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Targeted Early Numeracy

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Summary

The Targeted Early Numeracy (TEN) intervention program fulfilled a New South Wales State Government commitment to provide support for students experiencing substantial difficulty in learning numeracy in the early years. TEN was successfully piloted in 2009, and has continued to grow as part of the suite of programs operating under the Best Start Initiative.

The main objective of TEN was to enable teachers to assist Foundation/kindergarten to year 2 students' facility with number to reduce their risk of scoring in the lowest bands on the National Assessment Program – Literacy and Numeracy (NAPLAN) in year 3. TEN was implemented within a normal daily lesson block, without withdrawal or an additional specialist teacher.

Regions selected facilitators who were trained to provide intensive support to the schools over six months. Approximately 30 facilitators worked with 500 kindergartens to year 2 teachers each semester.

Target student group

Regions identified schools in need of early numeracy intervention. The program operated with students, teachers and principals of metropolitan, regional, rural, remote, and very remote schools across New South Wales. One thousand early years teachers, approximately 500 per semester, were involved. Students from kindergarten to year 2, likely to perform at or below the National Minimum Standard in numeracy in year 3, were included in the initiative.

The schools were provided with advice on how to carry out the initial assessment and analysis of results to determine which students were at risk. Teachers determined the target group of students included in the program.

Method

TEN used effective models of improving practice through in-class support focused on the needs of students. For example, any student who was not yet a perceptual counter at the start of year 1 was at risk of failing to progress with the rest of the cohort.



The teacher provided the target students with short, focused and frequent teaching activities designed to enable them to deal with additions and subtractions of things that they cannot see or touch (ie figural items). It focused on New South Wales Mathematics K–6 syllabus end-of-year expectations of what children were able to do in addition and subtraction.

The TEN program model included the use of:

- small group instruction (usually three to four students)
- short, focused, frequent numeracy sessions (typically 10-minute blocks)
- strategically targeted activities focusing on early arithmetical strategies
- explicit and systematic teaching
- five-weekly monitoring of student progress to identify and plan future instruction.

A baseline of student performance was established and the intervention program was implemented with continuous ongoing assessment used to determine its effectiveness (Jimerson, Burns & VanDerHeyden 2007).

The TEN program had clear (minimum) grade-based performance targets for students. For example, in the kindergarten year, students were expected (at least) to be a perceptual counter (ie able to count items they see, hear or touch) in the range to 20 by the end of the year. Object counting required students to be able to generate the oral counting sequence, match each counting word one to one with the objects and recognise that the last number word corresponded to the total (the ordinal to cardinal transition).

The teachers were provided with a focused assessment process to identify the number strategies students' employed. Student progress towards the grade-specific targets was monitored by the classroom teacher every five weeks in consultation with the TEN facilitator. Rate of progress of learning was a key measure in the intervention program.

Each region analysed school performance data to identify schools with the highest level of need for an early numeracy intervention program and negotiated the involvement of those schools. In selecting schools, regions considered each school's:

- year 3 NAPLAN numeracy results
- current and emerging commitments that could affect school capacity to effectively engage in the program
- Best Start Kindergarten Assessment numeracy results
- travelling distance between participating schools.



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Regions also managed the TEN facilitator selection process. The facilitators were exceptional teachers with current teaching experience in the early years of schooling. They were responsible for collaborating with participating schools to develop action plans and collate TEN data as requested by State Office.

TEN facilitators had a good understanding of assessment to inform programming and teaching, and related well to staff. They were provided with 12 days of additional professional learning, specific to their role, over 12 months. The facilitators were relieved of their teaching responsibilities at their base school and were paid at the level of an assistant principal.

The TEN facilitators worked in each of their participating schools to deliver professional learning sessions, provide in-class support, assist teachers with data analysis and monitor student outcomes. They collected information on teacher professional learning needs and documented teacher professional learning on [myPL@Edu](https://myPL@Edu.nsw.edu.au) (TEN is a registered course with the New South Wales Institute of Teachers).

School leadership teams and teachers had active roles in TEN and supported the implementation of the TEN program through additional funding if needed. They encouraged the commitment of all kindergarten, year 1 and year 2 teachers, completed a school needs survey related to numeracy targets and participated in professional learning sessions. They also worked to incorporate TEN as a strategy into the school plan and identified a TEN coordinator to maintain the program within the school.

Classroom teachers involved in the program were responsible for identifying the students to be included in the TEN program intervention group, administering the TEN assessment to each student and analysing student responses. They placed students on the Numeracy Early Learning Plan, prepared a program of instruction to address the identified needs of each student, and implemented explicit teaching strategies in early number by providing short, focused, frequent numeracy sessions throughout the day. Student progress was recorded and monitored twice per term for a semester, at a minimum.

The initial group of schools involved in the program moved into a maintenance mode with less frequent support as a new group of schools came into the program.



Results

For the targeted students, the five-weekly monitoring used teacher judgement of progress towards the minimum expectations. The teachers then used a form of continuous assessment to monitor change. Improvement in student progress was major.

The impact of the TEN program was monitored using measures of student progress against the kindergarten, year 1 and year 2 targets. Multiple data collections were made (four per semester) to monitor the proportion of students at risk of not achieving minimum grade expectations in number sense. TEN facilitators shared processes for collecting the student performance data at their professional learning days.

The proportion of students below grade expectations in number reduced over the 20-week intensive implementation of the program. Overall, there was a 60 per cent reduction in the number of students considered 'at risk' ($n = 5229$). There was not a uniform reduction across kindergarten to year 2: there was an 80 per cent reduction in kindergarten, a 50 per cent reduction in year 1, and a 40 per cent reduction in year 2 (semester 1, 2012). The problems associated with students' number knowledge were more entrenched and resistant to change the longer they existed.

Lessons learned

Evaluation of the program identified the following factors as having contributed to its success:

- clear articulation of the program's focus
- effective use of data to inform teaching
- side-by-side support provided by the TEN facilitator in the classroom
- facilitators who demonstrated high-quality leadership skills and deep understanding of numeracy development
- delivery of effective professional learning to the TEN facilitators.

The TEN facilitators were highly committed teachers, well supported through extensive professional learning programs and networks.

The learning framework in number which formed a central component of the numeracy continuum was a well-researched description of the progression of student learning. Teaching resources aligned to the continuum were readily available and teachers had



access to video examples to support their observations. The teachers were also provided with opportunities to meet, share and reflect on their practice as part of the program.

Principals and teachers involved reported that:

TEN had contributed to improved student outcomes, with overall data showing more than 80 per cent of participating students had achieved identified benchmarks.

Mascot Public School assistant principal Susanna Brikha observed that:

‘It has been great to see the growth in our students through the data. This has had a very positive impact on the staff and has encouraged them to continue with the program.’

Best Start software senior adviser Diane Read said:

Teachers had embraced the early intervention program, which gave additional support to ensure students were on track in numeracy by year 3.

North Wagga Public School year 2 teacher Tracey Gardner reflected on TEN:

‘I particularly liked how our TEN facilitator came into our classrooms and demonstrated activities while supporting me with continuous advice and encouragement regarding our overall improvement.’

Chittaway Bay Public School principal Helen McDonald identified the support provided by the facilitator working alongside the teachers in the classroom as the most valuable part of the program.

(Source: Robinson 2011)

Next steps

Schools planning to implement TEN should carry out a needs analysis, examining year 3 NAPLAN numeracy results and other sources of data (such as the Best Start Kindergarten Assessment in numeracy).

The program also requires a school commitment to act on assessment for learning data.



Research base

Mathematics learning is complex with multiple cognitive requirements. Higher level mathematics learning depends on initial number sense and facility with basic operations.

As early number sense predicts both later mathematics performance as well as more general academic performance, children's number knowledge develops along well documented pathways (Carpenter & Moser 1982; Fuson 1988; Steffe et al 1983; Young-Loveridge 1987). Moreover, development in certain components of number knowledge is associated with children being at risk of mathematics difficulties (Jordan et al 2006).

Drawing on a synthesis of national and international research, the New South Wales Department of Education has been using a learning framework to monitor students' progress (Wright & Gould 2002a). Data from the Count Me In Too project on students' solution strategies provided an empirical basis for communicating minimum grade expectations in early number development (Wright & Gould 2002b).

Information on the most advanced solution strategies students could demonstrate in number (described as a progression on the Numeracy Continuum, an expansion of the learning framework in number) provided an indication of each student's zone of proximal development. Frequent learning opportunities focused at the leading edge of a student's current number knowledge is effective in developing connected number knowledge (eds Kilpatrick, Swafford & Findell 2001).

Further reading and links

Best Start Kindergarten Assessment,

www.curriculumsupport.education.nsw.gov.au/beststart/index.htm 

Carpenter, TP & Moser, JM 1982, 'The development of addition and subtraction problem-solving skills', in TP Carpenter, JM Moser & TA Romberg (eds), *Addition and subtraction: a cognitive perspective*, Lawrence Erlbaum, Hillsdale, NJ, pp 9–24.

Case study, www.curriculumsupport.education.nsw.gov.au/beststart/ten/general.htm 
(available only on the New South Wales Department of Education intranet).

Count Me In Too, www.curriculumsupport.education.nsw.gov.au/countmein/index.htm 

Fuson, K 1988, *Children's counting and concepts of number*, Springer-Verlag, New York.



Jimerson, SR, Burns, MK, VanDerHeyden, AM 2007, *Handbook of response to intervention: the science and practice of assessment and intervention*, Springer, Springfield, IL.

Jordan, NC, Kaplan, L, Olah, N & Locuniak, MN 2006, 'Number sense growth in kindergarten: a longitudinal investigation of children at risk for mathematics difficulties', *Child Development*, 77(1), pp 153–175.

Kilpatrick, J, Swafford, J & Findell, B (eds) 2001, *Adding it up: helping children learn mathematics*, National Research Council, National Academy Press, Washington, DC.

New South Wales Department of Education, The numeracy continuum and introductory video, www.numeracycontinuum.com .

Robinson, W 2011, 'Numbers add up for TEN', *Side by side school news*, 14 February.

Steffe, LP, von Glaserfeld, E, Richards, J & Cobb, P 1983, *Children's counting types: philosophy, theory and application*, Praeger Scientific, New York.

Targeted Early Numeracy (TEN) Intervention Program, 2009, www.curriculumsupport.education.nsw.gov.au/beststart/ten/general.htm .

Wright, R & Gould, P 2002a, 'Using a learning framework to document students' progress in mathematics in a large school system', in AD Cockburn & E Nardi (eds), *Proceedings of the 26th PME International Conference*, I, pp 197–202.

Wright, R & Gould, P 2002b, 'Mapping overlapping waves of strategies used with arithmetical problems', in AD Cockburn & E Nardi (eds), *Proceedings of the 26th PME International Conference*, IV, pp 417–424.

Young-Loveridge, JM 1987, 'Learning mathematics', *British journal of developmental psychology*, 5, pp 155–167.

Contacts

For more information go to

www.curriculumsupport.education.nsw.gov.au/beststart/ten/general.htm .

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