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Bridging the Numeracy Gap

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Summary

The Bridging the Numeracy Gap (BTNG) project aimed to build teacher capacity and accelerate learning for mathematically vulnerable students in low socioeconomic status (SES) and Aboriginal and Torres Strait Islander communities. The project was implemented in two parts:

A. implementing and refining a mathematics education intervention strategy; and,
B. drawing on the findings of Part A to develop strategies to improve mathematical learning in schools identified as low SES and/or in isolated/small communities.

In each part, the intervention required a whole-school approach with three phases of instruction: whole-class teaching, short-term intensive interventions, and ongoing monitoring and support.

The initiative was grounded in three key approaches:

- classroom teachers using a one-on-one interview-based mathematics assessment tool and associated framework of growth points to guide instruction and curriculum development at individual, class and whole-school levels;
- professional learning opportunities for classroom teachers, Aboriginal teaching assistants and specialist teachers; and
- measuring the effectiveness of the Extending Mathematical Understanding (EMU) program implemented in the second year of formal schooling to provide intensive specialised instruction for students who were mathematically vulnerable.

The Bridging the Numeracy Gap Pilot Project was funded by DEEWR Smarter Schools National Partnerships for Literacy and Numeracy between 2009 and 2011. In kind contributions were made by the various dioceses to contribute to costs of system consultant salaries, travel and accommodation expenses, and training events.

Target student group

The initiative was undertaken across 42 low SES (rating 92 or below), remote and small community Catholic schools in Western Australia and across the Victorian dioceses of Ballarat, Sale and Sandhurst. More than 2000 students in Foundation to year 4 were included in the initial data collection, with 162 students participating in an EMU intervention program in either 2009 or 2010.

Also, more than 90 teachers, principals and Aboriginal teaching assistants participated in professional learning events over the two years of the project.

Method

The BTNG for students in low SES and Aboriginal community's project was implemented in two parts. Part A involved the implementation, evaluation and refinement of a mathematics intervention strategy for mathematics learning (the EMU program). This program was embedded in a systematic whole-school approach for improving learning outcomes in low SES schools (rating 92 or below). Part B involved developing relationships with identified low SES isolated/small communities in Victoria and Aboriginal communities in the Kimberley and Victoria, for the purpose of together designing and implementing strategies to improve mathematical learning. These strategies were also informed by the EMU program learning and teaching principles, but primarily sought to reflect the insights and wisdom of the communities themselves about how to enable students to thrive mathematically.

Overall, the project aimed to:

1. refine the Early Numeracy Interview (ENI, Clarke et al 2002) and the associated framework of growth points so that they were more appropriate for students in the participating primary schools
2. evaluate the effectiveness of a systematic implementation of the EMU program, within a whole-school approach, to determine whether progress following early intervention for vulnerable students in low SES schools was sustained over two years
3. monitor and evaluate student learning in remote communities in order to identify effective approaches for improving mathematics learning.

In Part A of the project, specialist teachers from the selected schools were provided with six days of specialised professional learning. The school staff were also provided training to use the Mathematics Assessment Interview (MAI, the revised and renamed ENI) to administer with class cohorts. Follow-up visits and systemic support were provided to these schools.

In Part B of the project, numeracy teams from schools including the principal, numeracy leader and Aboriginal teaching assistant (where appropriate), attended six days of training modelled on the EMU specialist teacher program principles and practices.

In addition to the professional learning, schools were required to collect and provide MAI data at the beginning of the year for independent coding. Data was used to inform planning and instruction to meet students' learning needs. The students who were identified as mathematically vulnerable were invited to participate in a mathematics intervention program.

The Catholic Education Office of Western Australia and Catholic Education Offices of Ballarat, Sale and Sandhurst had previously offered intervention in mathematics to schools involving specialist teacher training (EMU program) and the collection and analysis of student diagnostic assessment in mathematics. The BTNG pilot provided an opportunity to evaluate the effectiveness of a systemic implementation of intervention in mathematics within a whole-school approach to improving student mathematical understandings.

Insight about the effectiveness of the approaches used in this project was gained through collection and analysis of both qualitative and quantitative data. The quantitative data were obtained from the task-based MAI (Clarke et al 2002), which was conducted by classroom teachers at the beginning of 2009, 2010 and 2011 with more than 2000 students in the first five years of school. The MAI record sheets were independently coded to determine the growth points students reached in the domains of Counting, Place Value, Addition and Subtraction Strategies, and Multiplication and Division Strategies. The growth points were analysed to: measure children's growth in mathematical understanding over the period of the project; inform the refinement of the ENI that was renamed the Mathematics Assessment Interview (MAI) in 2010; and measure the impact of the EMU program for participating students in 2009 and 2010.

The EMU program involved 20 weeks of specialised instruction for groups of the most mathematically vulnerable students in year 1. Data were collected through a range of methods including audio-taped discussions, visual recordings of EMU sessions, and artefacts like student work samples and teachers' planning documents. These data were analysed to determine factors that influenced the effectiveness of the EMU program and other learning and teaching strategies implemented in this project.

Overall, student progress was measured from year to year so the students' learning in response to the intervention could be tracked over time. This was done primarily through the use of a diagnostic clinical interview (ie the MAI) at the beginning of the academic year, to identify student mathematical understanding and inform planning and instruction of mathematics. Students identified as being vulnerable were offered a 10- to 20-week intervention program where instruction was tailored to each student's specific learning needs.

The intervention involved groups of three students being withdrawn daily for 30 minutes to work with a trained specialist intervention teacher. The specialist teacher liaised with the classroom teacher, parents and school leadership to ensure the program was meeting the needs of the students. The students were also supported in the classroom by monitoring progress of learning and development of individual learning plans as required.

The specialist teachers worked collaboratively with the classroom teachers and were integral to the success of the intervention. The specialist teachers taught the specialised program and monitored students who had been identified as vulnerable; supported the professional learning of school staff in mathematics; and led the mathematics curriculum in the school.

Results

The initial findings indicated that the initiative had a positive impact on student learning.

Nearly 2000 students in foundation to year 4 were assessed using the MAI during 2009 and 2010. In 2009, 222 (46 per cent) students were identified as mathematically vulnerable, and in 2010, 274 (51 per cent) students were identified as mathematically vulnerable. In 2009 and 2010, 114 (12 per cent) and 130 (9 per cent) students respectively participated in an EMU intervention program. The majority of these were year 1 and 2 students.

The MAI data highlighted that:

- growth point distributions for Kimberley students when they begin school were similar to foundation to year 4 students in general
- up to 50 per cent of students in each year level cohort were vulnerable in at least one of the four number domains, and this highlights the critical need for intervention strategies
- the majority of students in years 3 and 4 understood 2-digit numbers, but not larger numbers
- the 2010 foundation to year 4 students, who were later identified as mathematically vulnerable, did not progress in their addition, subtraction, multiplication and division strategies growth points, despite a whole year at school. This suggests that some refinements to the curriculum are needed for these students.

The MAI data also highlighted that the EMU program accelerates mathematics learning for most students from one year to the next. Also, in the early part of the initiative many of the students who participated in the EMU intervention program demonstrated an increased level of confidence both in the small group sessions and on return to the classroom. A key success of implementing the second wave intervention program was the improvement in the children's confidence to tackle mathematics problems and activities. One parent commented:

> 'My daughter is counting the tiles in the bathroom, the venetian blinds and helps when I'm cooking. She never used to want to do maths but now she counts everything. She is teaching us!'

An EMU specialist teacher stated:

> 'It's really good to see them enthusiastic about maths; but also smiling at their successes and sharing their successes and their stories, and wanting to show you what they can do, and having the ability to articulate what strategies they're using.'

Furthermore, qualitative data showed the EMU specialist teacher also plays a key role in providing mathematics professional learning within a school. There has been a dramatic change in the pedagogy employed in mathematics lessons with the inclusion of manipulatives, and a move away from work-sheet-based activities. A teacher noted:

> 'There has been an overall improvement in mathematics education. Now there are lots of concrete materials out, and no textbooks. Noise, but all on task!'

A principal commented:

> 'I'm really confident that the teachers are teaching to where their students are at, when they go to do their numeracy block, so I feel I'm really lucky and I see that the kids move on so much quicker.'

In the Part B of the project, an initiative was undertaken to offer joint professional development sessions for teachers and Aboriginal teaching assistants. This was well received by both groups, and they saw it as a valuable means of strengthening the relationships of staff members to better meet the needs of the children.

> 'It has been great working with [the EMU facilitator]. He has a good way of explaining the maths to the children.'

It was anticipated that the intervention program would have a positive effect on students; however, the effect on families was unplanned. A number of parents spoke of the new knowledge they had developed as a side effect of their child participating in the program. Due to community commitments some Aboriginal teaching assistants were unable to attend all of the professional learning days. The professional relationship between teacher and teaching assistant did not flourish as well in these instances. The communities who did embrace the professional learning and worked as a collaborative group experienced positive outcomes in student participation and engagement. The confidence of the Aboriginal teaching assistants increased when they felt their contributions were valued.

The schools with multiple trained specialist teachers demonstrated a positive level of professional dialogue concerning mathematics instruction.

Lessons learned

Five factors that led to the success of the initiative were:

1. development across the whole school community
2. the principal taking a key curriculum leadership role
3. systemic and external expertise being employed to support reform
4. expertise and leadership being developed in the school
5. development being data driven.

Building whole school capacity for learning and teaching mathematics was a key for success. This was achieved by involving parents, staff, students and the broader community, so all could work with a common purpose. This included approaches that built the capacity of teachers, Aboriginal teaching assistants and parents to help children learn mathematics. It also included opportunities for families to engage in mathematical activities that sometimes included the broader community. This was critical for engagement and participation, relationships, and building community awareness and knowledge about learning mathematics.

It was crucial that the principals were acknowledged for their key role in **curriculum leadership within a collaborative leadership model** (principal, EMU specialist, mathematics leader, and parents/community members). Principals are key people in building strong relationships with the community based on respect and trust. Principals also have the power and responsibility to provide the time, space and resources necessary for pedagogical reform.

It was also important that the program was well **supported by systemic and external expertise, infrastructure and support**. However, this support and expertise was focused on the actual teaching and learning that was occurring in the particular school sites.

Following on from the previous point, the **development of specialist teachers** within each school was imperative in order to sustain and support the initiative. The qualified specialist teacher in each school provided mathematics leadership and professional learning within the school, implemented EMU programs (or equivalent) for vulnerable students, and monitored the progress of EMU students throughout the primary school to ensure that they continued to thrive mathematically.

Finally, it was critical that **quality data was collected on student performance** at the beginning and throughout any reform project. In this project the schools used rigorous assessment approaches, such as the MAI, for all primary school students. This was done at the commencement of the school year to determine each student's growth points. Whole-school data was also analysed to: identify issues related to learning and teaching mathematics; measure student mathematical growth from year to year; identify mathematically vulnerable students; refine the mathematics curriculum and instruction at individual, class and whole-school levels; plan mathematics professional learning opportunities for staff; and inform discussions with parents about student learning.

Next steps

An important part of the initiative was the development of numeracy education expertise and leadership in the school sites. Also, the Catholic Education Offices in Western Australia, Sale and Sandhurst have committed to supporting an EMU Professional Learner Leader to work across their dioceses to facilitate ongoing support for the newly trained numeracy leaders in the schools.

Now the MAI has been developed and refined, it has been embedded in the school programs and the teachers are skilled in its use. This assessment resource can be confidently employed across all the participating schools. Furthermore, the database developed through the initiative provides a baseline for measuring student progress in the ensuing years.

Research base

The EMU program was developed specifically for students who were seen as being vulnerable to falling behind in their school-based mathematics learning. It was developed as part of the Early Numeracy Research Project (Clarke et al 2002) by Dr Ann Gervasoni. The EMU learning and teaching principles informed the work with teachers, principals and Aboriginal teaching assistants.

Further reading and links

Catholic Education Office – Diocese of Sale, www2.ceosale.catholic.edu.au/services-to-schools/Extending_Mathematical_Understanding.aspx

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Extending Mathematical Understanding: Mathematics Intervention Specialist Teacher Course 2012, www.acu.edu.au/__data/assets/pdf_file/0006/382506/ACU_EMU_2012_Flyer.pdf

Gervasoni, A. et al 2010, *Bridging the Numeracy Gap for Students in Low SES Communities: The Power of a Whole-School Approach*, Fremantle: MERGA Inc.

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Contacts

Organisation: Catholic Education Office of Western Australia
Name: Peter Hayes
Position: Projects Leader, Literacy and Numeracy
Email: hayes.peter.j@cathednet.wa.edu.au
Phone: 08 6380 5322
Address: PO Box 198, Leederville WA 6903

Name: Melissa Croswell
Position: Second Wave Intervention Numeracy, Learning & Teaching K–12 Team
Email: croswell.melissa@ceo.wa.edu.au
Phone: 08 6380 5336; Fax: 08 6380 5325
Address: PO Box 198, Leederville WA 6903

Associated Organisation: Australian Catholic University
Name: Dr Ann Gervasoni
Email: Ann.Gervasoni@acu.edu.au
Phone: 03 5336 5395
Address: PO Box 650, Ballarat, Victoria 3350