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Improving numeracy achievement for students in years 7–9

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Summary

This initiative focused on improving numeracy outcomes for year 7–9 students in Catholic schools, where NAPLAN testing identified significant numbers of students in the lower achievement bands. The mathematics Learning and Teaching Consultant worked with school representatives to examine and analyse student data, identify issues preventing higher numeracy achievement and plan action to overcome such barriers. The key elements were focusing on year 7–9 students, building on existing school expertise, and supporting school-based decisions.

One of the aims was raising awareness of the importance of mathematics as a significant contributor to the development of student numeracy. The ideal was for each student to reach at least the minimum standard so they could take part in mathematics classes for their year level. For schools, the aim was to reduce the numbers of students in the lower bands of numeracy achievement, as identified in NAPLAN data.

In raising numeracy standards, it was also hoped that students would:

- be more confident in their ability to do mathematics
- achieve higher grades for mathematics
- rectify prior mathematical misconceptions
- be prepared to use mathematics in the workplace (and in life in general)
- be prepared for their upper school mathematics courses
- be prepared to undertake more advanced mathematics courses.

Target student group

There were 12 Catholic schools from Western Australia involved in this project, each with between four to seven classes at years 7, 8 and 9. Altogether, about 5000 students and 80 teachers were involved in any particular calendar year.

The NAPLAN data for all Catholic Education Office of Western Australia (CEOWA) secondary schools were analysed. This identified those schools with 20 per cent or more of year 7–9 students in the lower bands of NAPLAN achievement in 2008 and 2009. Twelve schools were then invited to participate in the project; after being briefed on the project details, they all wanted to be involved.

Method

This initiative involved six phases, and the CEOWA provided a years 7–12 mathematics consultant to support and facilitate the project. Although it had some centralised input, particularly in the early phases, the initiative was fundamentally school-based, so the pedagogical development could be specific to the particular needs of the students and teachers at each school.

Phase 1: Review how to improve numeracy outcomes for students in secondary schools

A selective review of the literature and best practice was conducted to identify the barriers to numeracy learning, and to determine effective strategies for numeracy development. The features of schools achieving exceptional mathematics outcomes were also identified. All reviews were shared with the secondary CEOWA schools, and the process of identifying barriers and strategies was repeated in each participating school.

Phase 2: Selection of participating schools

As outlined previously, schools with significant numbers of students at risk were identified through analysis of NAPLAN data, and by determining the proportion of students below or at the benchmark, and in the band one above the benchmark.

Phase 3: Selection of key teachers

Key teachers in project schools were selected by the mathematics curriculum leaders, with their involvement endorsed by the principal.

These key teachers were called 'Numeracy Coordinators'. Schools were encouraged to make their own decisions about the selection of their Numeracy Coordinators. Some schools decided to have a coordinator in each of years 7, 8 and 9. Other schools appointed one coordinator for all three year levels. In most schools, the Numeracy Coordinator was a teacher other than the learning area coordinator or head of department. Numeracy Coordinators were given a time allowance or monetary remuneration (or both).

Phase 4: Professional learning for Numeracy Coordinators

A program of professional learning was organised for the Numeracy Coordinators. It involved:

- analysis of the school NAPLAN data to identify topics in which student performance was below expectation
- identifying mathematics misconceptions held by students across the state
- developing the role and functions of the Numeracy Coordinator.

There was ongoing assessment of the school-based strategies throughout the project to provide evidence of success and to identify any need for further improvement.

Phase 5: Collection of data in project schools

The school staff engaged in a similar process to that outlined in Phase 1, but this time at the school level. Then teachers undertook three broad tasks:

- Rating the impact of the identified barriers to the development of effective numeracy.
- Identifying improvement strategies relevant to their school.
- Working with school leadership to develop and refine a model for numeracy education.

These tasks were undertaken collaboratively. Teachers and curriculum leaders worked together using school-based data to develop strategies for improving numeracy outcomes. From this point, schools undertook a range of actions based on the needs and factors of their school. Some of these actions were whole-department approaches. They included:

- appointing an assistant to the Learning Area Coordinator (Mathematics)
- appointing extra support teachers to assist students with low levels of numeracy achievement
- appointing mentors for teachers.

There were also activities that focused on teacher professional development. These included:

- scheduling an extra teacher to work with students in some classes
- coordinators holding meetings to share best teaching practice
- coordinators overseeing the assessment program and helping teachers write good quality assessments
- teachers attending professional learning events
- university personnel being invited to schools to work with teachers
- school-based professional development
- adoption of online resources to promote student engagement and enthusiasm
- a focus on mathematical literacy in two of the project schools.

Throughout the project, there was ongoing assessment of the school-based strategies to provide evidence of success and to identify any need for further improvement.

Phase 6: A four-day course in mathematical content for year 7 teachers

The course focused on year 7, as students at this level at CEOWA schools were in the process of moving to secondary schools. This meant that some primary teachers were moving with their students, and some teachers who had only taught from year 8 upwards were allocated to teach year 7. This course was an opportunity to share teaching practices and to update the year 7 curriculum to the standard defined by the National Statements of Learning (SOLs). The topics were identified in consultation with the heads of department (during the network days) and by comparing the SOLs with current curriculum expectations in Western Australia.

The course was held over four days in Term 3, 2009. The participants were involved in:

- preparing and sharing lessons
- reading and analysing research papers
- doing mathematics
- sharing best practice
- critiquing pedagogies for teaching specific topics.

Table 1: Course content for four-day course in mathematical content for year 7 teachers

Day	Session 1 (8:30 – 10:30)	Session 2 (10:50 – 12:50)	Session 3 (1:30 – 3:30)
1	• Collect and represent data • Describing chance	• Why do students struggle with fractions? • What do we want students to learn and understand?	• NAPLAN analysis • Project overview • Facilitation • Probing for understanding • Sequence of learning
2	• Number lines • Patterns • Number types • Mathematical 'literacy'	• Working mathematically with area and perimeter • Angles in parallel lines	• Software for teaching and writing assessments
3	• Introducing and using algebra • What's wrong with fruit salad algebra?	• Solving equations and inequalities	• Problem solving • Writing investigative tasks
4	• Linear functions	• The language of algebra • Advanced manipulation	• Geometric reasoning • Pythagoras' theorem • Similar and congruent triangles

Most of the 15 teachers attended for the four full days. The aim was to have at least one teacher from each pilot school. After the four-day course, the material was shared with other CEOWA schools. Many teachers in the course have remained in close contact with the other participants and with the consultant.

Results

This initiative was established to improve the NAPLAN results of students in the 12 participating schools, so NAPLAN data were monitored throughout. The numeracy coordinators were given professional development in analysing NAPLAN data, and the CEOWA consultant also supported schools in this process. Individual schools were encouraged to analyse their performance on the different strands of the NAPLAN questions. This analysis was the basis for teachers looking for reasons for low achievement on particular topics and strands (for example, ratio), and was used to monitor performance over the time of the project.

> ‘We have noted an improvement in students' interest in mathematics due to [buying an online Maths program], with a number of students attending after-school mathematics classes.’

To augment the NAPLAN data, anecdotal evidence was collected by the CEOWA consultant when talking to numeracy coordinators and teachers, and when visiting classes in the project schools. The consultant's observations gave insight into the teaching and learning situations in the various schools before and after the project. The consultant noted, among other things, that:

- there was a renewed enthusiasm from many heads of department for improving outcomes for lower secondary students
- teachers enjoyed working collaboratively, particularly on the focused goals of the initiative
- teachers have a lot of expertise to share, and such expertise can be more efficiently utilised
- stronger links with feeder primary schools were useful in developing better numeracy learning for year 7 students.

At the system level, the percentage of students in the two lowest bands of NAPLAN results for year 9 students at the project schools were examined and changes noted over the years. Similar comparisons were made for the percentage of students in the two highest bands, and these students were deemed to be achieving high levels of numeracy. In particular, changes from 2011 to 2012 were analysed for year 9 students, as the impact of any intervention would be seen most in the 2012 results. Results were also examined for each school, and for all students involved in the project.

The data indicated that, overall, the initiative had a moderate impact. However, the extent of the improvement was significant and it is likely that the initiative made a significant contribution to the improvements. The NAPLAN data in Table 2 shows that there were fewer students in the lower bands and more students in the top bands.

Table 2: Students in two top and bottom bands of NAPLAN Numeracy tests 2011–2012

Year of test	Year 9 students exempt or in the lowest two bands of the NAPLAN Numeracy test	Year 9 students in the top two bands of the NAPLAN Numeracy test
2011	24.0%	17.9%
2012	20.5%	19.1%

Of the 12 schools involved, there were nine schools in which the percentage of students who were exempt or in the lowest two bands fell between 2011 and 2012. At the same time, the percentage of students in the top two bands increased at eight of the 12 project schools. One school noted that data from 2008 NAPLAN testing showed that 1.8 per cent of their year 7 students were above the state average, and this had risen to 5.5 per cent by 2011. At the same time, the proportion of year 9 students near the state average went from 2.3 per cent below to 5.3 per cent above.

Lessons learned

Although the program was established in a different way in each school, there were some critical factors for its success, as outlined below.

- It was important to provide sufficient high-quality time for teachers to gather and analyse their data, share best practice, and plan for improvement.
- The identification of key personnel in each school to coordinate such a focused initiative is critical.
- The active support of all teachers is important for developing a school-wide approach. While the level of teacher engagement varied, everyone who understood the process and made the commitment was supportive.
- The support of the principal is essential.
- The goals and changes of the project needed to be seen as achievable and manageable. The reforms were a matter of reprioritising students' educational outcomes.

It was important that particular attention was given to teachers who had no experience of teaching mathematics to secondary students, as they were often more reluctant to consider new pedagogical approaches. These non-specialist teachers need extra support, particularly when confronted with change in an area where they already lack confidence.

At the system level, the design of the initiative had to be responsive to the particular needs of the various schools. So it had to be flexible, adaptable to local conditions, and allow schools to participate at a level appropriate to the available time and funding.

The single most important factor in this initiative was the Numeracy Coordinator. The Numeracy Coordinator drove the data analysis, facilitated the identification of barriers to higher achievement, and supported the development and selection of appropriate pedagogical strategies.

Next steps

‘The students are much more positive about mathematics.’ (Teacher)

The initiative has been variously developed in the different schools, but some schools are now providing more time for numeracy coordination and numeracy teaching. In some schools, teachers and Numeracy Coordinators have organised their own professional learning without the involvement of the CEOWA mathematics consultant. One school has allocated a weekly numeracy lesson in lower secondary. Numeracy Coordinators have begun to produce resources in their schools for the other teachers to use.

Teachers and schools are now more attentive to the achievement of their students in the topics tested by the NAPLAN program. Awareness of the importance of numeracy achievement – via the MySchool website – and the inclusion of Numeracy as one of the General Capabilities in the Australian Curriculum, have both contributed to a renewed focus on improving student numeracy outcomes. These recent developments, along with the gains of the current project, have seen sustainable and focused attention on teaching numeracy.

Research base

Many factors prevent students from achieving satisfactory numeracy levels, including the teaching methods, students' background knowledge, the number of students in each class needing support, readiness to learn, and disruptions to learning time (Westwood 2008).

To improve educational outcomes for senior students of mathematics, it is essential to have a renewed focus on improving what is happening in numeracy for students in the middle years.

While it is appropriate to have broad systemic development projects, schools ultimately need to be able to make decisions that suit the needs of their particular students (Kemmis & Grootenboer 2008). Therefore large educational reform programs must have processes for localised decision making and development as an integral dimension (Grootenboer 2013). It is at school that students meet the curriculum via their teachers, so this is the most critical site.

Further reading and links

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