0.526
NT QS students	17	45.006	3.087	47.047	4.858	2.041	0.025	0.502
NT Ind QS	4	46.3	3.482	48.05	3.792	1.75	0.007	0.481
NT COMP students	0	.	.	.	.			
QLD QS students	23	36.461	17.893	51.643	13.13	15.183	<0.001*	0.967
QLD Ind QS	8	18.95	8.011	41.488	7.648	22.538	0.001	2.878
QLD COMP students	9	59.533	13.032	65.289	8.284	5.756	0.159	0.527
SA QS students	1461	37.733	10.707	45.01	10.081	7.278	<0.001*	0.7
SA Ind QS	119	32.724	14.3	41.233	10.601	8.509	<0.001*	0.676
SA COMP students	570	49.166	10.734	53.474	10.505	4.308	<0.001*	0.406
TAS QS students	158	43.088	7.908	48.195	8.683	5.107	<0.001*	0.615
TAS Ind QS	14	45.521	8.072	47.314	7.597	1.793	0.371	0.229
TAS COMP students	79	54.192	9.59	57.316	11.935	3.124	0.001*	0.289
VIC QS students	842	43.009	9.418	51.202	10.331	8.193	<0.001*	0.829
VIC Ind QS	15	43.013	7.672	48.293	8.872	5.28	0.004	0.637
VIC COMP students	326	54.0	11.154	59.269	11.229	5.269	<0.001*	0.471
WA QS students	58	36.953	11.441	48.145	10.803	11.191	<0.001*	1.006
WA Ind QS	21	26.014	9.105	40.195	10.222	14.181	<0.001*	1.465
WA COMP students	26	52.315	14.944	56.35	7.933	4.035	0.085	0.337

Note: only students who did both 'pre' and 'post' test are included in the table.

5.4 *QuickSmart* Students by Grade (Scale scores) 2013

Grade		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
< Grade 4 QS	20	28.845	11.089	40.75	14.91	11.905	0.003*	0.906
< Grade 4 QS Ind	2	25.25	10.394	31.8	33.941	6.55	0.761	0.261
< Grade 4 Comp	11	31.482	6.829	41.464	7.914	9.982	<0.001*	1.351
Grade 4 QS	1287	34.466	8.994	42.307	9.891	7.841	<0.001*	0.829
Grade 4 QS Ind	118	33.463	10.188	39.633	9.493	6.17	<0.001*	0.627
Grade 4 Comp	305	44.437	8.953	51.634	10.592	7.197	<0.001*	0.734
Grade 5 QS	1483	39.496	8.552	46.797	9.918	7.301	<0.001*	0.788
Grade 5 QS Ind	127	36.106	9.017	42.829	10.047	6.723	<0.001*	0.704
Grade 5 Comp	425	50.57	9.382	55.46	10.461	4.889	<0.001*	0.492
Grade 6 QS	1251	43.811	8.605	50.107	9.23	6.296	<0.001*	0.706
Grade 6 QS Ind	105	42.229	9.364	47.516	9.779	5.288	<0.001*	0.552
Grade 6 Comp	441	55.266	9.577	59.303	10.841	4.037	<0.001*	0.395
Grade 7 QS	894	45.135	8.665	51.988	9.756	6.854	<0.001*	0.743
Grade 7 QS Ind	122	44.708	9.462	49.862	10.014	5.154	<0.001*	0.529
Grade 7 Comp	229	55.865	9.217	59.818	9.547	3.953	<0.001*	0.421
Grade 8 QS	866	45.965	11.43	53.512	9.654	7.547	<0.001*	0.713
Grade 8 QS Ind	118	41.68	16.009	51.943	11.725	10.264	<0.001*	0.731
Grade 8 Comp	164	58.364	11.755	61.945	9.547	3.581	<0.001*	0.334
Grade 9 QS	38	42.945	12.029	50.592	12.114	7.647	<0.001*	0.633
Grade 9 QS Ind	10	29.37	9.847	40.14	11.101	10.77	0.002*	1.026
Grade 9 Comp	11	53.1	10.725	56.082	8.504	2.982	0.18	0.308
Grade 10 QS	5	43.96	5.808	75.0	2.41	31.04	<0.001*	6.981
Grade 10 Comp	4	69.6	7.54	69.65	5.774	0.05	0.969	0.007
All Schools – QS Group	**5846**	**41.119**	**10.14**	**48.329**	**10.532**	**7.209**	**<0.001***	**0.697**
All Schools – Indigenous QS Group	**602**	**39.344**	**11.902**	**46.151**	**11.298**	**6.807**	**<0.001***	**0.587**
All Schools – Comp Group	**1591**	**52.186**	**10.784**	**57.018**	**10.961**	**4.832**	**<0.001***	**0.444**

5.5 PATM Stanine improvement for *QuickSmart* students



The Australian Council for Educational Research (ACER) PAT tests use a framework for describing results against national Australian norms. This technique applies stanine scores that divide the population using a scale of 1 to 9.

A stanine score of:

1 represents performance in the bottom 4% of the population,
2 represents performance in the lower or 4-10% of the population
3 represents performance in the lower or top 11-22% of the population
4 represents performance in the lower 23-39% of the population
5 represents performance in middle 40-59% of the population
6 represents performance in the higher 60-76% of the population
7 represents performance in the higher77-88% of the population
8 represents performance in the higher 89-96% of the population
9 represents performance in the top 4% of the population.

It is particularly difficult to move students out of the lower stanine bands. The results above show that *QuickSmart* has been quite successful in moving students into higher bands, as measured by the various PAT.

6 APPENDIX B: *QuickSmart* sessions

6.1 Attendance summary

	N (students)	N (schools)	Mean Sessions Offered	Mean Sessions Attended	% Mean Attended	Weeks completed	% Program completed
All QS students	**4551**	**288**	**59.403**	**48.516**	**82.266**	**16.172**	**53.906**
Male QS students	2083	276	58.230	47.242	81.769	15.747	52.492
Female QS students	2468	279	60.393	49.590	82.685	16.530	55.100
Indigenous QS students	502	125	61.233	46.709	77.108	15.57	51.899
Grade 3	30	12	63.767	50.167	81.827	16.722	55.741
Grade 4	1079	148	58.956	50.652	86.392	16.884	56.279
Grade 5	1101	176	64.447	53.563	84.260	17.854	59.515
Grade 6	991	180	56.124	45.801	82.440	15.267	50.890
Grade 7	693	88	55.359	43.052	78.277	14.351	47.835
Grade 8	627	59	60.831	46.367	75.954	15.456	51.519
Grade 9	21	8	57.476	44.333	78.118	14.778	49.259
Grade 10	5	1	60.0	53.8	89.667	17.933	59.778

Note: only students and schools for whom attendance data were provided are included in the table (about 58% of students).
Note: 'Weeks completed' is based on the assumption that the school did three *QuickSmart* sessions a week
Note: '% Program completed' is calculated relative to the full *QuickSmart* program of 30 weeks.