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Primary Mathematics Specialists initiative

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Summary

This Australian Government-funded initiative was adopted after a review of student NAPLAN results, to introduce new ideas and research to teachers through professional learning experiences.

The Primary Mathematics Specialists (PMS) initiative was implemented by the Department of Education and Early Childhood Development in 2010–11. Schools were selected because their students were performing below the state average on the 2011 NAPLAN (Numeracy) test.

The PMS initiative aimed to:

- increase workforce capacity to improve outcomes in mathematics – achieved initially by specialists building their own disciplinary and pedagogical content knowledge in the base school, and then by specialists supporting colleagues' learning in a cluster network
- deliver improved primary student results in mathematics – achieved by teachers offering engaging, well-structured and targeted lessons that focused on developing students' mathematical concepts and skills
- build sustained, continued improvement in teacher capacity and student outcomes within schools – achieved by specialists continuing to extend their mathematics content and pedagogical knowledge and building the capacity of their colleagues in their school and cluster network.

Eighty-one specialists from 27 schools participated in professional learning to improve their mathematical content and pedagogical knowledge. Three specialists worked in each of three primary schools within one cluster per region. Each PMS focused on one area of school (eg years Prep–2). Specialists spent half of each week working in their own classrooms. A high level of collegiality developed between the specialists.

Principals were involved from the beginning, leading the initiative in their schools in different ways. They:

- advertised and selected their specialists
- organised and provided staffing
- enabled timetabling for release of staff and collaborative approaches to planning, teaching and using data to inform the above
- assisted with data collection and analysis for whole-school approaches to mathematics teaching.

In some networks principals played a large role in coordinating network professional learning with the specialists and classroom teachers. The principals were a key component of the capacity building of the specialists.



Target student group

The initiative involved students from metropolitan, regional, rural and remote schools and included Aboriginal and Torres Strait Islander students, and students with English as a second language (ESL). Students' numeracy learning from Foundation to year 6 was monitored as an indicator of the success of the PMS initiative.

Method

The selection process

Schools selected their specialists and the role was integrated into their school improvement agenda.

Teachers who exhibited known characteristics of effective specialists were selected. They were organised, motivated, flexible and responsive in their approach to working with others. They were willing to explore changes in their own practice, mathematical content and pedagogical knowledge, and were considered to be leaders of change passionate about their work.

Each specialist received 20 days of professional learning during the implementation of the initiative. The professional learning sessions focused on developing understandings about how children learn mathematics and provided ideas and tools for the specialists to use with colleagues.

The PMS role

PMS worked with primary teachers in either Prep–year 2, years 3–4 or years 5–6 in their base schools, and then with schools across the cluster. Typical time allocation was:

- 0.3 full-time equivalent (FTE) working with teachers in a base school to build mathematics content and pedagogical knowledge
- 0.2 FTE building teacher capacity in other schools within the cluster
- 0.5 FTE teaching in their regular classroom.

PMS were based in schools and clusters with the highest number of students not meeting expected levels of achievement in mathematics. They:

- developed clear goals and processes for their work with teachers
- used data to inform and support the work they were involved in with teachers
- used innovative approaches for accessing a wide range of resources to support their work with teachers
- viewed continuous professional learning as vital to increasing content and pedagogical knowledge
- balanced their time between teaching in their own classroom and supporting colleagues.



Results

The PMS initiative had a substantial impact on student learning outcomes in mathematics. This was measured by assessment data of student learning outcomes in numeracy.

The external evaluator (Royal Melbourne Institute of Technology University) collaboratively designed data collection to determine the impact of the initiative on:

- building workforce capacity
- improving student learning outcomes
- sustaining school improvement.

Workforce capacity

Data were gathered from PMS using questionnaires, surveys, interviews and discussions throughout the year.

Table 1: Data collection strategies

Data collection method	Focus	Time of implementation
Online surveys of specialists, their principals, participating teachers and regional staff	To gain the opinions, ideas and thoughts about the initiative	August
Telephone interviews with regional network leaders, principals, assistant principals	Perception of the initiative in terms of its success in raising the profile of mathematics in their school and networks, building teacher capacity in mathematics and improving student learning outcomes	August
Online survey of the specialists (74 attended and 67 responded)	Response to the five-day professional learning program	September
Regional discussion meetings with the specialists and often network leaders and principals	Planning professional learning for the network Gauging the progress of the initiative	October



There was strong evidence from the evaluation that the expertise of the specialists was enhanced as a result of participating in the professional learning activities. On conclusion of professional learning, the evaluators reported, the specialists' confidence in teaching mathematics rose from 68 per cent prior to commencing the program (November 2009) to 80.2 per cent following the five-day program (March 2010). The specialists believed they had developed a more strategic approach, and focused on individual student learning. PMS engaged students through differentiation, using data to inform planning for explicit teaching, and widening their resource base.

The majority of principals (17 out of 25) and most of the regional network leaders (8 out of 11) believed the specialists raised the profile of mathematics in their schools, supported teachers with their understanding of mathematical content and pedagogical knowledge, and helped to establish a culture of evidence-based learning.

The majority of teachers (over 80%) who completed the online survey believed the initiative supported them in their mathematics teaching. Many described changes to their planning; particularly the use of data to assess students' needs and inform explicit teaching. They used rich tasks to differentiate their class activities.

Student learning outcomes

Student learning in numeracy was improved to a major extent. Data on numeracy learning were collected from more than 5000 students. Student learning outcomes were measured using a range of tests and other formal assessment tools at different times of the year. Before and after comparisons with participants and nonparticipants and comparisons between different categories of participants or stakeholders were conducted. Data from Aboriginal and Torres Strait Islander students, ESL students, new arrivals to Australia and refugee students were made available for analysis.

All data from the following were submitted by the PMS to the evaluator (RMIT). Data anomalies such as blank records, data for only March or September and student absences for either March or September were removed. The refined data sets were used in the analysis.



Table 2: Assessment timetable

Assessment	Year levels	Time of implementation
Mathematics Online Interview Prep	Prep–year 2	March and September
VCAA On Demand Testing (Adaptive) Mathematics – Number	Years 3–6	March and September
VELS Number teacher judgements	Prep–year 6	June and December
NAPLAN	Years 3 and 5 students	May

During 2009–11, for those schools involved in the program from the start, almost half of the schools achieved student growth that was above the state average. It is important to note that the overall state achievement for all students for that period also grew, and so the benchmark used was an upwardly moving target.

Data collected from the small number of Aboriginal and Torres Strait Islander students were mixed. Achievement scores were well below other students on both the 2009 and 2011 NAPLAN (Numeracy) test. Results from the VCAA On Demand Testing (Number), however, showed that they performed above the expected level in years 3, 4 and 6.

Language Background Other Than English (LBOTE) students performed as well or better than other students in the initiative. They achieved, on average, higher scores than other students in the project on NAPLAN (Numeracy) tests. However, achievement grew less than the state average and the average of all students in the project over that period. The results from the VCAA On Demand Testing (Number) indicated they performed similarly to all other students and were above the expected level for years 3 to 5.

The refugee and new arrival student cohort's data were considered too small to analyse.

School improvement

The greatest gains in implementing the initiative over the period 2010–11 occurred in schools where specialists were strongly supported by their leadership team. The support included providing the specialist with the 0.5 time release and a timetable that supported the specialists to meet together and work effectively with the other teachers. Conversely, the least effective implementation occurred in schools where the success factors mentioned were not evident and this was reflected in the student achievement data.



A lack of continuity of specialist staffing proved to be a significant factor inhibiting the success of the initiative and this was true for all schools.

The researchers, supported by Regional Network Leader input, identified ten schools where there was strong implementation. The average growth of student achievement was compared among these schools. The results follow.

Table 3: Outcomes

Implementation status	Student achievement
Strong implementation	Improvement was well above expected growth and above other groups in the initiative, for example, growth shown by years 3–6 student data from VCAA On Demand Testing (Number) exceeded expected growth across all years. Students demonstrated 24 to 36 weeks progress within the six-month period, compared with the expected 20 weeks progress.
Acceptable implementation	The majority of participating schools embraced the initiative and many had substantially improved student achievement, that is, above state averages and expected growth.
Experiencing concerns during implementation	These schools demonstrated above expected growth in year 3, along with expected growth in year 4, and less than expected growth in years 5 and 6.

Lessons learned

An external evaluation of the initiative was undertaken by the Royal Melbourne Institute of Technology University. Evaluation of the initiative included analysis of:

- perception data – perceptions of PMS, principals, teachers and regional staff about the initiative and the building of teacher capacity. These data were drawn from surveys, school visits and interviews. Perceptions of the PMS regarding the professional learning program were drawn from pre- and post-program online surveys, daily participant evaluation sheets, and observations of sessions
- factors that facilitated effectiveness of the initiative.

Perception data showed that the response to the initiative was extremely positive from regional staff, principals, PMS and the teachers involved.



They all agreed that the initiative has raised the profile of mathematics in their schools, and the capacity of the specialists to lead improved mathematics teaching in their own classroom, in their professional learning team, in their school, and gradually through their network.

Principals listed a wide range of success factors. They felt the defining factors were the release time and the professionalism and character of the specialists. They also identified the inclusion of the specialist in the leadership team as crucial to embedding the initiative in school practice.

PMS valued the professional learning sessions highly. There was also an increase in collegiality among PMS.

The research evaluation identified those schools successful in implementation:

- provided the recommended 0.5 time release for PMS
- allocated full days as part of the 0.5 time release
- linked PMS work with school initiatives as a priority
- included PMS in decisions relating to timetabling, classes to be involved, expectations of their role
- timetabled regular meeting times with PMS to plan and share experiences and report to the principal and the leadership team on their work and progress
- promoted the value of the PMS position in the community
- provided ongoing, high quality professional learning for the PMS.

The positive external evaluation findings led to the initiative being continued in 2012.

Comments from participating schools

'Every child enjoys and is engaged with maths. The differentiation in the lessons has meant that all children are supported at their level and all are experiencing success. Teachers have changed their way of teaching in other subjects as well due to the influence and the success they are having in maths with the support of the specialists.'

'The confidence of the maths teachers is contagious. Parents are very happy with the way in which maths is now being taught.'

'Our three specialists have effectively contributed to whole-school development, content-based learning and networking learning with other schools. The power in this project is having the skills of our people developed thus, internalising the approach to commence sustainable practice.'



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'We support this initiative with regular timetabled, focused professional learning, which is attended by everyone including all leadership personnel. Regular focused mathematics walks are in place. Mathematics is planned for every week by teams and this is supported through our meeting schedule structure. We have organised to have the three specialists released at the same time to allow for shared planning time and allocated a section of the school to each. This distribution of the role allows the specialists to work at the same grade levels as their own class, thus enabling them to transfer good practice in their own room to classes in their professional learning team group. The specialists have been allocated professional learning time at both whole-school and professional learning team levels.'

Next steps

Positive unplanned consequences of the initiative were the effective ways schools responded to their own contexts and needs to improve their implementation approaches. Some schools reviewed the specialist time allocations over a 12-month period and supported the PMS allowing them to build specialist capacity within their school before engaging with cluster networks.

To support strong implementation of this initiative, the following are useful:

- appoint multiple specialists from within the school to work across all year levels and provide high quality professional learning to colleagues
- identify the PMS role explicitly in school plans
- develop the PMS role in the instructional leadership team to demonstrate a direct partnership with the management of school planning and teaching
- allocate time for ongoing PMS professional learning
- reduce staff changes to PMS as they require new training
- provide 'catch up' professional development for new PMS, perhaps using online professional learning modules for PMS to access at any time
- address competing high-level expectations of PMS in their dual roles (part-time teaching role and part-time PMS role)
- timetable professional learning team meetings in mathematics as a weekly priority to discuss outcomes and encourage improvement
- support clusters as equal partners, regardless of the distance between schools; in the long term, this has potential to lead to higher levels of sustainability of the initiative
- dedicate professional learning and meeting time for teachers
- provide time for PMS to prepare for meetings with and professional learning of teachers
- allocate timetabled time release (minimum 0.5) for specialists to work effectively with teachers



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- consider accessing professional learning activities at a statewide and regional level to continue the development of specialists' mathematics content and pedagogical knowledge
- conduct regular meetings of PMS to discuss issues and share ideas
- review case studies of different models of implementation
- consider timetabling a mathematics block for coaching in classrooms
- release staff for collaborative planning
- provide individual teacher feedback sessions during class time.

Research base

The 2006 Victorian Parliamentary Inquiry into the Promotion of Mathematics and Science Education identified teacher quality as one of the most important factors supporting high quality teaching and effective learning in mathematics. For primary teachers, the main issues related to their knowledge, conceptual understanding and background in the subject, and their level of confidence in delivering engaging learning experiences.

A Department of Education, Employment and Workplace Relations (DEEWR) report, *Opening Up Pathways: Engagement in STEM across the Primary–Secondary school transition* (Tytler 2008), found there was a persistent and progressive decline in student attitudes to, and interest in, mathematics during the middle years of schooling. The report found that the quality of teaching and teachers was central to students having a rich and rewarding experience in mathematics and science that was pivotal to later career choices.

Further reading and links

In addition, the following reports and research informed the development of the Primary Mathematics Specialists initiative:

Council of Australian Governments, 2007, Council of Australian Government's National Reform Agenda: Victoria's Plan to Improve Literacy and Numeracy Outcomes

Department of Education and Early Childhood Development, 2001, Early Numeracy Research Project

Department of Education and Early Childhood Development, 2004, Principles of Learning and Teaching (PoLT)

Department of Education and Early Childhood Development, 2005, Victorian Essential Learning Standards (VELS)



Department of Education and Early Childhood Development, 2007, Effective Mathematics Teaching

Department of Education and Early Childhood Development, 2009, Energising Science and Mathematics Education in Victoria Blueprint Implementation Paper

Department of Education and Early Childhood Development, 2009, 5Es Instructional Model. The Office for Government School Education, Melbourne, State of Victoria.

Department of Education and Early Childhood Development, 2009, Numeracy in Practice: Teaching, Learning and Using Mathematics

Donalson, G et al, 2012, *Becoming a Primary Mathematics Specialist Teacher*, Routledge, Abingdon, Oxfordshire

Human Capital Working Group, Council of Australian Governments (commissioned by), 2008 National Numeracy Review Report

RMIT University, 2011, External Evaluation of Primary Mathematics Specialists Initiative

Tytler, R, 2008, Opening Up Pathways: Engagement in STEM across the Primary–Secondary School Transition

<http://www.innovation.gov.au/skills/ResourcesAndPublications/Documents/OpenPathinSciTechMathEnginPrimSecSchTrans.pdf> 

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