Improving the Numeracy Performance of Middle-School Students through Enhancing Basic Academic Skills: Evidence From the use of QuickSmart with Indigenous Students

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Abstract:
Indigenous students in the middle-school years experiencing difficulties in basic mathematics are a particularly vulnerable group. During these years gaps in performance between educationally disadvantaged students and their peers widen, potentially leading to ongoing economic and social disadvantage. This chapter reports on a pedagogical approach, referred to as QuickSmart, that has been employed in Australia since 2001 to support middle-school students. The pedagogical approach that underpins the QuickSmart numeracy program can be considered at three levels. The first is as an intervention program that withdraws pairs of students from their classroom instruction for three 30-minute periods each week for a 30-week period. The second level constitutes the pedagogical themes that are important within QuickSmart lessons. For example, the instruction offered in QuickSmart lessons builds on the pre-existing knowledge and understandings of students to encourage their self-belief through successful learning experiences and through focusing on what are seen as foundational skills in mathematics. This approach is very suited to enhancing the learning of many Indigenous students. The third level of pedagogical emphasis relates to the benefits that flow from recruiting Indigenous teacher assistants as Instructors and examining their involvement in the QuickSmart professional learning program. This chapter concludes with evidence drawn from examples of the learning progress of Indigenous middle-school students who completed the QuickSmart Numeracy program. These data show, based on effect-size statistics, cognitive growth for students in QuickSmart of up to two years in the 30-week program as compared to the growth of average-achieving students in the same class who have not accessed the program.

Key words: academic achievement; numeracy; basic academic skills, Indigenous students, Indigenous paraprofessionals
Background

*QuickSmart* is an innovative program of research that is having a strong impact in schools. It is one of very few programmatic interventions conducted in Australian schools and, as such, critical attention has been paid to the ongoing evaluation of the program. Over the period from 2001 to 2008 systematic data collection has accrued substantial empirical evidence regarding the value and applicability of the *QuickSmart* numeracy program (e.g., Graham, Bellert, & Pegg, 2001; Graham, Bellert, Thomas, & Pegg, 2007; Pegg, Graham, & Bellert, 2005). The accumulation of such evidence over time from multiple jurisdictions across a range of geographic and socioeconomic contexts is, in effect, a powerful evaluation procedure for establishing the veracity, usefulness, effectiveness and sustainability of the program.

Over the last ten years, research related to the *QuickSmart* program has accumulated compelling evidence indicating that persistently low-achieving middle-school students, including a significant number of Indigenous students, can meet national numeracy and literacy benchmarks and improve significantly on standardised tests (e.g., Graham, Pegg & Alder, 2007; Pegg & Graham, 2007). For example, on the 2008 national testing program (NAPLAN) assessments, the Northern Territory (NT) profile of results showed that students’ achievement of national minimum standards in numeracy was better than their attainment in reading (MCEETYA, 2008). The *QuickSmart* numeracy program has operated in an increasing proportion of Northern Territory schools since 2005. It is currently implemented in more than half of all NT schools.

The *QuickSmart* numeracy program has been in demand because it is a research-based intervention program (e.g. Bellert, 2009; Graham, Bellert, & Thomas, 2005; Pegg, Graham, & Bellert, 2005) for middle-school students that addresses current educational needs in schools. Between 2001 and 2011, close to 600 schools from New South Wales, the Northern Territory, Western Australia, South Australia, the Australian Capital Territory and Victoria implemented *QuickSmart* numeracy programs. This represents more than 10,000 *QuickSmart* students, of whom approximately 30% or 3000 identified as Indigenous students. The number of participating numeracy students/schools doubled from 2009 to 2010 and further increased into 2011.

Working with Indigenous and disadvantaged students and low socioeconomic schools is an important focus of the SiMERR National Research Centre and the *QuickSmart* program. Importantly, the positive results of the *QuickSmart* Numeracy project implemented with Indigenous students from 31 schools in Western Sydney were mentioned as a Key Schooling Achievement in the 2010 Prime Minister's *Closing the Gap* Report. *QuickSmart* was the only intensive literacy or numeracy project singled out for particular mention, with students’ improved speed and accuracy scores highlighted in the report (p. 37).
Through improving the educational attainment of lower-achieving students, including many Indigenous students, the research described in this chapter addresses core factors that can enhance the life potential of many young Australians. The significance of this research in terms of the Australian Government’s National Research Priorities lies in the links that exist between basic academic skills and quality of life outcomes in terms of improving Indigenous health and well-being, enhancing social inclusion and ameliorating systemic disadvantage. The systematic review conducted by DeWalt, Berkman, Sheridan, Lohr, and Pignone (2004) is an example of the evidence available about these links. DeWalt et al. (2004) analysed 684 articles to confirm that individuals with low levels of basic academic skills are up to three times more likely to experience poorer health because of their lack of knowledge about disease markers and health resources.

This finding is particularly important to Indigenous Australians because, for example, smoking is the biggest single risk factor for Aboriginal and Torres Strait Islander Australians (ATSIA) with approximately half the ATSIA population reporting that they began smoking before or during their first year of high school – a rate two to three times higher than that of the non-Indigenous population (COAG, 2008). Aboriginal students with poor levels of basic skills, then, are particularly at risk with the proportion of the population achieving at least the minimum standard of literacy and numeracy attainment decreasing as their level of remoteness increases (COAG, 2009; Pegg & Panizzon, 2007). Further, research by Hawthorne (1996) and Staunton, Feehan, and McGee (1990) would suggest that students with poor academic achievement are at risk for substance abuse, more likely to carry a weapon, take a weapon to school, miss school, and be in a physical fight that requires medical attention. Conversely, a solid base of academic skills seems associated with better employment prospects for individuals, cost savings for businesses, and less likelihood of criminal or addictive behaviour (Hartley & Horne, 2006; Wilkinson & Marmot (2003).

Pursuing the links between health and academic achievement further, a recent combined report from the Australian Institute of Health and Welfare and the Australian Bureau of Statistics (2009) suggested that poor health hinders many Indigenous children’s school attendance and restricts their ability to learn. In particular, otitis media (an inflammation or infection of the middle ear) has a detrimental effect on the educational outcomes of many students. Five percent of all Indigenous children are likely to have significant hearing problems, especially partial deafness, compared with one percent of the non-Indigenous population (Malin, 2003). This profile of susceptibility to ear infections makes it particularly important that Indigenous students are given excellent instruction and ongoing support in developing basic academic skills. As Howard, Cooke, Lowe and Perry (2011) argue, enhanced educational opportunities for Indigenous students are most likely to occur through relevant curriculum, quality instruction, increased student participation and through fostering the engagement of Indigenous community members. The instructional approach and implementation practices of
QuickSmart include many features that address just these types of educational improvement.

The following chapter is divided into five sections. Each section explores briefly a different aspect of QuickSmart and its relationship to Indigenous students, teachers and teacher assistants. The first three sections consider the pedagogic underpinnings of QuickSmart as (i) an intervention, (ii) a teaching process, and (iii) a vehicle for the professional development of teachers and teacher assistants. The next two sections concern research. Section four describes the research agenda associated with QuickSmart, while the fifth section summarises and explores the findings of two example data sets taken from the results of students drawn from two states in Australia.

The Pedagogy of Intervention

The QuickSmart instructional approach focuses on the role of automaticity in developing students’ fluency and facility with basic academic facts, and is informed by relevant literature associated with learning difficulties/disabilities and quality instruction (e.g., Baker, Gersten, & Lee, 2003; McMaster, Fuchs, Fuchs, & Compton, 2005; Westwood, 2007), effective instruction (e.g., Rowe, Stephanou, & Urbach, 2006), mathematics education (e.g., Fuchs & Fuchs, 2001) and educational interventions (e.g., Deshler, Mellard, Tollefson, & Byrd, 2005; Marston, 2005). It provides instruction that is intense enough (30 minutes, three times a week in small group settings) and of sufficient duration (for up to 30 weeks) to make a difference to participating students. A teacher or competent teacher assistant commences instruction after completing the initial two-day workshop that introduces the program. Two more two-day professional learning workshops for school staff members involved in QuickSmart (i.e., teachers, teacher assistants, support teachers and administrators) are scheduled during the 30-week intervention period during the first year.

QuickSmart is described as a fourth-phase intervention. It is usually implemented following the classroom teacher’s initial teaching of the content (first phase), and subsequent attempts to differentiate instruction to address students’ difficulties (second phase). The third phase occurs when the teacher receives collaborative support from another teacher or teacher assistant within the classroom. The fourth phase refers to intensive focused instruction that necessitates the student being withdrawn from class for a number of periods a week over an extended timeframe.

It is important to note that the structured approach of the QuickSmart program, with its appropriate use of technology and emphasis placed on both practice and strategy instruction, is very much in tune with how many teachers consider students can be usefully supported. QuickSmart is particularly attractive because it is a carefully structured program that focuses on improving numeracy skills. The program shares many of the features of effective third-wave teaching outlined in the discussion paper prepared for the
Taskforce on Indigenous Education (June, 2001). This is particularly important because Indigenous students make up approximately one-third of the total number of QuickSmart students who have completed the program since 2001. Specifically, in QuickSmart numeracy lessons:

- there is an emphasis on self-regulation, metacognition and self-esteem building, with the goal of increasing independence in learning;
- there are opportunities for extended deliberate practice of unknown facts and in the application of taught strategies;
- student progress is regularly monitored and extensive, detailed feedback is given in each lesson;
- attention is given to clarifying the mathematical use of language in ways that respect each student’s language background;
- reinforcement, initially extrinsic, gives way to intrinsic motivation as the long-term goal;
- there is a focus on problem-solving through developing a strategic approach to understanding the question posed and making a suitable plan to solve it; and,
- problems to be solved are at an appropriate difficulty level for the students and, where possible, reflect classroom demands.

The widespread use of QuickSmart as an intervention program reflects the need to adapt the common instructional processes evident in Australian schools to address the diverse range of basic skills competency evident in classrooms across the middle-school years. National data confirm that the learning needs of students in the bottom 30% of the achievement spectrum are not being met under current teaching and organisational structures (COAG 2008; 2009). This situation is also evident in international contexts such as North America with, for example, only 47% of First Nations’ students fulfilling Year 10 numeracy expectations compared to 77% of non-Aboriginal students (Poirier, 2007). It is vital to enhance students’ life chances by providing them with a personally relevant, highly targeted, and motivational experience that allows them to acquire in a practical, usable and understandable form the basic academic skills necessary for academic success.

The Pedagogy of QuickSmart Lessons

In terms of pedagogical practice, the QuickSmart approach contributes a unique combination of instructional features that in combination are innovative and effective for improving the academic achievement of middle-school students. This pedagogy incorporates many features of mathematics instruction (e.g., relevance, explicit explanation and feedback, and the use of focused games) that are specifically suggested as effective for teaching Indigenous students (Al-Yaman & Higgins, 2011; Harrison, 2011; Howard et al., 2011). These include:
(i) an orientation to using both time and accuracy as key dimensions of learning;
(ii) the use of explicit strategy instruction that is individually tailored to students’ needs;
(iii) maximising student on-task time through highly structured but flexible lesson formats;
(iv) the provision of extensive support materials, including a variety of learning/teaching resources;
(v) the inclusion of formative assessment tasks in each lesson with a focus on individual improvement;
(vi) the use of information obtained from formative assessment to provide opportunities for targeted and deliberate practice of basic academic skills;
(vii) the incorporation into the program of the Cognitive Aptitude Assessment System (CAAS) software which operationalises automaticity by capturing data related to students’ response speed and accuracy; and
(vii) a focus on developing metacognitive skills in learners, that is, the ability of learners to monitor their own learning and to set realistic learning goals for themselves.

The overarching aim of QuickSmart is to increase students’ accuracy and automaticity of basic academic skills. To guide the instructional approach pertinent to this aim and underpin the pedagogy of intervention, a metaphor and a mnemonic were developed. In introducing the QuickSmart program, the idea of practice making an easy pathway in memory like heavy traffic makes a roadway was explained and explored. The main ideas of the approach are also presented to the students embedded in a mnemonic associated to the pathway metaphor. The key word, “PATH”, was presented as standing for Practice, Attention to understanding, Time, and How to. By using the “PATH”, participants in the QuickSmart intervention learned to develop effective strategy use (How to) that flows from clearer understandings (Attention to understanding) as they participated in enjoyable and focused practice activities (Practice) that externalise time as a dimension of instruction (Time). Each lesson also provides students with opportunities to monitor their own learning and to receive and record immediate, formative feedback.

Specifically, the pedagogical approach used in the QuickSmart intervention focuses on a variety of practice and recall strategies geared to developing understanding and fluency of basic academic skills. Each lesson involves revision of the previous session, a number of guided and deliberate practice activities featuring overt self-talk, discussion and practice of memory and retrieval strategies, timed speedsheet activities followed by independent practice activities, and an educational game.

Ongoing assessment and instruction form a continuous cycle in QuickSmart lessons. The instruction delivered by one adult to two students is personal, connected and targeted. Teacher observations and information gained from questioning students about their knowledge and strategy use form the
basis of instructional decision-making and individualisation. Assessment information is derived from many of the activities in each lesson such as flashcards, speed sheets and independent practice. A computer assessment system, used in most lessons, provides on-going data related to students’ levels of automaticity in basic academic skills. Students are also able to evaluate their own learning through recording and graphing important information, such as how many flashcards they answered accurately. Using this performance information, students are encouraged to set realistic future goals.

In order to develop transfer of learning to other settings the pedagogical approach used in the QuickSmart intervention emphasises equipping students with knowledge that can also be used in the classroom and in many other real-life settings. For example, the relevance and utility of basic academic understandings and skills is emphasised to students. They are explicitly encouraged to link their learning in QuickSmart lessons to the ‘main game’ of classroom learning. As Harrison (2011) notes the relevance of skills is important to clarify for Aboriginal learners.

As already indicated, QuickSmart numeracy programs follow a structured lesson sequence based on a ‘focus set’ of number facts. An important underlying goal of each lesson is to “structure for success” by providing students with a regular and predictable learning sequence. Instructional time is made available for students to practise and improve on what they already ‘know’, and to learn and practice new knowledge. This pedagogical approach provides potent opportunities for students to be more successful in each successive lesson as the result of enjoyable, achievable and personally challenging deliberate-practice activities. Throughout the lessons, students are frequently and genuinely praised for their efforts to learn and improve their skills. Often this feedback is used as an opportunity to reinforce effort and effective strategy use. For example, an instructor may comment that, “Wow, you got 35 flashcards in a minute, very impressive! One reason I can see that you’ve improved is that now you’re adding whole tens instead of counting one by one”. Throughout each QuickSmart lesson every effort is made to ensure that students spend the majority of time on-task, actively engaged with a variety of learning and practice activities. Such explicit teaching and feedback in a small group situation are important features of pedagogy suited to Aboriginal learners. As Howard and Perry (2011) write,

“There are aspects of mathematics where such explicit teaching is recommended, including mathematical vocabulary, standard algorithms (after much exploration and use of the children’s own algorithms) and arithmetic facts. Aboriginal children often find the structure of such explicitness reassuring, provided they are able to trial their developing ideas on their peers and their teachers, and receive helpful feedback from these trials” (p. 137).

In summary, implementation and refinement of the pedagogical approach used in QuickSmart, means that many of the common learning obstacles that can preclude students from achieving age-appropriate academic outcomes in
numeracy can be addressed. Overcoming basic-skills deficits, however, requires consistent and long-term instruction, explicit strategy knowledge, and the systematic use of timed and deliberate practice activities. It is also important to maintain interest and promote students’ intrinsic motivation and sense of self-efficacy through frequent occasions of authentic success. Some very useful procedures for overcoming learning obstacles were features in the QuickSmart program. Many of these procedures are also identified in the research literature relating to effective instruction for Aboriginal students (e.g., Al-Yaman & Higgins, 2011; Howard, Cooke, Lowe & Perry, 2011). These include:

- a structured and predictable lesson sequence;
- content based on topics of high interest to the students;
- repeated opportunities for students to succeed and to know they are improving, e.g., recording and graphing of results;
- graduated prompting which is responsive to students’ needs;
- externalising time in a low key but focused and consistent way, e.g., through the use of stopwatch, timers, repeated tasks, etc.;
- timed, focused recall activities, including card games and activities;
- explicit strategy instruction;
- explicit instruction focused on developing metacognitive awareness through asking students to become aware of and explain their thinking processes;
- a long-term, intensive intervention; and
- the use of an explanatory metaphor/story to focus students’ attention on their learning processes and the purpose of the intervention.

The research findings collected to date have indicated that the carefully constructed instructional design of the QuickSmart program is successful in supporting most students to overcome learning obstacles. The QuickSmart program is also underpinned by a carefully constructed series of professional development workshops. The pedagogy of QuickSmart professional learning is discussed in the next section.

The Pedagogy of QuickSmart Professional Learning

A further integral and innovative component of the QuickSmart approach is the series of professional learning opportunities that are provided to all teaching and support staff, numeracy co-ordinators and educational leaders. QuickSmart uses a nested model of implementation (Resnick, 2009) that sets up:

- groups within a school working at the student level;
- groups of schools within a cluster working at teacher professional learning levels;
• clusters of schools within a region working at the policy level while also ensuring the fidelity of implementation; and finally,
• regions of schools within a State that are working to support and evaluate the program.

Such a comprehensive model that aims to work at the policy, school, teacher and student levels is recommended as an approach “that works” to encourage school completion for Indigenous students (Al-Yaman & Higgins, 2011). To date, school communities’ involvement in these professional learning experiences has been affected by a number of factors such as the number of schools in a cluster, the implementation activities at each level of the model, the type of commitment to the support of the program that different tiers of education are prepared to make, and whether it is the first year of implementation or a subsequent year. Of particular interest from the point of view of Indigenous education are the clear attempts to build connections within and between members of the school community that are important to the implementation of this program. An overview of the professional learning pedagogy that accompanies QuickSmart is provided below.

**Region Staff and Principals’ Information Session**

The first professional information session provided as part of the QuickSmart program’s implementation entails a two-hour meeting for senior administrators, principals and other members of school executives. This meeting offers senior staff the opportunity to engage briefly with details of the program, examine the results of the research that establishes the intervention’s effectiveness, and understand the necessary commitments to being involved in the QuickSmart program.

At this session participants have the opportunity to ask questions and to address or clarify relevant issues. On the basis of the information presented during this day, principals decide whether their schools will participate in the QuickSmart program.

**Principals’ Professional Learning Workshop**

The first professional learning opportunity provided as part of the QuickSmart program’s implementation is a workshop session lasting a full day for principals and other members of school executives. The purpose here is for senior school personnel to engage deeply with details of the program including the rationale, theory base and instructor roles, and to examine more thoroughly the results of the research that establishes the intervention’s effectiveness and the implications of this to their school context. Where possible, site visits to an existing school that is using QuickSmart are arranged.

It is important to inform and encourage the involvement of school leaders in the implementation of QuickSmart in order to set up conditions conducive to community involvement and the sustainability of the program. School executive members administer budget allocations and oversee staffing decisions that can affect which programs operate successfully in their schools.
Principals are expected to attend a further workshop day in the second and subsequent years of QuickSmart being implemented in their school. During these workshop sessions, the QuickSmart activities undertaken at their school in the previous year are reviewed, and Principals supported in managing and extending the QuickSmart program’s impact in the coming year. Most significantly, the focus in these workshops more explicitly addresses the transformational aspects of QuickSmart for all students in the school and also for all members of the school community.

**QuickSmart Professional Learning Workshops**

The QuickSmart professional learning program consists of an intensive series of professional inputs built around the QuickSmart intervention and research program. School QuickSmart School Coordinators and QuickSmart Instructors participate in three two-day professional learning workshops within the first year, three one-day workshops in the second year and two one-day workshops in the third year.

The first year is considered basic skills training in QuickSmart resulting in certification as a QuickSmart Instructor. These workshops introduce the QuickSmart approach to participants who learn about and discuss the underlying perspectives informing the program, trial the QuickSmart materials, refine their teaching and assessment techniques, and share their experiences with peers. In the second and third workshops the QuickSmart team from each school reports back to other teams from schools that make up a geographically proximate learning community of about 10 to 15 schools. Providing information to parents about QuickSmart and encouraging their involvement in and support of the program in their child’s school is emphasised during these workshops. Successful strategies for encouraging community involvement are shared between participants.

Workshops undertaken in years two and three focus on advanced skills training. Here participants review in a deeper way the central ideas addressed in the first year. In particular, sessions focus on: the cognitive and neuroscientific basis of QuickSmart; features such as deliberate practice, formative assessment, and feedback; issues associated with learnable skills; and evaluative frameworks that are suitable in a QuickSmart environment.

In summary, the professional learning program that accompanies the QuickSmart program is focused on supporting instructors to understand and provide:

- effective instruction that maximises student on-task time, and provides learning scaffolds to ensure that students experience improvement and success;
- a motivational environment that is safe for vulnerable learners and builds trust between Instructor and students;
- deliberate practice that is integral to every lesson, allows for success and is focused on providing targeted feedback to improve learning;
- guided and independent timed practice activities;
• strategy instruction and concept development;
• evidence of competence and increasing student confidence by encouraging a ‘can do’ and ‘have a go’ attitude;
• appropriate teacher and peer modeling; and
• motivational academic activities that provide opportunities for modeling and for developing fluency.

**QuickSmart Research Agenda**

*QuickSmart* can be considered applied research “that is undertaken to acquire new knowledge but directed towards a specific, practical aim or objective” (HERDC, 2011, p.8). It does not represent a single research activity. Underpinning and informing *QuickSmart* is a longitudinal programmatic coordinated set of research projects aimed at understanding and addressing numeracy and literacy under-performance in middle-school students across Australia. The research that informs *QuickSmart* is focused particularly on cognitive processing, the conditions necessary for gaining facility with lower order tasks or basic academic skills, and the potential complementary effects of improved mastery of these skills on higher order learning processes. Accordingly, the research has three overall goals:

- to investigate the nature of improved fluency on the acquisition of basic academic skills;
- to observe whether improved fluency with the basics has any effect on the performance of more demanding academic tasks, such as comprehension and mathematical problem solving, as reflected in students’ performance on state-wide tests or standardised achievement tests; and
- to monitor longitudinally the retention or further development and refinement of both basic and higher-order skills.

As *QuickSmart* has been evolving for ten years the focus of research has expanded to consider:

- ways to improve the provision of *QuickSmart* professional development through a deeper analysis of the results that highlights differences in the approaches of the clusters/schools that achieve greater learning growth for their students;
- documenting the occurrences of ‘learnable’ features of instruction that are evident after students have graduated out of the program (e.g. goal-setting, classroom engagement);
- the assessment of ‘self-factors’ such as student self-efficacy, self-confidence, and scaffolded risk taking that are an important part of the *QuickSmart* research framework;
- links between the qualitative and quantitative data associated with particular learning obstacles;
- models for successfully scaling-up evidence-based interventions across schools in different states and territories;
• creating closer links between learning theory and educational neuroscience.

The QuickSmart project uses a quasi-experimental research design involving collecting and analysing pre-test and post-test data from two groups of students: (i) the ‘QuickSmart students’, who participate in the numeracy and/or literacy intervention programs; and (ii) ‘comparison students’, who do not participate in the intervention programs. The decision to use a quasi-experimental design (whereby participants and non-participants are carefully selected according to set criteria) rather than an experimental design (where participants and non-participants are randomly assigned) was informed by ethical considerations: a paramount consideration was to offer QuickSmart to as many students as possible who would benefit from opportunities to improve their academic performance.

Another consideration in developing the QuickSmart project was to commit to serious data collection involving gathering information from all sites involved in the QuickSmart program. It is the accumulation of evidence from multiple jurisdictions across a range of geographic and socio-economic contexts that should take precedence in establishing the veracity, usefulness, effectiveness and sustainability of an intervention program rather than some large-scale single definitive study.

Primary school students who participate in QuickSmart programs meet the following criteria:

• experiencing persistent difficulty in either literacy or numeracy;
• displaying a good attitude to working in small groups, and
• having average cognitive potential without major attention difficulties.

Likewise, participants from high school settings are selected by secondary head teachers using the criteria that the students:

• are experiencing learning difficulties in either literacy or numeracy;
• performed in the lowest two bands on the State-wide Year 7 screening tests; and
• had a regular school attendance pattern.

In order to gain a clearer indication of the effectiveness of QuickSmart for improving accuracy and automaticity of basic academic skills, response time and accuracy and standardised test data are also collected from comparison students. In general, the group of comparison students includes average-achieving students as nominated by their teachers. Comparison data afford important opportunities to examine the differences in performance levels for students with learning difficulties compared to a sample of average-achieving students.

Pre-test and post-test data are collected by QuickSmart instructors/coordinators for QuickSmart and Comparison students using two forms of assessment: the Cognitive Aptitude Assessment System (CAAS) tests and independent state-wide or standardised achievement tests. Independently prepared tests in the form of state-wide tests or standardised achievement tests are used to provide data about the transfer of basic fact knowledge to more complex academic and cognitive tasks. To date, the Progressive Achiev-
Test scores in Mathematics (PATMaths) are being used in New South Wales, South Australia, the Australian Capital Territory, and Victoria, and a version of the Multilevel Assessment Program (MAP) is used in the Northern Territory.

**Research Evidence and Interpretation**

This section focuses on the achievement of Indigenous students who have participated in the QuickSmart numeracy intervention. Increasing numbers of Indigenous students have participated in the QuickSmart numeracy program in the North Coast Region and the New England Region of New South Wales (NSW), and the Northern Territory since 2006. As demonstrated by the sample analyses discussed below, Indigenous students who participated in the QuickSmart Numeracy intervention in all these regions have made impressive academic gains that are comparable to the academic gains made by non-Indigenous QuickSmart students.

To explore these research findings the following summary tables have been created to consider data for New South Wales and the Northern Territory, respectively. These tables focus on the independent tests used to assess the efficacy of the QuickSmart program. In NSW the test administered is the Progressive Achievement Test in Mathematics (PATM) produced by the Australian Council for Education Research (ACER). In the Northern Territory the test used was developed by the Numeracy and Assessment branches within the NT Department of Education and Training based on previous Territory-wide Multi-level Assessment Program (MAP) Tests.

Table 1 shows the data for Indigenous QuickSmart students, non-Indigenous QuickSmart students and average-achieving comparison students from the same school settings. In terms of gain scores, the QuickSmart groups exceeded the comparison group in all analyses. This means that QuickSmart students were able to ‘close the gap’ on their average-achieving peers at the basic level of increased scores. Also, all growth scores for QuickSmart students were above the anticipated five units of growth over the period of a year suggested by ACER, despite students not having access to a calculator during the test.

**Table 1: NSW paired data for Indigenous, non-Indigenous and comparison students on PATM assessments**

<table>
<thead>
<tr>
<th>Students Groups</th>
<th>Students with paired data</th>
<th>Pre-Mean Scores (Standard Deviation)</th>
<th>Post-Mean Scores (Standard Deviation)</th>
<th>Average Gain Scores</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous QS students</td>
<td>195</td>
<td>39.57 (9.77)</td>
<td>46.18 (10.79)</td>
<td>6.61</td>
<td>0.64</td>
</tr>
<tr>
<td>Non-Indigenous</td>
<td>511</td>
<td>43.25</td>
<td>49.77</td>
<td>6.52</td>
<td>0.68</td>
</tr>
</tbody>
</table>
Analysis in terms of effect size also supports the findings associated with gain scores. In the analyses of data from both QuickSmart cohorts, the effect sizes reported were in excess of 0.4, which indicates an important level of growth. The effect sizes for the QuickSmart cohorts were also considerably higher than that recorded for the comparison students, which fell within the expected range for average-achieving students of 0.2 to 0.4. Overall, the results of the QuickSmart intervention for Indigenous students mirror very closely the findings of the larger non-Indigenous cohort. The key point here is that despite starting from a lower base, the Indigenous students recorded gains equivalent to those of the larger cohort of QuickSmart students. Hence, participation in the QuickSmart program facilitates work with students at their level and enables them to achieve similar rates of growth as non-Indigenous students as measured by a standardised assessment.

These data complement the large amount of qualitative data from parents, teachers and the students themselves that is also collected from participating QuickSmart schools. Though not a focus of this chapter, these reports indicate that many students who undertake QuickSmart exhibit such positive behaviours and attitudes as: improved attention and participation in class; a willingness to take risks with and to enter into discussions about their learning; a decrease in behaviour issues inside and outside the classroom; improved school attendance; and a willingness to see a future in which they have a place for themselves based on what they know and can learn.

Table 2: Paired data for Indigenous, non-Indigenous and comparison students on Northern Territory-developed assessments

<table>
<thead>
<tr>
<th>Students Groups</th>
<th>Students with paired data</th>
<th>Pre-Mean Scores (Standard Deviation)</th>
<th>Post-Mean Scores (Standard Deviation)</th>
<th>Average Gain Scores</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous QS students</td>
<td>258</td>
<td>17.68 (8.62)</td>
<td>23.45 (9.07)</td>
<td>5.77</td>
<td>0.65</td>
</tr>
<tr>
<td>Non-Indigenous QS students</td>
<td>268</td>
<td>23.10 (7.84)</td>
<td>29.41 (7.46)</td>
<td>6.31</td>
<td>0.82</td>
</tr>
<tr>
<td>Comparison Indigenous students</td>
<td>82</td>
<td>24.96 (9.24)</td>
<td>28.43 (9.14)</td>
<td>3.47</td>
<td>0.38</td>
</tr>
<tr>
<td>Comparison Non-Indigenous students</td>
<td>167</td>
<td>31.54 (8.98)</td>
<td>34.51 (8.07)</td>
<td>2.97</td>
<td>0.35</td>
</tr>
</tbody>
</table>
Overall, the results of the QuickSmart intervention for Indigenous students mirrored very closely the findings of the larger cohort. In terms of gain scores, the QuickSmart Indigenous students exceeded their comparison Indigenous peers in all analyses and often by large amounts. This means that QuickSmart Indigenous students made substantial gains on their average-achieving peers. Also, all growth scores for QuickSmart Indigenous and non-Indigenous students were above the anticipated 5 units suggested by the test publisher ACER.

In terms of effect size, these results support, in a different form, the findings associated with gain scores and mirror the results of the larger cohort of non-Indigenous students. Specifically, effect sizes for the QS Indigenous students were considerably in excess of the ‘expected’ 0.4. In fact the effect size for the QS Indigenous cohort was significantly higher than that recorded for the comparison students, though still below that of non-Indigenous QuickSmart students. The effect size for the Indigenous comparison students of 0.38 reinforces the importance of programs like QS that can accelerate students’ growth in order to narrow the achievement gap between Indigenous students and their same-age peers.

Implications and Conclusion

National test data (Ainley, Kos, & Nicholas, 2008; Council of Australian Governments, 2008) provide a compelling case for the need to develop programs that improve the literacy and numeracy outcomes for students who are performing at or below the National Literacy and Numeracy Benchmarks. There is a specific need for such programs to be effective for Indigenous and rural students and those with a language background other than English (Ainley, Kos, & Nicholas, 2008; Commonwealth of Australia, 2008a). In this regard data from QuickSmart interventions confirm that many hundreds of Indigenous students have undertaken QuickSmart in NSW and the Northern Territory. In addition, there are undoubtedly Indigenous students who have participated but not been identified. Overall, the data discussed in this chapter highlight the impressive gains in academic growth that QuickSmart Indigenous students have achieved. In most cases, these students have more than doubled the effect size of the comparison students’ academic growth.

Without doubt, the focus of this research program on low-achieving Indigenous students is an important one for research in school education. It is particularly important in terms of intervention research that findings are rigorously evaluated because the student population targeted in this work is among the most vulnerable in our education system (Dobson, 2001; Fuchs & Fuchs, 2005). It is obvious that educationally disadvantaged students should only participate in interventions that are accepted as educationally sound. Interventions based on unsubstantiated ideas have the potential to take up these
students’ valuable instructional time and to result in little, or no, maintained gains in performance (Strain & Hoyson, 2000).

In terms of the significance of this research program, assessment data from national testing programs (e.g., National Assessment Program Literacy and Numeracy (NAPLAN), 2008) underscore the necessity to improve educational outcomes for students who are not reaching minimum standards. Further, because of the widening gap between outcomes for Indigenous and non-Indigenous students in Year 3, Year 5 and Year 7, there is a particular need to identify approaches, like QuickSmart, that are effective for Indigenous students early in their schooling experiences and during their middle school years (Frigo, Corrigan, Adams, Hughes, Stephens, & Woods, 2004).

In summary, the QuickSmart research program is concerned with the improvement and provision of appropriate interventions delivered in rural and regional educational contexts to all low-achieving students including Indigenous students, with the aim of improving their basic academic skills and performance. Such improvement has clear educational benefit and accompanying positive long-term social implications. This research takes a long-term approach to enhancing the academic achievement and wellbeing of Indigenous school students. Its focus on the enhancement of educational opportunity aims to empower all participants to have the skills to make positive life choices towards optimal health, economic self-reliance and stable family structures. The ability to make such choices is vitally important in promoting the wellbeing of all Australians.

We conclude this chapter with comments taken from an Independent report prepared by Thomas and Murphy (2008) based upon an evaluation of a federally funded QuickSmart intervention covering five months in late 2008. After five months of implementation, the effect size growth for Indigenous students \((n=105\) matched pairs) of 0.42 on a standardised test of basic mathematics represents a watershed of successful learning for these children.

Thomas and Murphy (2008) write that:

The evaluators have been impressed with the outcome of the QS intervention program... This success must obviously be attributed to the structure and delivery of QS--its theoretical and practical underpinnings are substantial and impressive--and also to its inherent attractiveness to students. In the nine schools in which the evaluators observed lessons being conducted students’ enthusiasm was obvious and elements of both competition and cooperation spurred them on to further achievement… Most noticeable to the evaluators is the importance of the tutors in the QS program. The QS team at University of New England has devoted and continues to devote attention to the elevation of tutors’ standards. Of particular satisfaction to the evaluators has been the observation of so many Indigenous tutors conducting QS lessons. These tutors are enthusiastic and devoted and with few, if any, exceptions, keen to expand their knowledge of QS in future professional development workshops.
References


Teaching K-12 in the Age of Information and Communication Technologies, 1, 1-27.


Bio

John Pegg's work is far ranging, and he is particularly known internationally and nationally for his contribution to theory-based cognitive research in Mathematics Education and Assessment. Highlights of his work in this area include over 50 Keynote addresses to national and international research forums, and state and national teacher conferences. Recently he has been the team leader involved in many large-scale nationally significant projects linked to: the validation of teaching standards for the Australian Institute for Teaching and School Leadership; underachieving students in mathematics; state-wide diagnostic testing programs in science; developmental-based assessment and instruction; the validation of the New South Wales professional teaching standards; the ‘Maths? Why Not?’ project; and investigating junior high school faculties achieving outstanding student learning outcomes.

Lorraine Graham began teaching primary school in the early 1980s. Like many teachers, she was most challenged by those students who didn't learn
as easily as their classmates. Subsequently, she completed a postgraduate Diploma in Teaching Exceptional Children from the University of Southern Queensland and then sought to continue further study overseas. Lorraine completed her Master of Arts (Education) (Honours) degree and then her Ph.D. in Instructional Psychology at Simon Fraser University, Vancouver, Canada. During this time she developed and researched the 3H Strategy for improving reading comprehension. She is most interested in developing effective instructional interventions, the teaching of comprehension strategies and general approaches to improving the academic performance of low-achieving students. Her work with QuickSmart brings together her major research interests and provides contact with a collegial team of educators at UNE and in QuickSmart schools. In recognition of her contributions to her disciplinary area, Lorraine was admitted as a Fellow to the International Association for Research in Learning Disabilities in 2007.

Index words

Provide a list of words that will be used in the index.

academic achievement; numeracy; basic academic skills, Indigenous students, Indigenous paraprofessionals; QuickSmart; professional learning; effect size; PATH; Cognitive Aptitude Assessment System (CAAS)

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