quicksmart

# Annual Numeracy Program Report

# 2010

**The SiMERR National Research Centre**

**The University of New England**

**ARMIDALE NSW**

# Table Of Contents

**LIST of Tables**

# 1  *QuickSmart* in 2010

In 2010, the *QuickSmart* team at the University of New England received data from 4846 students who participated in *QuickSmart* Numeracy lessons and 1644 average-achieving comparison peers. These students were drawn from nineteen clusters of schools from 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 (CAAS) and on standardised test measures, specifically the Progressive Achievement Tests in Mathematics (ACER, 2010) and the VCAA On-Demand tests used by some schools in Victoria.  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 CAAS 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.

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 CAAS 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 CAAS results recorded for Comparison students should also be interpreted with the knowledge that many of these students' results also are limited in terms of growth by a ceiling effect.

Average results from all numeracy students are 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. Note that the *p*-values included in tables in this report represent the probability or likelihood that there is no difference between mean scores for pre-intervention and post-intervention results. If this value is less than 0.05 this difference is usually considered statistically significant. This means that there is a less than 5% probability that the result was obtained by chance. If the *p*-value is more than 0.05 the two means may still be importantly different, however, there is an increased possibility that chance factors influenced the result. In our analyses this sometimes happens when the number of students in the group is quite small (as is often the case for comparison students).

### 3.1.1 Combined CAAS Analysis

### 3.1.1.1 Division

**Table 1:** CAAS division - all students 2010

| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Division QS (speed secs) | 3486 | 5.237 | 2.94 | 2.875 | 1.901 | -2.362 | <0.001* | -0.954 |
| Division COMP (speed secs) | 1254 | 3.627 | 2.109 | 2.915 | 1.683 | -0.712 | <0.001* | -0.373 |
| Division QS (accuracy %) | 3502 | 63.957 | 24.678 | 87.478 | 15.488 | 23.522 | <0.001* | 1.142 |
| Division COMP (accuracy %) | 1253 | 82.767 | 16.772 | 89.419 | 12.588 | 6.652 | <0.001* | 0.449 |
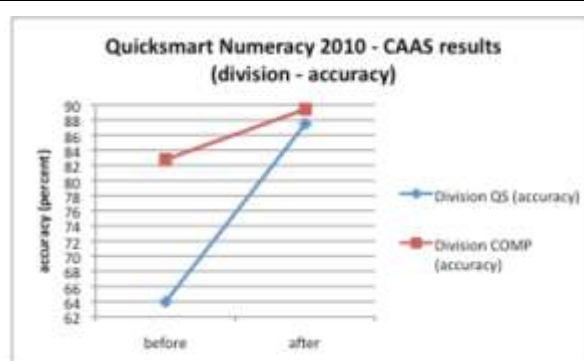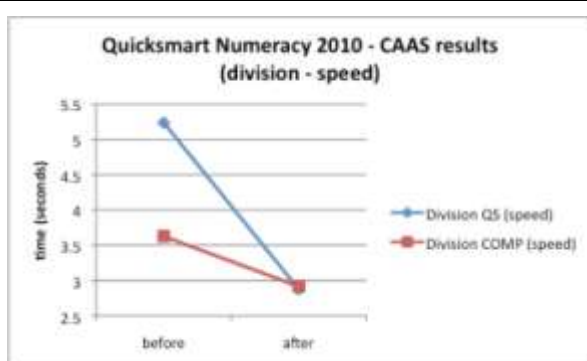


On the division test, there were paired data for 3486 *QuickSmart* students and 1253 comparison students. The desired criterion for response speed on the CAAS assessments is between 1 and 2 seconds as an indication of automaticity. The decrease in time for *QuickSmart* students is 2.362 seconds, which is a strong result. The effect size for this result is -0.954, 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 23.5 percentage points, which is a very strong result. The effect size is 1.142, 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.

### 3.1.1.2 Multiplication

**Table 2:** CAAS multiplication - all students 2010

| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Multiplication QS (speed secs) | 3898 | 4.676 | 2.73 | 2.536 | 1.656 | -2.14 | <0.001* | -0.948 |
| Multiplication COMP (speed secs) | 1338 | 3.111 | 1.877 | 2.539 | 1.415 | -0.572 | <0.001* | -0.344 |
| Multiplication QS (accuracy %) | 3917 | 74.485 | 19.906 | 91.17 | 11.893 | 16.686 | <0.001* | 1.018 |
| Multiplication COMP (acc %) | 1338 | 88.108 | 12.582 | 92.196 | 9.568 | 4.089 | <0.001* | 0.366 |
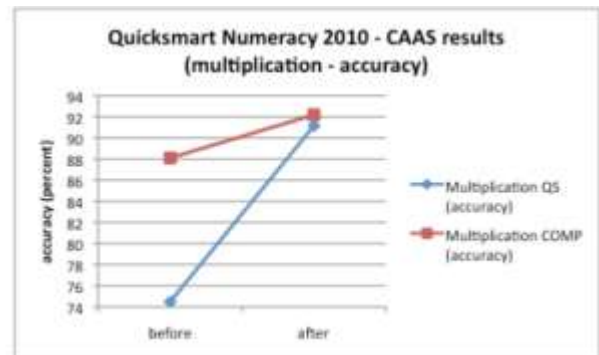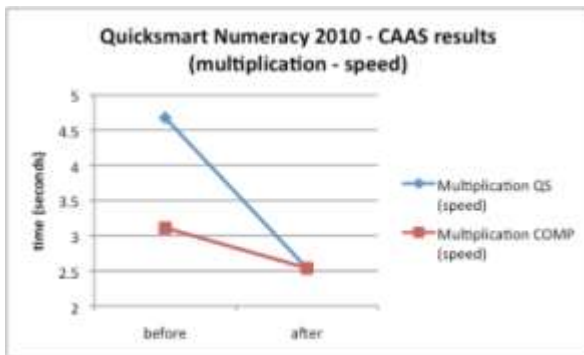


The results for multiplication indicate a significant improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

### 3.1.1.3 Subtraction

**Table 3:** CAAS subtraction - all students 2010

| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Subtraction QS (speed secs) | 3640 | 3.56 | 1.874 | 2.149 | 1.181 | -1.411 | <0.001* | -0.9 |
| Subtraction COMP (speed secs) | 1241 | 2.355 | 1.194 | 1.967 | 0.868 | -0.387 | <0.001* | -0.371 |
| Subtraction QS (accuracy %) | 3662 | 88.853 | 11.885 | 96.171 | 6.791 | 7.318 | <0.001* | 0.756 |
| Subtraction COMP (accuracy %) | 1241 | 94.747 | 6.883 | 96.766 | 5.521 | 2.019 | <0.001* | 0.324 |

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:** CAAS subtraction to 20 - all students 2010

| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Subtraction to 20 *QS* (speed secs) | 1942 | 4.052 | 2.174 | 2.302 | 1.294 | -1.75 | <0.001* | -0.978 |
| Subtraction to 20 COMP (speed secs) | 655 | 2.485 | 1.332 | 2.072 | 0.976 | -0.412 | <0.001* | -0.353 |
| Subtraction to 20 *QS* (accuracy %) | 1942 | 86.265 | 13.402 | 95.397 | 7.777 | 9.132 | <0.001* | 0.833 |
| Subtraction to 20 COMP (acc %) | 655 | 94.039 | 8.477 | 96.778 | 6.622 | 2.738 | <0.001* | 0.36 |



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:** CAAS addition - all students 2010

| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Addition *QS* (speed secs) | 3743 | 3.338 | 1.568 | 2.134 | 1.038 | -1.204 | <0.001* | -0.905 |
| Addition COMP (speed secs) | 1268 | 2.319 | 1.174 | 2.024 | 0.856 | -0.296 | <0.001* | -0.288 |
| Addition *QS* (accuracy %) | 3764 | 93.1 | 9.083 | 97.507 | 5.237 | 4.406 | <0.001* | 0.594 |
| Addition COMP (accuracy %) | 1268 | 95.918 | 6.822 | 97.271 | 5.964 | 1.353 | <0.001* | 0.211 |

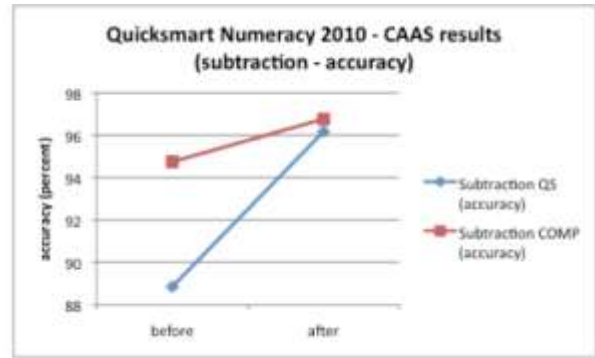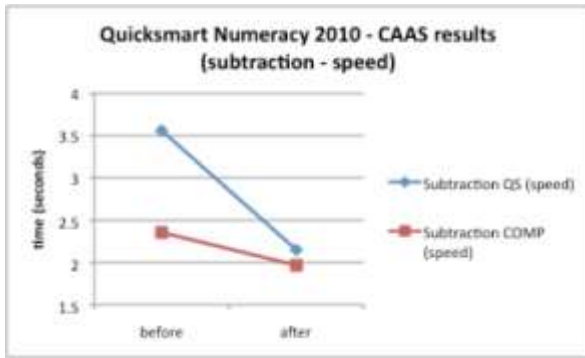

The results for addition indicate a strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

### 3.1.1.6 Addition to 20

**Table 6:** CAAS add to 20 results - all students 2010

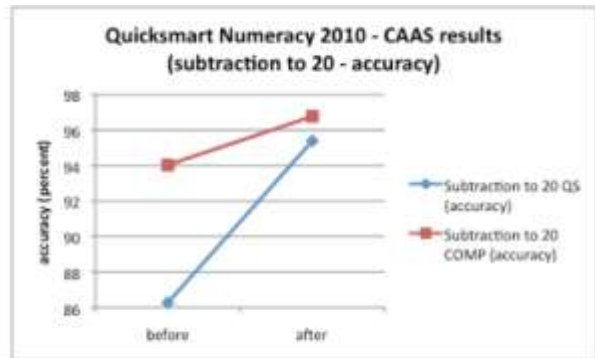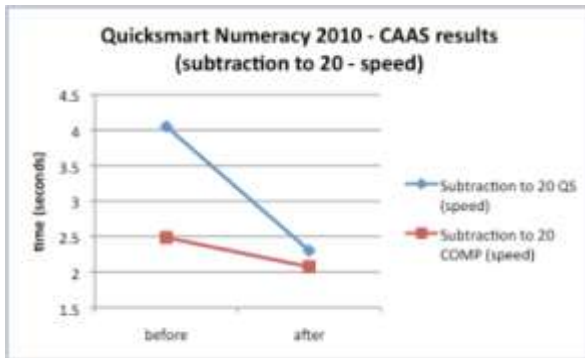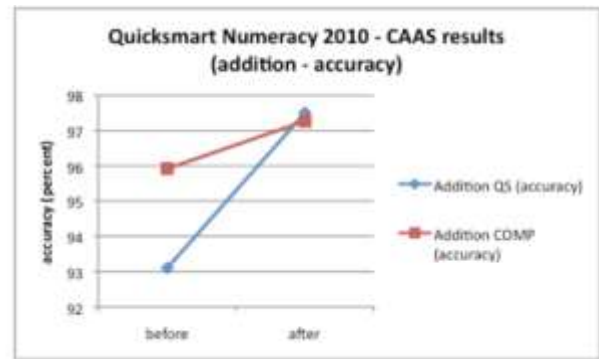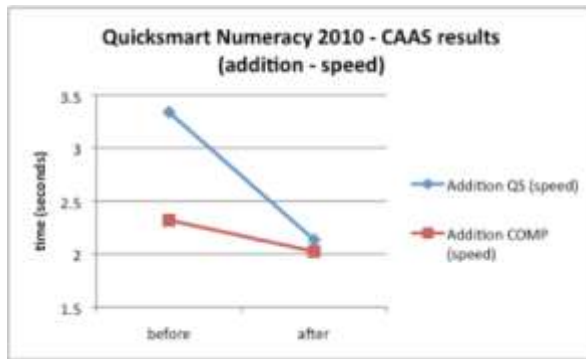| CAAS Operation | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Addition to 20 *QS* (speed secs) | 2467 | 2.944 | 1.486 | 1.794 | 0.85 | -1.15 | <0.001* | -0.95 |
| Addition to 20 COMP (speed secs) | 750 | 1.993 | 0.954 | 1.754 | 0.859 | -0.239 | <0.001* | -0.264 |
| Addition to 20 *QS* (accuracy %) | 2467 | 93.728 | 8.74 | 98.202 | 3.989 | 4.473 | <0.001* | 0.658 |
| Addition to 20 COMP (accuracy %) | 750 | 96.647 | 5.797 | 98.035 | 4.028 | 1.388 | <0.001* | 0.278 |
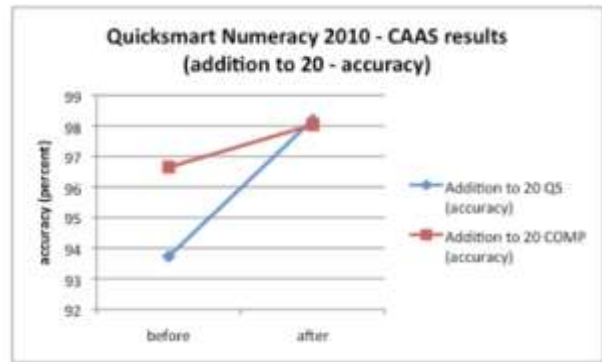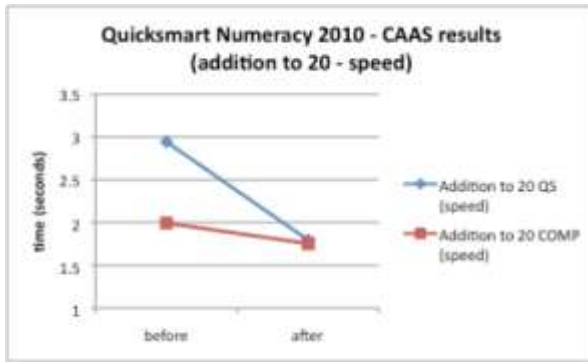
The results for addition to 20 indicate a strong improvement for the *QuickSmart* students. The diagrams illustrate the narrowing of the gap between the *QuickSmart* students and comparison students.

### 3.1.2 CAAS By Demographics

#### 3.1.2.1 Division by Gender

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

**Table 7:** CAAS division results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 1681 | 5.062 | 2.86 | 2.841 | 1.955 | -2.221 | <0.001* | -0.906 |
| Male COMP (speed) | 624 | 3.351 | 1.904 | 2.755 | 1.614 | -0.596 | <0.001* | -0.338 |
| Female QS (speed) | 1805 | 5.401 | 3.003 | 2.908 | 1.849 | -2.494 | <0.001* | -1.0 |
| Female COMP (speed) | 630 | 3.901 | 2.263 | 3.074 | 1.735 | -0.827 | <0.001* | -0.41 |
| | | | | | | | | |
| Male QS (accuracy) | 1693 | 64.333 | 24.396 | 87.433 | 15.346 | 23.1 | <0.001* | 1.133 |
| Male COMP (accuracy) | 624 | 83.735 | 15.826 | 90.332 | 11.792 | 6.597 | <0.001* | 0.473 |
| Female QS (accuracy) | 1809 | 63.605 | 24.941 | 87.521 | 15.623 | 23.916 | <0.001* | 1.149 |
| Female COMP (accuracy) | 629 | 81.807 | 17.62 | 88.514 | 13.279 | 6.707 | <0.001* | 0.43 |

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:** CAAS multiplication results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 1870 | 4.621 | 2.732 | 2.498 | 1.614 | -2.124 | <0.001* | -0.947 |
| Male COMP (speed) | 671 | 2.962 | 1.815 | 2.412 | 1.356 | -0.55 | <0.001* | -0.343 |
| Female QS (speed) | 2028 | 4.727 | 2.729 | 2.572 | 1.694 | -2.155 | <0.001* | -0.949 |
| Female COMP (speed) | 667 | 3.261 | 1.928 | 2.667 | 1.461 | -0.594 | <0.001* | -0.347 |
| | | | | | | | | |
| Male QS (accuracy) | 1885 | 73.994 | 20.089 | 91.145 | 11.775 | 17.151 | <0.001* | 1.042 |
| Male COMP (accuracy) | 671 | 88.612 | 12.038 | 92.599 | 8.945 | 3.987 | <0.001* | 0.376 |
| Female QS (accuracy) | 2032 | 74.94 | 19.728 | 91.193 | 12.005 | 16.253 | <0.001* | 0.995 |
| Female COMP (accuracy) | 667 | 87.6 | 13.097 | 91.791 | 10.147 | 4.191 | <0.001* | 0.358 |

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

### 3.1.2.3 Subtraction by Gender

**Table 9:** CAAS subtraction results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 1717 | 3.353 | 1.807 | 2.092 | 1.217 | -1.261 | <0.001* | -0.818 |
| Male COMP (speed) | 614 | 2.169 | 1.174 | 1.846 | 0.86 | -0.323 | <0.001* | -0.313 |
| Female QS (speed) | 1923 | 3.745 | 1.913 | 2.2 | 1.147 | -1.544 | <0.001* | -0.979 |
| Female COMP (speed) | 627 | 2.537 | 1.185 | 2.086 | 0.861 | -0.451 | <0.001* | -0.435 |
| | | | | | | | | |
| Male QS (accuracy) | 1733 | 89.121 | 11.62 | 96.29 | 6.846 | 7.169 | <0.001* | 0.752 |
| Male COMP (accuracy) | 614 | 94.951 | 6.738 | 97.016 | 5.036 | 2.065 | <0.001* | 0.347 |
| Female QS (accuracy) | 1929 | 88.612 | 12.115 | 96.065 | 6.74 | 7.452 | <0.001* | 0.76 |
| Female COMP (accuracy) | 627 | 94.548 | 7.023 | 96.522 | 5.951 | 1.974 | <0.001* | 0.303 |

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:** CAAS subtraction to 20 results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 966 | 3.885 | 2.121 | 2.274 | 1.357 | -1.612 | <0.001* | -0.905 |
| Male COMP (speed) | 337 | 2.27 | 1.131 | 1.94 | 0.934 | -0.33 | <0.001* | -0.318 |
| Female QS (speed) | 976 | 4.217 | 2.214 | 2.33 | 1.229 | -1.887 | <0.001* | -1.054 |
| Female COMP (speed) | 318 | 2.712 | 1.485 | 2.213 | 1.001 | -0.499 | <0.001* | -0.394 |
| | | | | | | | | |
| Male QS (accuracy) | 966 | 86.441 | 13.076 | 95.153 | 8.066 | 8.712 | <0.001* | 0.802 |
| Male COMP (accuracy) | 337 | 94.048 | 8.255 | 97.003 | 6.802 | 2.955 | <0.001* | 0.391 |
| Female QS (accuracy) | 976 | 86.09 | 13.723 | 95.638 | 7.477 | 9.548 | <0.001* | 0.864 |
| Female COMP (accuracy) | 318 | 94.031 | 8.719 | 96.539 | 6.428 | 2.509 | <0.001* | 0.328 |

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:** CAAS addition results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 1779 | 3.269 | 1.604 | 2.092 | 1.051 | -1.177 | <0.001* | -0.868 |
| Male COMP (speed) | 630 | 2.187 | 1.259 | 1.881 | 0.842 | -0.306 | <0.001* | -0.285 |
| Female QS (speed) | 1964 | 3.4 | 1.532 | 2.173 | 1.025 | -1.228 | <0.001* | -0.942 |
| Female COMP (speed) | 638 | 2.451 | 1.069 | 2.165 | 0.846 | -0.285 | <0.001* | -0.296 |
| | | | | | | | | |
| Male QS (accuracy) | 1795 | 92.511 | 9.427 | 97.438 | 5.381 | 4.927 | <0.001* | 0.642 |
| Male COMP (accuracy) | 630 | 95.897 | 6.325 | 97.2 | 6.836 | 1.303 | <0.001* | 0.198 |
| Female QS (accuracy) | 1969 | 93.638 | 8.726 | 97.569 | 5.102 | 3.932 | <0.001* | 0.55 |
| Female COMP (accuracy) | 638 | 95.938 | 7.285 | 97.34 | 4.959 | 1.402 | <0.001* | 0.225 |

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

### 3.1.2.6  Addition to 20 by Gender

**Table 12:** CAAS addition to 20 results – all students by gender 2010

| Group | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | *p* | Effect size |
|---|---|---|---|---|---|---|---|---|
| Male QS (speed) | 1222 | 2.904 | 1.519 | 1.781 | 0.919 | -1.123 | <0.001* | -0.894 |
| Male COMP (speed) | 381 | 1.864 | 1.001 | 1.712 | 1.023 | -0.152 | <0.001* | -0.15 |
| Female QS (speed) | 1245 | 2.983 | 1.453 | 1.807 | 0.776 | -1.176 | <0.001* | -1.009 |
| Female COMP (speed) | 369 | 2.127 | 0.884 | 1.798 | 0.645 | -0.329 | <0.001* | -0.425 |
|  |  |  |  |  |  |  |  |  |
| Male QS (accuracy) | 1222 | 93.702 | 8.62 | 98.16 | 4.102 | 4.459 | <0.001* | 0.661 |
| Male COMP (accuracy) | 381 | 96.769 | 5.176 | 98.013 | 4.136 | 1.244 | <0.001* | 0.266 |
| Female QS (accuracy) | 1245 | 93.754 | 8.859 | 98.242 | 3.876 | 4.488 | <0.001* | 0.656 |
| Female COMP (accuracy) | 369 | 96.522 | 6.38 | 98.059 | 3.918 | 1.537 | <0.001* | 0.29 |

The results show that in speed, females outperformed males, but in accuracy the genders performed equally well.

### 3.1.2.7  Indigenous students

**Table 13:** CAAS results - Indigenous students 2010

| Test | N | Pre-Mean | Pre-SD | Post-Mean | Post-SD | Gain | p | Effect size |
|---|---|---|---|---|---|---|---|---|
| Add to 20 QS (spd) | 270 | 3.286 | 1.767 | 1.975 | 1.015 | -1.311 | <0.001* | -0.91 |
| Add to 20 QS (acc) | 270 | 92.685 | 12.001 | 97.748 | 4.459 | 5.063 | <0.001* | 0.559 |
|  |  |  |  |  |  |  |  |  |
| Addition QS (speed) | 343 | 3.583 | 1.777 | 2.319 | 1.219 | -1.265 | <0.001* | -0.83 |
| Addition QS (acc) | 343 | 92.903 | 9.622 | 96.951 | 6.896 | 4.048 | <0.001* | 0.484 |
|  |  |  |  |  |  |  |  |  |
| Sub to 20 QS (spd) | 194 | 4.571 | 2.446 | 2.73 | 1.765 | -1.842 | <0.001* | -0.864 |
| Sub to 20 QS (acc) | 194 | 83.92 | 14.822 | 93.825 | 8.921 | 9.905 | <0.001* | 0.81 |
|  |  |  |  |  |  |  |  |  |
| Sub QS (speed) | 336 | 3.94 | 2.215 | 2.41 | 1.405 | -1.53 | <0.001* | -0.825 |
| Sub QS (accuracy) | 336 | 87.045 | 13.963 | 95.169 | 8.088 | 8.124 | <0.001* | 0.712 |
|  |  |  |  |  |  |  |  |  |
| Mult QS (speed) | 352 | 5.223 | 3.276 | 2.817 | 1.791 | -2.406 | <0.001* | -0.911 |
| Mult QS (accuracy) | 352 | 70.78 | 23.525 | 88.957 | 14.391 | 18.177 | <0.001* | 0.932 |
|  |  |  |  |  |  |  |  |  |
| Division QS (speed) | 299 | 5.452 | 3.129 | 3.255 | 2.325 | -2.197 | <0.001* | -0.797 |
| Division QS (acc) | 299 | 58.259 | 27.781 | 84.057 | 18.114 | 25.798 | <0.001* | 1.1 |

These results indicate that in 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, even though slightly smaller than for the overall *QuickSmart* group, is still very strong to substantial. This is particularly so for subtraction, multiplication and division. 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). In division accuracy, the Indigenous students improved more than the overall *QuickSmart* group.

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

To complete this section on CAAS results, it is important to note that there were 437 students who the instructors confirmed were not able to complete all the CAAS 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 CAAS 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:** CAAS results where no pre-test data was available - 2010

|  | N | Mean | Std. Deviation |
|---|---|---|---|
| ADD20_SP sec | 49 | 1.98 | 1.028 |
| ADD20_AC % | 49 | 98.8 | 2.924 |
| ADD_SP sec | 80 | 2.693 | 2.064 |
| ADD_AC % | 80 | 97.206 | 5.726 |
| SUB20_SP sec | 45 | 2.653 | 2.08 |
| SUB20_AC % | 45 | 94.724 | 9.167 |
| SUB_SP sec | 146 | 2.541 | 1.5 |
| SUB_AC % | 146 | 94.74 | 7.858 |
| MULT_SP sec | 211 | 3.587 | 2.335 |
| MULT_AC % | 211 | 86.014 | 16.658 |
| DIV_SP sec | 437 | 3.714 | 2.62 |
| DIV_AC % | 437 | 81.484 | 20.045 |

The results in Table 14 are impressive given that these students did not have the skills or confidence to complete the CAAS pre-tests. In addition and subtraction, the average response rates were below 2.7 seconds and above 94.5% accuracy. Even though some of these students may not have progressed to multiplication and division during *QuickSmart* lessons, their results are encouraging, particularly in accuracy, with response speeds below 3.8 seconds and accuracy over 81% 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 CAAS 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. Males performed slightly better in addition accuracy and multiplication accuracy. Females performed slightly better in division accuracy, subtraction accuracy, and in the speed of response for all of the operations. These differences, however, are too small to warrant further investigation.

Indigenous students had lower starting and finishing points in all 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 analysis of the PATM data for all students for whom paired data were available. PATM analyses for individual clusters are provided in as 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) 2010

| Year and School number | Students with paired data | Average Gain score | Significance | Effect size |
|---|---|---|---|---|
| All schools – QS group | 3784 | 6.78 | <0.001 | 0.706 |
| All schools – Comp group | 1268 | 4.995 | <0.001 | 0.481 |

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) 2010

| Gender | Students with paired data | Average Gain score | Significance | Effect size |
|---|---|---|---|---|
| Male QS Students | 1812 | 6.941 | <0.001 | 0.707 |
| Male Comp Students | 648 | 4.815 | <0.001 | 0.46 |
| Female QS Students | 1972 | 6.633 | <0.001 | 0.705 |
| Female Comp Students | 620 | 5.184 | <0.001 | 0.502 |

The results indicate that there is no gender-based difference between *QuickSmart* students who completed the PATM test.

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) 2010

| Indigenous students | Students with paired data | Average Gain score | Significance | Effect size |
|---|---|---|---|---|
| QS students | 383 | 5.774 | <0.001 | 0.601 |
| All schools – Comp group | 1268 | 4.995 | <0.001 | 0.481 |

Once again these results show substantial improvement for the Indigenous students who participated in *QuickSmart*. While starting at a lower base, these students were able to report a rate of growth almost equivalent to the total cohort of *QuickSmart* students and in excess of that achieved by the comparison group.

### 3.2.3 Results on the Victorian On-Demand VCAA Assessment

Table 18 reports the 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).

There are at least two points to keep in mind about the On-Demand test results presented here. Firstly, for many Victorian schools using this test, it was their first administration of the on-line On–Demand tests. Subsequently, inconsistencies in the administration of these tests were noted. Therefore, results may have varied across schools more than otherwise would have been the case. This means that the results reported here in terms of growth in students' numeracy performance are likely to be conservative. Secondly, 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) 2010

| | Students with paired data | Average Gain score | Significance | Effect size |
|---|---|---|---|---|
| All schools – QS group | **159** | **0.404** | **<0.001** | **0.713** |
| All schools – Comp group | **71** | **0.364** | **<0.001** | **0.643** |
| | | | | |
| Indigenous – QS Group | 9 | 0.345 | 0.086 | 0.474 |

The results are encouraging despite the irregularities in the administration of the On-Demand tests already noted. *QuickSmart* students showed an average growth of eight months over the course of the intervention and a strong improvement measured by Effect Size statistics. This is impressive in light of the fact that (i) this was the first year of implementation of *QuickSmart* in this group of schools, and (ii) 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.

These results also show an important improvement for the small number of Indigenous students who participated in *QuickSmart*. While starting at a lower base, these students were able to report gain scores almost equivalent to that achieved by the comparison group of 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 nearly 3900 students. 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 – Cluster Results

## 5.1    Standardised Test results by cluster – (Scale scores for PAT, VELS levels for VCAA On-demand tests) 2010

| Cluster of Schools | | Pre-Intervention | | Post-Intervention | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | N | Mean | SD | Mean | SD | Gain | p | Effect size |
| ACT (QS) | 44 | 36.955 | 6.099 | 45.643 | 8.707 | 8.689 | <0.001* | 1.156 |
| Adelaide CEO (QS) | 204 | 42.781 | 8.499 | 48.116 | 8.706 | 5.334 | <0.001* | 0.62 |
| Adelaide Hills (QS) | 211 | 44.656 | 9.089 | 53.041 | 10.105 | 8.385 | <0.001* | 0.873 |
| Ballarat (QS) | 271 | 42.386 | 8.905 | 49.919 | 10.859 | 7.534 | <0.001* | 0.759 |
| Horsham Num (QS) | 160 | 44.29 | 8.427 | 52.96 | 11.565 | 8.67 | <0.001* | 0.86 |
| Hunter (QS) | 274 | 42.106 | 10.218 | 47.296 | 9.159 | 5.191 | <0.001* | 0.535 |
| Lismore Diocese (QS) | 182 | 41.78 | 7.677 | 50.1 | 8.58 | 8.32 | <0.001* | 1.02 |
| #Melbourne East (Dand) (QS) | 221 | 2.599 | 0.57 | 3.004 | 0.607 | 0.406 | <0.001* | 0.689 |
| #Melbourne East (Yarra) (QS) | 159 | 2.788 | 0.565 | 3.192 | 0.569 | 0.404 | <0.001* | 0.713 |
| New England Region (QS) | 410 | 42.117 | 8.283 | 47.926 | 10.226 | 5.809 | <0.001* | 0.624 |
| North Coast Region (QS) | 556 | 41.699 | 8.754 | 49.768 | 10.76 | 8.069 | <0.001* | 0.823 |
| North Sydney (QS) | 107 | 44.355 | 10.264 | 52.427 | 9.725 | 8.072 | <0.001* | 0.807 |
| North Tasmania (QS) | 251 | 43.207 | 7.727 | 48.232 | 8.851 | 5.025 | < 0.001* | 0.605 |
| Port Augusta (QS) | 157 | 40.015 | 7.524 | 44.815 | 9.987 | 4.801 | <0.001* | 0.543 |
| Port Pirie/Adelaide Diocese (QS) | 170 | 44.165 | 9.084 | 51.615 | 9.37 | 7.449 | <0.001* | 0.807 |
| South Tasmania (QS) | 157 | 38.914 | 8.382 | 45.503 | 10.344 | 6.589 | <0.001* | 0.7 |
| Western Australia (QS) | 120 | 45.81 | 7.684 | 50.59 | 8.381 | 4.78 | <0.001* | 0.59 |
| Western Region (QS) | 59 | 50.498 | 11.882 | 54.635 | 15.197 | 4.137 | <0.001* | 0.303 |
| Western Sydney (QS) | 435 | 36.04 | 7.373 | 42.73 | 7.881 | 6.69 | <0.001* | 0.88 |

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

## 5.2   PAT results – All Students (Scale scores) 2010

| Demographic | | Pre-Intervention | | Post-Intervention | | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | SD | Mean | SD | Gain | *p* | Effect size |
| **All QS Students** | **3784** | **41.926** | **8.935** | **48.707** | **10.235** | **6.78** | **<0.001** | **0.706** |
| **All comparison students** | **1268** | **53.909** | **9.686** | **58.904** | **11.059** | **4.995** | **<0.001** | **0.481** |
| | | | | | | | | |
| Indigenous QS Students | 383 | 39.492 | 9.014 | 45.266 | 10.157 | 5.774 | <0.001 | 0.601 |
| | | | | | | | | |
| Male QS Students | 1812 | 42.019 | 9.253 | 48.961 | 10.339 | 6.941 | <0.001 | 0.707 |
| Male comparison students | 648 | 54.355 | 9.733 | 59.17 | 11.139 | 4.815 | <0.001 | 0.46 |
| | | | | | | | | |
| Female QS Students | 1972 | 41.841 | 8.633 | 48.473 | 10.136 | 6.633 | <0.001 | 0.705 |
| Female comparison Students | 620 | 53.443 | 9.623 | 58.627 | 10.977 | 5.184 | <0.001 | 0.502 |

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