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## ACTION: improved outcomes in numeracy

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## Summary

ACTION (Accelerating Catholic Tasmanian Schools to Improve Outcomes in Numeracy) is a partnership between the Department of Education, Employment and Workplace Relations (DEEWR), the Tasmanian Catholic Education Office (TCEO) and 11 Catholic primary schools.

It is well established that the teacher is the most significant factor in improving student outcomes. For this reason, investing in ongoing and sustainable staff development is important if pedagogy and learning is to be enhanced.

The ACTION project aimed to raise mathematics outcomes for all students in 11 Catholic primary schools in the Tasmanian Diocese through sustainable teacher development.

The project explicitly addressed the five broad areas identified by Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) as the basis of successful approaches in literacy and numeracy:

- student-centred approaches
- investment in lifting teacher capacity
- leadership and whole-school approaches
- use of broader community- and parental-engagement strategies
- effective use of student outcome data.

In particular, the project aimed to raise teachers' mathematical confidence and enhance mathematical pedagogy in the classroom. This was done through targeted and regular professional learning sessions, and by developing mathematics curriculum leadership capacity in the schools. The goal was improved student outcomes on a range of measures, including standardised national tests, such as NAPLAN.

## Target student group

The initiative was undertaken in 11 Catholic primary schools in the Tasmanian Diocese. One hundred and fifty-four teachers and approximately 2,330 students were involved.



## Method

### The ACTION strategy

Many teachers in Tasmanian Catholic schools felt that they lacked the confidence to teach mathematics and felt anxiety about the discipline. This had the potential to reduce student capacity in mathematics learning and disadvantage Tasmanian students. In addition, there were very few skilled numeracy lead teachers with the capacity to drive school-based professional learning, and a lack of professional development opportunities. A major concern in the Archdiocese of Hobart was to provide effective support for students who consistently showed underachievement in standardised and national testing. The proposed ACTION strategy had the potential to raise student standards in numeracy by focusing on student thinking and learning, and on explicit teaching that would guide instruction.

The ACTION strategy focused on three broad integrated areas:

1. Ongoing and focused teacher professional development.
2. Curriculum leadership.
3. Home–school partnerships.

The focus on each area was data-driven; together, they were designed to build a significant and sustainable improvement in the mathematical learning outcomes of students by enhancing pedagogy. The strategy was supported by the Australian Catholic University (ACU) and the Tasmanian Catholic Education Office (TCEO).

### *Teacher professional learning*

The key factor in any educational reform is the teacher, so the primary focus needs to be on teacher development to improve student outcomes. With this in mind, the main focus of this strategy was improved mathematical pedagogy through regular and ongoing teacher development. The teacher professional learning program included the following features.

- Three professional learning days for teachers and principals held on student-free days in 2009 and 2010. These days were facilitated by leading numeracy presenters from ACU at regionally based sessions.
- Teachers read and engaged with one research-based professional article each month to gain increased understanding and fresh perspectives on teaching numeracy.
- Monthly one-hour after-school team meetings facilitated by TCEO Education Officers to support the growth of strong on-site professional learning communities that focused on pedagogy, research and reflective practice.
- TCEO Numeracy Education Officers worked with schools one day per fortnight. This involved coaching and mentoring school-based Numeracy Coordinators and teachers through team teaching, coaching and collaborative planning.



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Alongside this shared agenda across the ACTION schools, each school had its own formal and informal events that focused on mathematical pedagogy. These provided opportunities for teachers to share and discuss classroom experiences and student thinking, thus building individual and corporate understanding of effective mathematics teaching practice.

The intense professional development focus on mathematics and numeracy over two years was designed to build pedagogical capacity within each school and across the Tasmanian Diocese. The whole-school focus meant that changes were sustainable and resilient in terms of teacher movement.



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### *Curriculum leadership*

Allied to the teacher development program was a focused agenda to build the curriculum leadership capabilities of Numeracy Coordinators in the schools. While there is value in having external experts providing advice and support, having this curriculum expertise and leadership in the school is more likely to lead to sustainable educational improvement. Therefore, one teacher in each school was supported to complete a Postgraduate Certificate in Mathematics Education (through ACU), with 20 release days per year and coaching and mentoring by TCEO Numeracy Officers. This approach was designed to build the Numeracy Coordinator's research and theoretical knowledge, and the practical application of that knowledge to enhance pedagogy and learning with the teachers and students in their school.



### *Home–school partnerships*

Home–school partnerships were established at each school to encourage parents to take an active shared role in the mathematics education of their children. Although there was no consistency in how schools developed the partnerships with home, their activities included the following:

- Encouraging parents to be involved in mathematics or numeracy lessons at the school by volunteering some of their time to work with students.
- Presenting workshops to help parents understand approaches to mathematics, and providing strategies they could use to help their children learn mathematics.

The use of the broader-community and parental-engagement strategies were designed to improve student engagement by having the key people in the children’s mathematical learning ‘all on the same page’.

### *Early Numeracy Research Project Framework*

The ACTION strategy was built on the [Early Numeracy Research Project \(ENRP\)](#)  framework developed by Doug Clarke and his colleagues at ACU. Key features of the ENRP framework are an initial one-on-one student assessment interview and the typical learning path mapped out by a series of ‘growth points’.

In this project, all students were initially interviewed using the Early Numeracy Assessment Interview (Clarke, Gervasoni & Sullivan 2000) to identify each child’s developmental growth point in Number, and to subsequently differentiate and customise instruction for individuals. The ENRP growth points of mathematical understanding (Clarke, Clarke & Horne 2006) were also used to inform and direct teachers to think about the key mathematical concepts children need to learn to progress to the next growth point.

## **Results**

‘Mount Carmel College in Sandy Bay was identified as doing well in literacy but consistently falling behind in numeracy prior to 2008. The school was involved in the ACTION project for four years, from February 2008. NAPLAN results from 2011 identified this school had an effect size of two, which is equivalent to four years growth in two years. This school has had a skilled lead teacher who undertook postgraduate study and was released from class to support teachers one day per fortnight. The school committed to regular professional learning and a whole-school focus on numeracy improvement. The principal attended all professional learning sessions. The assistant principal remarked in 2009, ‘There is no going back as far as I’m concerned and I think anyone who’s been involved in this project would realise that you just couldn’t go back [to previous ways of teaching].’



A range of positive outcomes emerged from the ACTION project, and the benefits are continuing since completion of the initial project in 2011. The positive outcomes were verified and substantiated by qualitative and quantitative data collected throughout the project, relating to student, teacher, systemic and community outcomes. Some highlights included:

- improved student learning outcomes (eg NAPLAN scores)
- increased teacher confidence and proficiency in teaching mathematics
- increased leadership capacity in schools, particularly in mathematics curriculum and pedagogy
- greater parental engagement in individual student's mathematics learning.

### Improved student learning outcomes

Through measurement against the ENRP growth points, there was clear evidence that students' development in Number was markedly improved through involvement in the ACTION strategy. The data were independently analysed by Professor Marj Horne from ACU. In her report she noted:

'The comparisons for the subsequent grades between 2009 and 2010 show steady improvement both across the grades and from year to year quite clearly, with the 2010 data showing overall improvement over the 2009 data at each year level.'

In general, the aggregated data showed that the students in the ACTION strategy had achieved greater gains (in terms of growth points) than those in the original ENRP, and this finding was consistent across all aspects of Number.

The NAPLAN data also showed that, overall, the students in the ACTION strategy achieved greater gains in Numeracy than students from Tasmanian schools not involved in the strategy. It is important to note that the gains were not necessarily consistent across all schools. For example, St Finn Barr's Primary School results indicated that in general their students gained almost 36 months growth in the 24 months between sitting the NAPLAN tests. (St Finn Barr's was involved in the ACTION strategy from the start. Some other schools whose gains were not as significant joined later.)

### Increased teacher confidence and proficiency

Throughout the project, anecdotal evidence and formal data indicated an improvement in the participating teachers' mathematical confidence and pedagogical content knowledge. Furthermore, there was a greater awareness and focus on mathematics and pedagogy to enhance students' mathematical learning.





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'Teachers are informally talking in the staffroom about 'I'm going to do the maths differently today, I'm going to have a hands-on approach, I'm going to teach so the children understand what they're doing rather than just doing calculations.'  
(Gerard Cronly, Principal, St Therese's Catholic Primary School)

Teachers reported that the demonstration lessons gave them confidence to try new ideas and affirm their practice; they valued the contextualised experience because they were able to see how the lessons worked with the students in their classroom. The cyclical model of demonstration lessons, time to reflect and plan for new learning had a positive impact on the way teachers were able to observe student learning, plan the next steps and teach for understanding. Also, the focus on students through one-on-one interviews provided data that enabled professional learning to focus on children's mathematical thinking in classroom contexts.

'I always assumed that children who could count, could count beyond 109 and I was quite surprised when testing children individually that many children in my class couldn't count over 109, they stumbled or they went on to 200 and 300, and so on.' (Catherine Montgomery, Teacher, St Therese's Catholic Primary School)

The teachers' [Pedagogical Content Knowledge \(PCK\)](#)  was examined annually through an instrument (developed by Clarke and Roche 2008) that focused on early years number concepts. The results showed a general improvement in the teachers' PCK from 2008 to 2011. The results of the assessment in 2008 were used to inform subsequent professional learning, and this appeared to be effective. For example, after the 2008 assessment it was clear that some professional learning was necessary in the area of 'tens facts', so this was a focus in 2009, and the improvement in the scores was evident. The data indicate that some work is still needed in the areas covered by Questions 4 and 5 (division and place value).

### Increased curriculum leadership capacity

'Having people on-site now with the confidence to actually lead professional learning within the school has been a real plus. I think it has been great for staff morale.' (Therese McDevitt, Assistant Principal, Mount Carmel College)

In each school, a Numeracy Coordinator was trained to develop focused in-school curriculum leadership in mathematics. These teachers all undertook a Postgraduate Certificate in Mathematics Education through ACU.



One outcome of the ACTION project is that now each school has a skilled and qualified leader of mathematics, and these teachers will continue to be curriculum leaders in their schools beyond the funding period.

‘Deep reflection, collaboration and attention to current research through the Postgraduate Certificate in Education (Mathematics) through ACU has dramatically changed classroom practice.’ (Penny Dilger, Assistant Principal/Teacher, St John's Catholic School, Richmond)

## Greater parental engagement

In the middle of the project, a survey was used to ascertain parents' perceptions of mathematics across the 11 ACTION schools. Seven hundred and forty-three responses were received. Overall, the results showed that:

- parents were unanimous in seeing their children's mathematical learning as being very important
- about 75 per cent of parents thought that their children enjoyed mathematics
- parents were generally aware that children learn mathematics in a variety of ways
- most parents valued problem-solving skills in mathematics
- about 70 per cent of parents agreed that all children can learn mathematics well.

The results indicated that the core messages of the ACTION strategy were, in general, being received and accepted by the parent community. The results also highlighted some areas for further development, especially as about 30 per cent of parents indicated a lack of confidence in their own mathematical understanding.

## Lessons learned

There have been a number of important lessons learned by individual teachers and schools, and these are evident to a greater or lesser extent across the ACTION strategy sites. The key lessons learned were:

- the importance of a whole-school, data-driven approach to pedagogical development
- the importance of a sound theoretical framework to underpin pedagogical practice
- the importance of strategic, timely and thoughtful support for effective pedagogical change
- the importance of building site-based capacity for sustainability.

Although these messages are well established in the research literature, the impact was derived from participants being able to actually see these things *in action* and *in context*.





As mentioned, the ACTION strategy was rolled out across the whole school in the 11 participating schools. This focus enabled formal development activities to be coordinated and targeted so that sustained thought could be given to mathematics and numeracy. The whole-school approach also meant that informal teacher meetings and discussions tended to have a mathematical focus, which also promoted reflective consideration of associated pedagogy. An integral part of the whole-school commitment was the use of the initial one-on-one ENRP interviews to collect data about students' mathematical understanding. This provided shared and common data that was used to inform teacher-development programs and classroom practice.

'We now work collaboratively with parents as well. Our home-school partnerships have been enhanced. Mathematics was taught considerably differently for most parents when they were at school.'

The initial assessment interview was part of the ENRP program, which also included a framework of 'growth points'; this well-researched program provided a solid foundation for the activities of the ACTION strategy. The framework was valuable because it was theoretically sound but practical, allowing teachers to make informed decisions about classroom practice and student learning.

The intense focus of the ACTION strategy was demanding and challenging for teachers, so it was crucial that it was well supported at a range of levels. It was strongly supported by leaders at the systemic and school level, and this support included active participation. The provision of high-quality and timely professional development was crucial, and the staff from ACU and TCEO were instrumental in the project's success.

The investment in provision of formal qualifications for Numeracy Coordinators provided leadership and support at the site where it was needed, and this will be sustainable after the formal project is complete.

## Next steps

The significant investment of time, money and focus has meant that there has been a fundamental shift in mathematical pedagogy practices, to a greater or lesser degree, across all the school sites. The in-school Numeracy Coordinators and TCEO Numeracy Education Officers continue to offer support, leadership and guidance to the teachers in the 11 schools.

A significant resource that has evolved through the project and has subsequently flourished is the [ACTION Mathematics Project](#)  website.



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## Research base

Research in Australia and overseas has shown that there is a clear link between the mathematical content and pedagogical knowledge of teachers and student learning outcomes (for example, Hill, Ball & Schilling 2008). Further, primary school teachers often feel somewhat anxious about mathematics and this can affect their pedagogy in the mathematics classroom (Grootenboer, Lomas & Ingram 2008).

Bobis (2000) and Clarke (1994) identified key principles of professional learning that teachers found useful in building their pedagogical content knowledge. These included:

- a focus on student thinking and learning
- the use of research data
- an extended time frame for ongoing planning, reflection, trialling of new approaches and feedback
- collaboration with other teachers and mentors; team teaching
- a focus on mathematics in professional learning sessions.

These principles largely support recent findings from three large-scale studies in Australia and New Zealand (Bobis et al. 2005) that revealed several common features of the success of the professional learning programs for teachers. These included:

- a focus on research-based mathematical learning frameworks
- a focus on children's thinking through one-on-one interviews, with the teachers as researchers
- ongoing reflective professional learning, with the whole staff involved.



A focus on research-based frameworks was useful because teachers were able to use the frameworks as a lens for viewing students' learning over time, and make meaning from it (Bobis et al 2005). The one-on-one student interviews enabled the professional learning to focus authentically on children's mathematical thinking in a classroom context. Teachers had time to make sense of the children's thinking through collaborative discussions with colleagues.

Fullan and Hargreaves (1998) noted that professional reading on a regular basis would give teachers access to other perspectives, new ways of working and new teaching techniques. They stated, 'just one hour for one article a week gives access to at least four ideas and insights a month' (1998, p 7).

Home-school partnerships enlisting parents' support also have a critical impact on student outcomes. The earlier that parents have the opportunity to become positively involved in their children's mathematics education, the stronger their support can be as motivators and positive role models (Ford, Follmer & Litz 1998). It was noted that parents need to understand that instructional practices are different from their own experiences of mathematics; that mathematics is more than arithmetic; and that mathematics can be exciting and enjoyable. They noted that as children are the main focus of parent-teacher partnerships, practices that encourage parent-teacher relationships have a positive effect on children's sense of wellbeing. Low SES children are much more likely to experience lower levels of wellbeing (Biddulph, Biddulph and Biddulph 2003). The effects of quality teaching are maximised when supported by effective school-home partnership practices focused on student learning. School-home partnerships that have shown the most positive impacts on student outcomes have student learning as their focus (Alton-Lee 2003).

## Further reading and links

[ACTION Mathematics Project](#) .

Alton-Lee, A 2003, [Quality teaching for diverse students in schooling: best evidence synthesis](#) , Ministry of Education, Wellington, NZ.

Biddulph, F, Biddulph, J & Biddulph, C 2003, *The complexity of community and family influences on children's achievement in New Zealand: best evidence synthesis*, Ministry of Education, Wellington, NZ.

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Clarke, DM 1994, 'Ten key principles from research for the professional development of mathematics teachers', in Aichele, DB & Croxford, AF (eds.), *Professional development for teachers of mathematics*, (1994 Yearbook of the National Council of Teachers of Mathematics), pp. 37–48, NCTM, Reston, Virginia.

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Gervasoni, A, Hadden, T, Turkenburg, K, [Exploring the number knowledge of children to inform the development of a professional learning plan for teachers in the Ballarat Diocese as a means of building community capacity](#) .

Gervasoni, A, [Children's number knowledge in the early years of schooling](#) .

Grootenboer, P, Lomas, G & Ingram, N 2008, 'The affective domain and mathematics education', in Forgasz, H, Barkatsas, A, Bishop, A, Clarke, B, Keast, S, Seah WT & Sullivan, P (eds.), in *Research in mathematics education in Australasia 2004–2007*, (pp 255–269), Sense, Amsterdam.

Hill, H, Ball, D. L & Schilling, S 2008, 'Unpacking “pedagogical content knowledge”: conceptualizing and measuring teachers' topic-specific knowledge of students', *Journal for Research in Mathematics Education*, 39 (4), pp 372–400.

Roche, A & Clarke, D 2009 'Making Sense of partitive and quotitive division: a snapshot of teachers' pedagogical content knowledge', in Hunter, R, Bicknell, B & Burgess T (eds), [Crossing divides: Proceedings of the 32nd annual conference of the Mathematics Education Research Group of Australasia](#) , (vol 2), Palmerston North, NZ: MERGA.

Rowley, G, Gervasoni, A, Clarke, D, Horne, M, McDonough, A 2001, [The early numeracy research project: using interviews to monitor growth in mathematics](#) .



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## Contacts

The [ACTION Mathematics Project](#)  website has a range of resources and ideas for teachers, as well as discussion spaces and blogs. The site is maintained by Louise Hodgson a Numeracy Education Officer with TCEO, who was the leader of the ACTION strategy project.