Annual Numeracy Program Report 2012

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 2012

In 2012, the *QuickSmart* team at the University of New England received data from 5880 students who participated in *QuickSmart* Numeracy lessons and 1767 average-achieving comparison peers. These students were drawn from schools from nineteen 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), and the VCAA On-Demand tests used by some schools in Victoria. One school provided data for the NT Baseline test, however there was insufficient use of this test 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.

In addition, 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 skills of under-achieving students in the middle years of schooling. 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 that were collected at the beginning and end of the *QuickSmart* program. These results represent 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) test, 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. PATM provides information about how the knowledge, skills and attitudes developed in *QuickSmart* are used and how they transfer to other broad areas of mathematics. Some schools in Victoria used the On-Demand Testing designed by Victorian Curriculum and Assessment Authority (VCAA) instead of PATM. One school provided NT Baseline test data for analysis.

The results from these analyses are reported below in separate sections and include 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. These facts 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. 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 comparison students should also be interpreted with the knowledge that many of these results were influenced by the ceiling effect.

For all tests in this study (OZCAAS, PATM, and VCAA) the comparison group represents average-achieving students picked 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 have the same starting points as 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 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 of the 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 practitioners are sharing *QuickSmart* resources and activities throughout the school. Our information from school reports is that a majority of Principals have begun this process in their school within the first two years of *QuickSmart* implementation. 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* in their classrooms, and consequently their scores are higher at post-test because of this exposure.

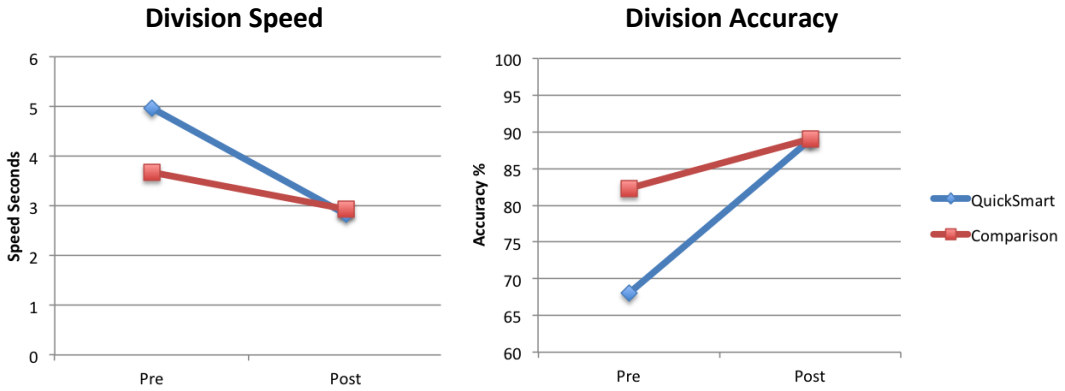
In order to obtain the difference between the improvement of *QuickSmart* students and comparison students we analysed the data using paired-samples *t*-tests. To protect against the cascading Type I error associated with multiple *t*-tests we lowered the significance level from the customary 0.05 to 0.01. [The reason for this is, if the tests were to be repeated many times, on average in the longer run, the decision that the means 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 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Division QS (speed secs)	4452	4.97	2.632	2.835	1.897	-2.135	<0.001*	-0.931
Division COMP (speed secs)	1360	3.68	2.112	2.933	1.614	-0.747	<0.001*	-0.397
Division QS (accuracy %)	4452	68.026	23.884	88.941	15.38	20.915	<0.001*	1.041
Division COMP (accuracy %)	1360	82.33	18.59	89.103	14.834	6.773	<0.001*	0.403



On the division test, there were paired data for 4452 *QuickSmart* students and 1360 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 2.135 seconds, which is a strong result. The effect size for this result is -0.931, 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.

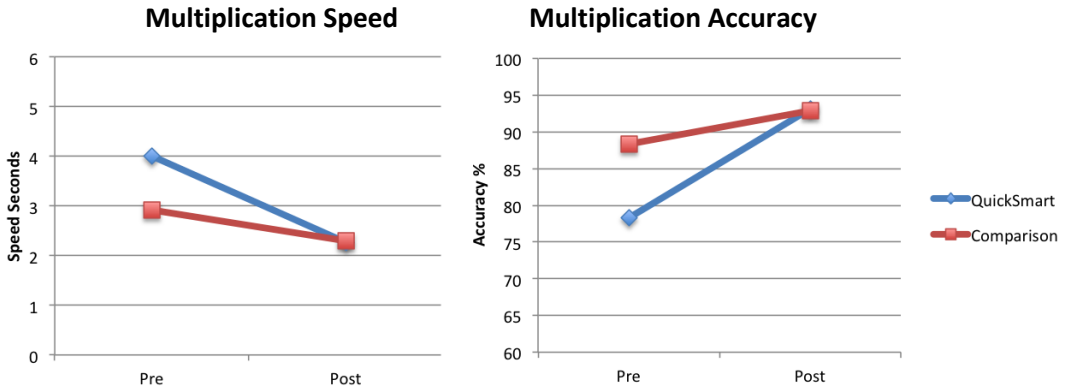
In terms of accuracy, the *QuickSmart* students' average scores have improved by over 20 percentage points, which is a very strong result. The effect size is 1.041, which again indicates substantial improvement for the *QuickSmart* group.

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 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Multiplication QS (speed secs)	4941	4.015	2.31	2.27	1.457	-1.745	<0.001*	-0.904
Multiplication COMP (speed secs)	1413	2.914	1.697	2.293	1.238	-0.621	<0.001*	-0.418
Multiplication QS (accuracy %)	4941	78.28	18.236	93.161	10.538	14.881	<0.001*	0.999
Multiplication COMP (acc %)	1413	88.357	13.588	92.849	10.434	4.492	<0.001*	0.371

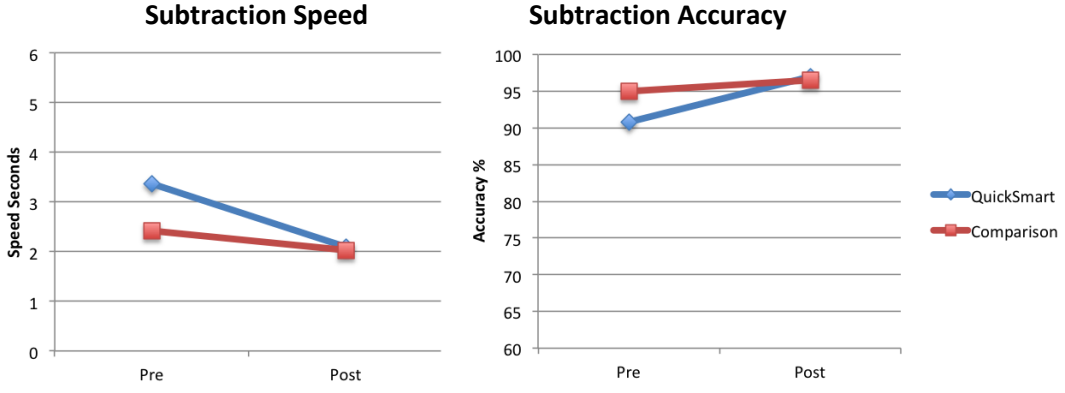


The results for multiplication indicate a significant improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

3.1.1.3 Subtraction

Table 3: OZCAAS subtraction - all students 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Subtraction QS (speed secs)	3729	3.371	1.834	2.097	1.241	-1.274	<0.001*	-0.814
Subtraction COMP (speed secs)	1073	2.427	1.302	2.031	1.073	-0.396	<0.001*	-0.332
Subtraction QS (accuracy %)	3729	90.816	10.882	96.978	5.909	6.162	<0.001*	0.704
Subtraction COMP (accuracy %)	1073	94.944	8.108	96.492	6.844	1.548	<0.001*	0.206

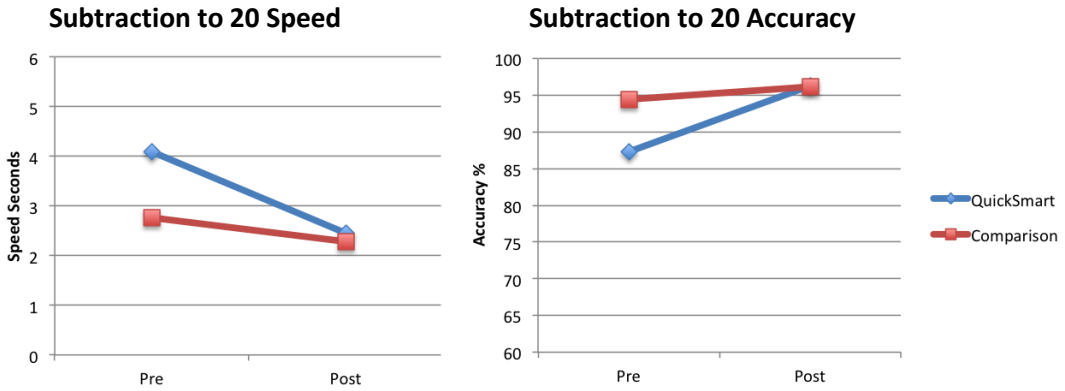


The results for subtraction indicate a very strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

3.1.1.4 Subtraction to 20

Table 4: OZCAAS subtraction to 20 - all students 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Subtraction to 20 *QS* (speed secs)	3178	4.086	2.351	2.453	1.523	-1.633	<0.001*	-0.824
Subtraction to 20 COMP (speed secs)	842	2.76	1.451	2.284	1.259	-0.476	<0.001*	-0.35
Subtraction to 20 *QS* (accuracy %)	3178	87.324	13.696	96.237	6.797	8.913	<0.001*	0.824
Subtraction to 20 COMP (acc %)	842	94.44	8.406	96.104	7.846	1.664	<0.001*	0.205

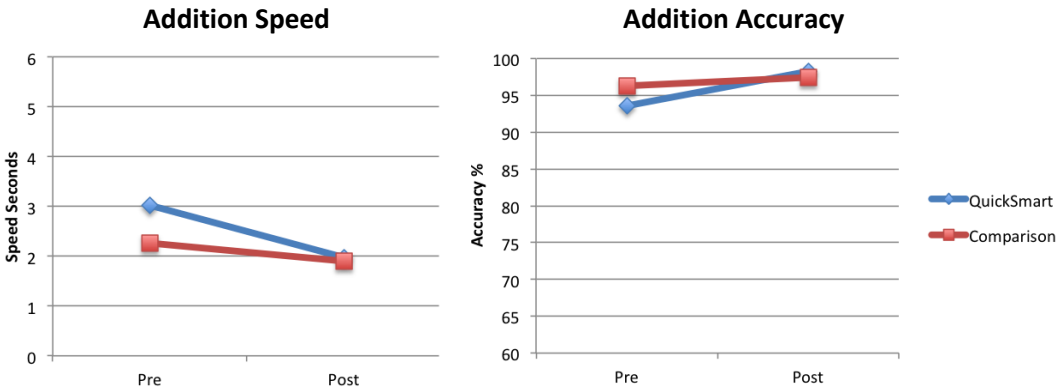


The results for subtraction to 20 indicate a significant improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students as a result of the *QuickSmart* intervention.

3.1.1.5 Addition

Table 5: OZCAAS addition - all students 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Addition *QS* (speed secs)	3966	3.016	1.577	1.978	1.078	-1.038	<0.001*	-0.768
Addition COMP (speed secs)	1121	2.266	1.061	1.901	0.849	-0.365	<0.001*	-0.38
Addition *QS* (accuracy %)	3966	93.558	8.795	98.221	4.128	4.663	<0.001*	0.679
Addition COMP (accuracy %)	1121	96.3	6.745	97.393	5.743	1.092	<0.001*	0.174

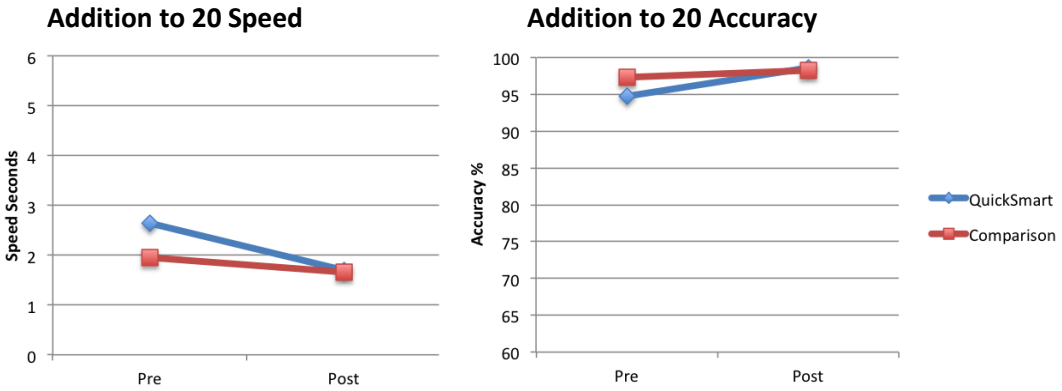


The results for addition indicate a strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

3.1.1.6 Addition to 20

Table 6: OZCAAS add to 20 results - all students 2012

OZCAAS Operation	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Addition to 20 *QS* (speed secs)	3236	2.638	1.474	1.7	1.03	-0.937	<0.001*	-0.737
Addition to 20 COMP (speed secs)	850	1.946	0.826	1.653	0.725	-0.293	<0.001*	-0.377
Addition to 20 *QS* (accuracy %)	3235	94.717	7.923	98.562	3.693	3.845	<0.001*	0.622
Addition to 20 COMP (accuracy %)	850	97.32	4.78	98.314	3.742	0.994	<0.001*	0.232



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.

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 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2162	4.756	2.497	2.798	1.866	-1.959	<0.001*	-0.889
Male COMP (speed)	656	3.456	1.888	2.765	1.532	-0.691	<0.001*	-0.402
Female QS (speed)	2290	5.172	2.738	2.871	1.926	-2.302	<0.001*	-0.972
Female COMP (speed)	704	3.889	2.283	3.09	1.672	-0.799	<0.001*	-0.399
Male QS (accuracy)	2162	68.715	23.294	88.452	15.507	19.737	<0.001*	0.997
Male COMP (accuracy)	656	82.992	18.675	89.577	15.206	6.586	<0.001*	0.387
Female QS (accuracy)	2290	67.374	24.415	89.402	15.249	22.028	<0.001*	1.082
Female COMP (accuracy)	704	81.714	18.502	88.661	14.476	6.947	<0.001*	0.418

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 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	2415	3.946	2.269	2.263	1.49	-1.683	<0.001*	-0.877
Male COMP (speed)	678	2.832	1.646	2.161	1.159	-0.671	<0.001*	-0.472
Female QS (speed)	2526	4.082	2.347	2.277	1.424	-1.805	<0.001*	-0.93
Female COMP (speed)	735	2.99	1.741	2.415	1.295	-0.575	<0.001*	-0.375
Male QS (accuracy)	2415	78.042	18.319	92.968	10.511	14.926	<0.001*	0.999
Male COMP (accuracy)	678	88.531	13.914	93.243	10.319	4.711	<0.001*	0.385
Female QS (accuracy)	2526	78.508	18.157	93.345	10.564	14.837	<0.001*	0.999
Female COMP (accuracy)	735	88.196	13.287	92.485	10.534	4.289	<0.001*	0.358

The results of *QuickSmart* students show that in terms of speed the females have improved slightly more than males, and they have had similar improvements to males in accuracy.

3.1.2.3 Subtraction by Gender

Table 9: OZCAAS subtraction results – all students by gender 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	1800	3.242	1.864	2.044	1.279	-1.199	<0.001*	-0.75
Male COMP (speed)	509	2.271	1.282	1.913	0.974	-0.357	<0.001*	-0.314
Female QS (speed)	1929	3.491	1.799	2.147	1.203	-1.344	<0.001*	-0.879
Female COMP (speed)	564	2.568	1.304	2.136	1.146	-0.431	<0.001*	-0.351
Male QS (accuracy)	1800	90.701	10.855	96.78	6.076	6.078	<0.001*	0.691
Male COMP (accuracy)	509	95.202	7.433	96.635	6.575	1.433	<0.001*	0.204
Female QS (accuracy)	1929	90.923	10.909	97.163	5.743	6.24	<0.001*	0.716
Female COMP (accuracy)	564	94.711	8.673	96.364	7.081	1.652	<0.001*	0.209

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 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	1578	3.882	2.296	2.34	1.443	-1.541	<0.001*	-0.804
Male COMP (speed)	403	2.572	1.41	2.06	1.072	-0.512	<0.001*	-0.409
Female QS (speed)	1600	4.287	2.387	2.565	1.591	-1.723	<0.001*	-0.849
Female COMP (speed)	439	2.932	1.467	2.49	1.379	-0.443	<0.001*	-0.311
Male QS (accuracy)	1578	87.73	13.154	96.394	6.395	8.664	<0.001*	0.838
Male COMP (accuracy)	403	95.062	7.606	96.553	7.329	1.492	0.001*	0.2
Female QS (accuracy)	1600	86.924	14.203	96.082	7.17	9.158	<0.001*	0.814
Female COMP (accuracy)	439	93.869	9.05	95.692	8.28	1.823	<0.001*	0.21

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 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	1923	3.018	1.651	1.954	1.118	-1.064	<0.001*	-0.754
Male COMP (speed)	533	2.183	1.072	1.789	0.865	-0.394	<0.001*	-0.404
Female QS (speed)	2043	3.015	1.503	2.001	1.038	-1.013	<0.001*	-0.784
Female COMP (speed)	588	2.342	1.045	2.002	0.821	-0.34	<0.001*	-0.361
Male QS (accuracy)	1923	92.781	9.781	98.115	4.226	5.334	<0.001*	0.708
Male COMP (accuracy)	533	96.44	5.92	97.514	5.731	1.074	0.001*	0.184
Female QS (accuracy)	2043	94.289	7.686	98.321	4.031	4.032	<0.001*	0.657
Female COMP (accuracy)	588	96.174	7.418	97.283	5.756	1.109	<0.001*	0.167

The results of *QuickSmart* students show that in both speed and accuracy the males have improved slightly more than females in respect to gain. The females have a slightly higher effect size for speed, because the standard deviation of their results in smaller.

3.1.2.6 Addition to 20 by Gender

Table 12: OZCAAS addition to 20 results – all students by gender 2012

Group	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Male QS (speed)	1611	2.615	1.463	1.684	1.078	-0.931	<0.001*	-0.725
Male COMP (speed)	405	1.869	0.804	1.578	0.724	-0.291	<0.001*	-0.38
Female QS (speed)	1625	2.66	1.485	1.717	0.979	-0.943	<0.001*	-0.75
Female COMP (speed)	445	2.016	0.839	1.721	0.721	-0.295	<0.001*	-0.377
Male QS (accuracy)	1611	94.452	7.776	98.539	3.389	4.087	<0.001*	0.681
Male COMP (accuracy)	405	97.619	3.997	98.362	3.401	0.744	0.001*	0.2
Female QS (accuracy)	1624	94.98	8.059	98.585	3.973	3.606	<0.001*	0.567
Female COMP (accuracy)	445	97.047	5.385	98.27	4.032	1.223	<0.001*	0.257

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

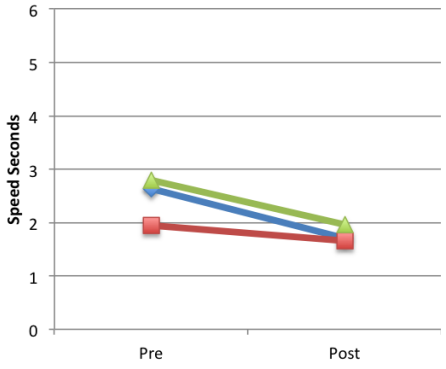
Table 13: OZCAAS results - Indigenous students 2012

Test	N	Pre-Mean	Pre-SD	Post-Mean	Post-SD	Gain	*p*	Effect size
Add to 20 QS (spd)	342	2.787	2.438	1.955	2.147	-0.832	<0.001*	-0.362
Add to 20 QS (acc)	342	94.678	8.807	98.724	3.026	4.046	<0.001*	0.614
Addition QS (speed)	456	3.102	2.326	2.1	1.99	-1.002	<0.001*	-0.463
Addition QS (acc)	456	93.36	9.513	98.225	4.659	4.865	<0.001*	0.65
Sub to 20 QS (spd)	338	4.358	3.088	2.733	2.457	-1.624	<0.001*	-0.582
Sub to 20 QS (acc)	338	85.988	15.432	96.094	7.435	10.105	<0.001*	0.834
Sub QS (speed)	420	3.581	2.606	2.301	2.0	-1.28	<0.001*	-0.551
Sub QS (accuracy)	420	89.355	13.139	96.492	7.423	7.137	<0.001*	0.669
Mult QS (speed)	529	4.021	2.58	2.441	1.871	-1.58	<0.001*	-0.701
Mult QS (accuracy)	529	78.298	20.049	91.782	12.061	13.484	<0.001*	0.815
Division QS (speed)	462	5.056	2.817	2.91	2.024	-2.147	<0.001*	-0.875
Division QS (acc)	462	68.245	25.464	88.038	17.473	19.794	<0.001*	0.906

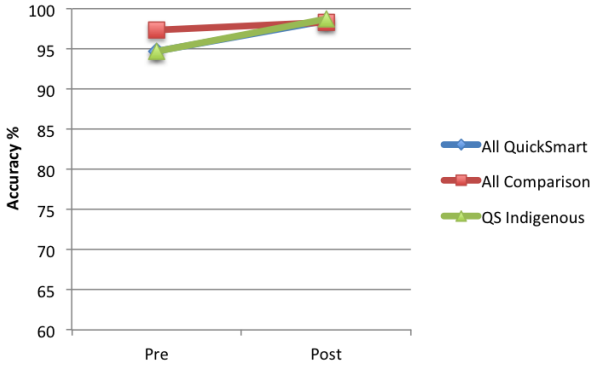
These results indicate that in most instances for both the pre-intervention and post-intervention the Indigenous students' mean scores were slightly lower than those of the overall *QuickSmart* group. In other words, these students had lower starting and finishing points. However, their improvement was 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



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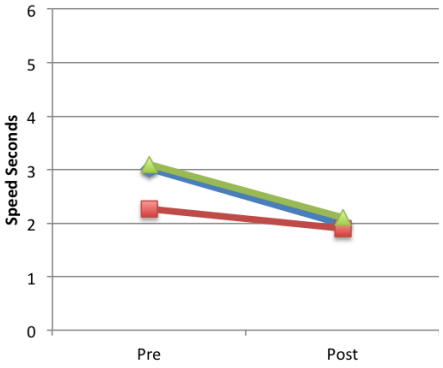
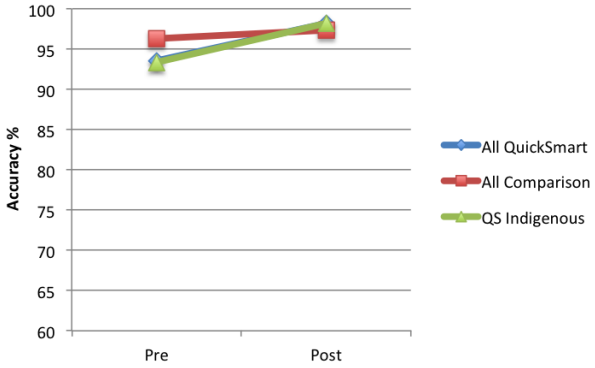
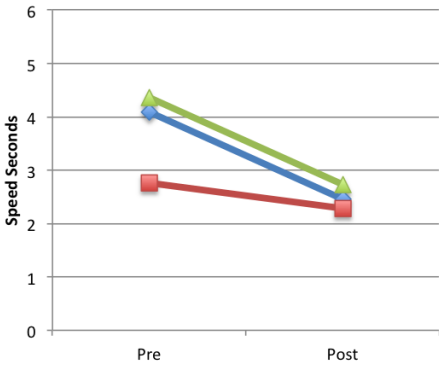


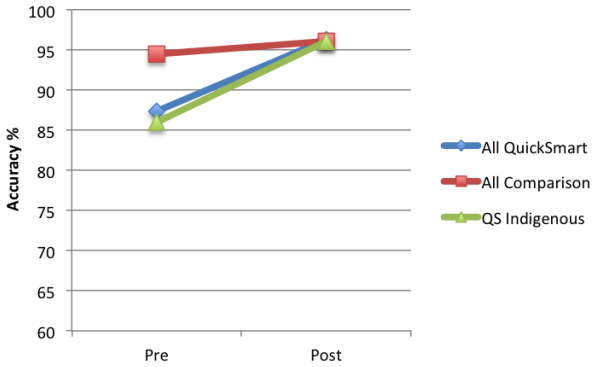
Addition Accuracy



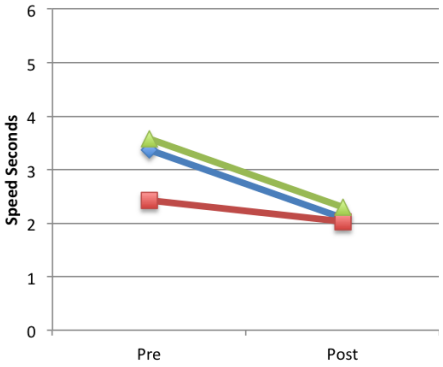
Subtraction to 20 Speed



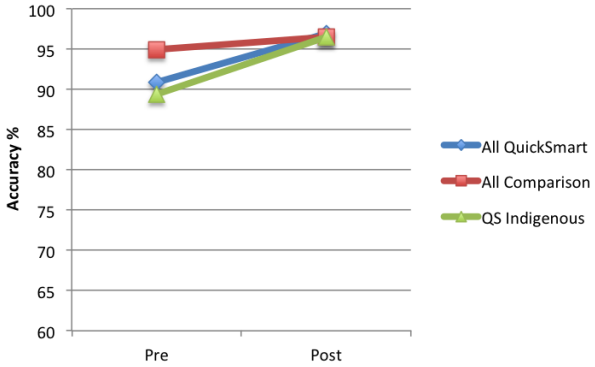
Subtraction to 20 Accuracy



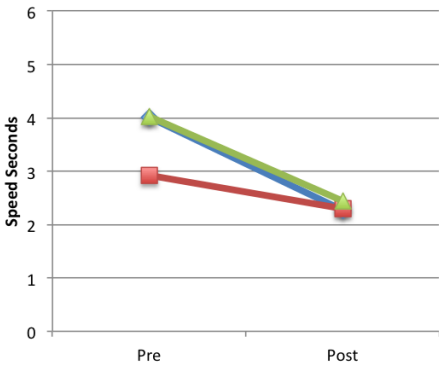
Subtraction Speed



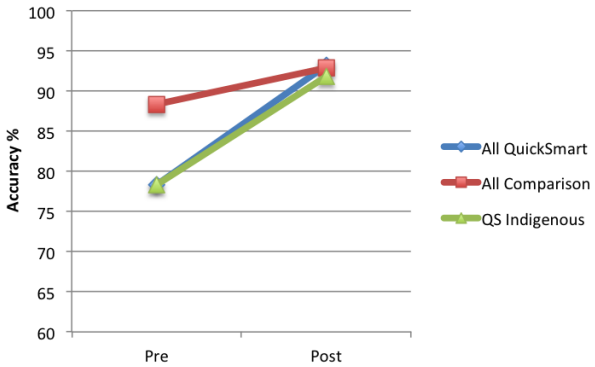
Subtraction Accuracy



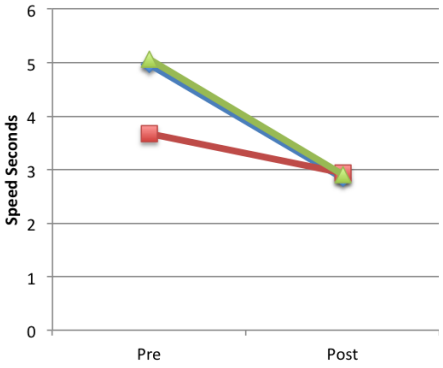
Multiplication Speed



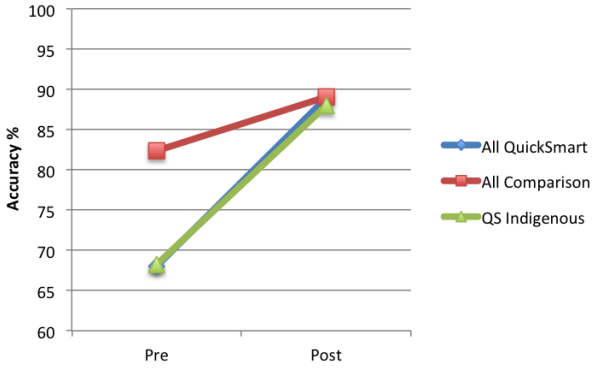
Multiplication Accuracy



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 415 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 - 2012

	N	Mean	Std. Deviation
Addition to 20 Speed	84	1.721	0.855
Addition to 20 Accuracy	84	98.44	3.343
Addition Speed	135	1.991	0.961
Addition Accuracy	135	97.972	8.8
Subtraction to 20 Speed	113	2.762	1.587
Subtraction to 20 Accuracy	113	94.262	7.912
Subtraction Speed	213	2.181	1.415
Subtraction Accuracy	213	96.302	6.374
Multiplication Speed	226	2.681	1.805
Multiplication Accuracy	226	90.21	13.987
Division Speed	444	3.468	2.153
Division Accuracy	444	84.336	17.576

The results in Table 14 are impressive given that these students did not have the skills or confidence to complete the OZCAAS pre-tests. In addition and subtraction, the average response rates were below 3 seconds and above 94% 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 seconds and accuracy over 84% 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.

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 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 to indicate the magnitude of the change in academic achievement for the *QuickSmart* and comparison students.

Table 15: PATM results - (Scale scores) 2012

	Students with paired data	**Average Gain score**	**Significance**	**Effect size**
All *QuickSmart*	4363	6.983	<0.001*	0.693
All comparison	1362	5.031	<0.001*	0.429

The results indicate a very strong improvement for *QuickSmart* students. This improvement is greater than that of 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) 2012

Gender	Students with paired data	Average Gain score	Significance	Effect size
Male QS Students	2105	6.783	<0.001*	0.661
Male Comp Students	659	4.813	<0.001*	0.406
Female QS Students	2258	7.168	<0.001*	0.725
Female Comp Students	703	5.234	<0.001*	0.452

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

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) 2012

Indigenous students	Students with paired data	Average Gain score	Significance	Effect size
Indigenous *QuickSmart*	502	6.604	<0.001*	0.575

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.

3.2.3 Results on the Victorian On-Demand VCAA Assessment

Table 18 reports the paired-samples *t*-tests analysis of the VCAA data for all students for whom paired data were available. VCAA analyses for relevant Victorian clusters are provided as an Appendix to this report. (Note: Students who were absent at the end of the year were not included in the analysis).

When looking at the VCAA results, it must be kept in mind that the scale of the On-Demand test is restricted, with most students' scores expected to lie between 2 and 3.5. This restricted range is an artefact of the scaling used in these tests. Specifically, students' achievement at the end of Year Four is pegged to an On-Demand test score of 3.0 and achievement at the end of Year 5 is expected to be 3.5, and so on. For On-Demand results the value 0.25 is equivalent to 6 months growth.

Table 18: VCAA results - (VELS scores) 2012

	Students with paired data	Average Gain score	Significance	Effect size
All *QuickSmart*	59	0.342	<0.001*	0.774
All comparison	43	0.191	<0.001*	0.303

The results are encouraging. *QuickSmart* students showed an average growth of eight months over the course of the intervention and a very strong improvement measured by Effect Size statistics. This is impressive in light of the fact that most of the low-achieving students included in *QuickSmart* groups would not usually be expected to achieve a level of improvement commensurate to the duration of instruction. Again encouragingly, when *QuickSmart* students' On-Demand scores are compared to those of their average-achieving peers in the comparison group, it is evident that the *QuickSmart* students' results are slightly better.

There were too few students to do an indigenous VCAA analysis.

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 Standardised Test results by Region – (Scale scores for PAT, VELS levels for VCAA On-demand tests) 2012

School Region		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
ACT QS Students	29	38.0	6.724	41.914	6.615	3.914	0.004*	0.587
Adelaide QS Students	427	41.884	9.742	48.293	10.161	6.409	<0.001*	0.644
Ballarat QS Students	320	41.989	8.83	48.526	9.059	6.537	<0.001*	0.731
Horsham QS Students	138	42.151	6.326	49.987	9.213	7.836	<0.001*	0.992
Hunter QS Students	577	41.356	10.577	48.404	11.291	7.048	<0.001*	0.644
Melbourne QS Students	549	42.534	9.013	49.758	10.115	7.224	<0.001*	0.754
New England QS Students	77	38.734	9.312	46.556	8.486	7.822	<0.001*	0.878
North Coast NSW QS Students	1044	42.693	9.512	50.849	10.624	8.156	<0.001*	0.809
North Tasmania QS Students	146	44.501	8.361	49.331	8.398	4.83	<0.001*	0.576
North West NSW QS Students	278	47.297	9.512	52.758	10.721	5.461	<0.001*	0.539
Perth QS Students	54	38.539	13.131	46.309	9.62	7.77	<0.001*	0.675
SA Regional QS Students	182	43.614	8.605	49.705	10.38	6.091	<0.001*	0.639
Queensland QS Students	49	39.657	10.283	47.927	10.117	8.27	<0.001*	0.811
Riverina QS Students	70	50.789	9.84	56.376	8.154	5.587	<0.001*	0.618
South Tasmania QS Students	49	40.404	8.732	47.641	8.81	7.237	<0.001*	0.825
Southern Sydney QS Students	57	41.256	10.456	48.06	10.159	6.804	<0.001*	0.66
Western NSW QS Students	272	41.699	9.941	47.61	11.476	5.911	<0.001*	0.551
Western Sydney QS Students	45	34.167	7.598	42.869	6.588	8.702	<0.001*	1.224
#Vic VCAA QS Students	59	2.839	0.415	3.181	0.468	0.342	<0.001*	0.774

Note 1: only students who did both 'pre' and 'post' test are included in the table.
Note 2: some results for Victoria (#) are for the VCAA test, all others are PAT test.

5.2 PAT results by demographic (Scale scores) 2012

Demographic		**Pre-Intervention**		**Post-Intervention**				
	N	**Mean**	**SD**	**Mean**	**SD**	**Gain**	***p***	**Effect size**
All QS Students	**4363**	**42.489**	**9.697**	**49.472**	**10.434**	**6.983**	**<0.001***	**0.693**
All comparison students	**1362**	**52.971**	**11.468**	**58.002**	**11.977**	**5.031**	**<0.001***	**0.429**
Indigenous QS Students	502	41.455	11.298	48.059	11.689	6.604	<0.001*	0.575
Male QS Students	2105	42.363	10.005	49.146	10.524	6.783	<0.001*	0.661
Male comparison students	659	53.457	11.772	58.27	11.956	4.813	<0.001*	0.406
Female QS Students	2258	42.607	9.401	49.775	10.342	7.168	<0.001*	0.725
Female comparison Students	703	52.516	11.165	57.75	12.0	5.234	<0.001*	0.452

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

5.3 VCAA results (VELS) 2012

Demographic		**Pre-Intervention**		**Post-Intervention**				
	N	**Mean**	**SD**	**Mean**	**SD**	**Gain**	***p***	**Effect size**
All QS Students	**59**	**2.839**	**0.415**	**3.181**	**0.468**	**0.342**	**<0.001***	**0.774**
All comparison students	**43**	**3.784**	**0.637**	**3.974**	**0.621**	**0.191**	**<0.001***	**0.303**

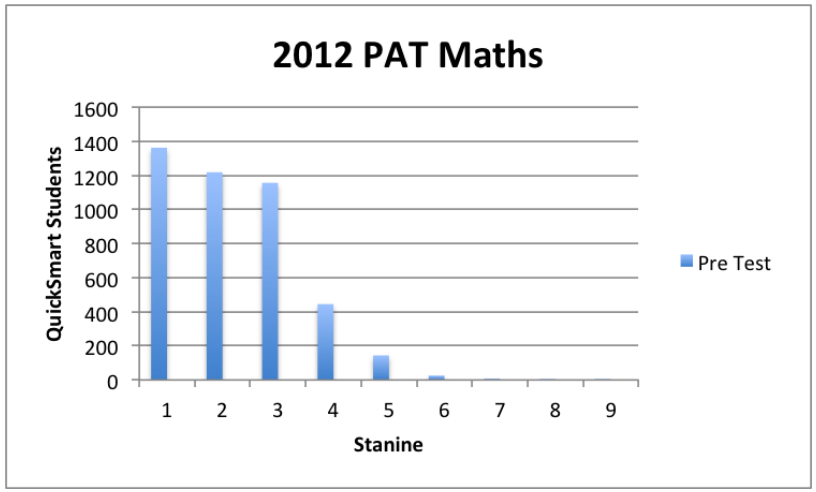
Note: only students who did both 'pre' and 'post' test are included in the table.

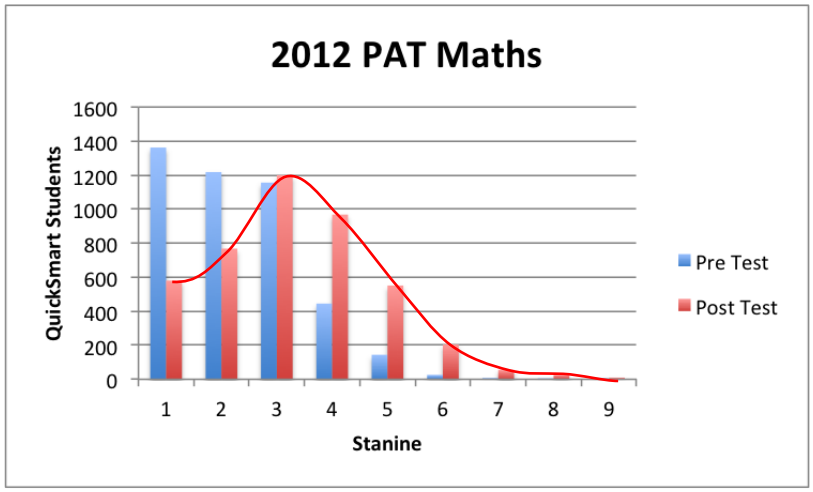
5.4 PAT results by State (except NT)

School		Pre-Intervention		Post-Intervention				
	N	Mean	SD	Mean	SD	Gain	*p*	Effect size
All QS Students	**4363**	**42.489**	**9.697**	**49.472**	**10.434**	**6.983**	**<0.001***	**0.693**
All comparison students	**1362**	**52.971**	**11.468**	**58.002**	**11.977**	**5.031**	**<0.001***	**0.429**
ACT QS students	29	38.0	6.724	41.914	6.615	3.914	0.004*	0.587
ACT Ind QS	1	39.5	.	44.3	.	4.8		
ACT COMP students	7	51.314	7.416	52.3	8.948	0.986	0.797	0.12
NSW QS students	2420	42.707	10.145	49.93	10.922	7.223	<0.001*	0.685
NSW Ind QS	427	42.373	11.028	48.891	11.701	6.518	<0.001*	0.573
NSW COMP students	649	51.798	11.533	56.818	12.346	5.02	<0.001*	0.42
QLD QS students	49	39.657	10.283	47.927	10.117	8.27	<0.001*	0.811
QLD Ind QS	9	40.6	12.917	42.611	14.263	2.011	0.369	0.148
QLD COMP students	12	56.75	8.147	59.067	9.856	2.317	0.28	0.256
SA QS students	609	42.401	9.443	48.715	10.239	6.314	<0.001*	0.641
SA Ind QS	17	35.565	6.88	40.012	10.581	4.447	0.119	0.498
SA COMP students	233	54.239	11.648	60.346	11.67	6.107	<0.001*	0.524
TAS QS students	195	43.472	8.619	48.906	8.512	5.434	<0.001*	0.634
TAS Ind QS	19	39.474	5.945	45.821	6.763	6.347	0.001*	0.997
TAS COMP students	79	50.892	8.237	54.233	11.358	3.341	0.001*	0.337
VIC QS students	1007	42.308	8.631	49.398	9.679	7.09	<0.001*	0.773
VIC Ind QS	19	40.458	9.055	48.353	8.773	7.895	<0.001*	0.886
VIC COMP students	355	54.665	10.889	59.789	10.743	5.124	<0.001*	0.474
WA QS students	54	38.539	13.131	46.309	9.62	7.77	<0.001*	0.675
WA Ind QS	10	18.88	14.077	35.17	10.84	16.29	<0.001*	1.297
WA COMP students	27	52.789	19.804	54.756	16.906	1.967	0.232	0.107

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

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.