MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

NUMERACY DEVELOPMENT IN NEW ZEALAND

THE STORY CONTINUES ...

Since its beginnings in 2000, more than 21 000 primary teachers have been involved in the NDP (Numeracy Development Projects). Most primary and many intermediate schools have now completed the initial phase, and almost all year 1–8 teachers, including 670 Māori-medium teachers, have had the opportunity to participate. It is estimated that the learning of 500 000 primary and intermediate students has now been directly influenced by the involvement of their teachers in the NDP.

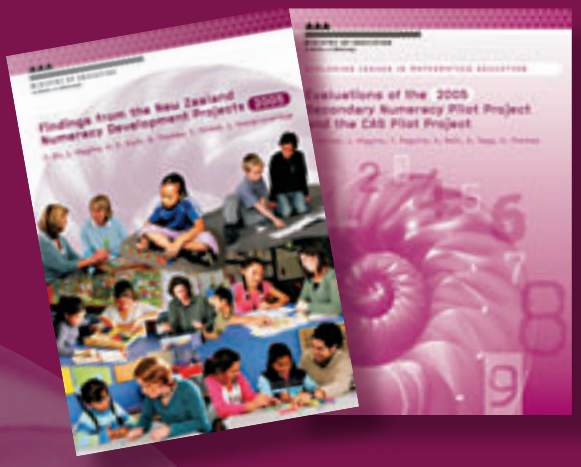
Beginning in 2005, secondary school mathematics teachers are also being given the opportunity to have professional development focused on number and algebra. In the first year of the Secondary Numeracy Pilot Project (SNP), 450 teachers in 43 schools participated. The project was led by seven regional co-ordinators and 32 school-based facilitators.

Concurrently with the expansion of the NDP, an unprecedented volume of research has been undertaken by academics to gauge the effectiveness of the projects and inform future direction and strategies. The consensus of this research is that the NDP has had a major impact on the way in which mathematics is taught in New Zealand schools: teachers have a much clearer understanding of how young people acquire numerical and mathematical understanding and how, as teachers, they can help their students achieve this.

The research contains good grounds for optimism as well as caution. There is still plenty to be done. The large volume of student achievement data and research into teaching practice, together with the reflections of teachers, principals, facilitators, and co-ordinators, ensures that areas needing attention are identified. A strength of the NDP has been the willingness of policy makers to address aspects that have been less successful. Ongoing, dynamic, and evidence-based decision making has been a particular feature of the projects.

This pamphlet summarises the 2005 research findings and the professional development and research focuses for 2006.

2005 NDP EVALUATION AND RESEARCH



Researchers and associates focused on three strategic themes:

- student achievement
- professional practice
- sustainability.

Their findings have been compiled into a compendium.

Evaluations of the 2005 Secondary Numeracy Pilot Project and the Computer Algebraic Systems (CAS) Pilot Project have been published as a report, focusing on:

- student performance and progress
- the impact of the SNP on teachers and facilitators
- assessment of number knowledge
- the use of CAS technology to improve teaching and learning.

The compendium and report are available from Learning Media or online from TKI and NZ Maths.

Student Achievement	Evaluators and Papers
Overall, there was a positive impact on students' achievement. The gaps between ethnic groups appear to be reducing. Further investigation is needed into students' multiplicative thinking and their understanding of fractions.	**Jenny Young-Loveridge** *Patterns of Performance and Progress on the Numeracy Development Project: Looking Back from 2005*
Students in the longitudinal study performed significantly better than other New Zealand students on the majority of test items related to NDP topics. They performed particularly well on tasks involving fractions but less well on calculations that were too hard to perform mentally. Measured against the Number Framework strategy stages, students in the study continued to show improving achievement over time.	**Gill Thomas and Andrew Tagg** *Numeracy Development Project Longitudinal Study: Patterns of Achievement*
NDP students are carrying forward their understanding of algebraic thinking from year 8 to year 9. Not all students showed the same level of achievement, with significant differences between schools.	**Kathryn C. Irwin and Murray Britt** *Algebraic Thinking in the Numeracy Project: Year Two of a Three-year Study*
Many students think mathematics is useful for everyday life and important for the future, particularly for getting a job. Students also think that mathematics is problem solving and content (number, algebra, geometry, measurement, and statistics).	**Jenny Young-Loveridge, Merilyn Taylor, Sashi Sharma, and Ngārewa Hāwera** *Students' Perspectives on the Nature of Mathematics*
The number of students making no stage gain is declining, especially in multiplication and fractions. The relationship between te reo Māori and mathematical thinking needs to be emphasised in ongoing professional development.	**Tony Trinick and Brendan Stevenson** *An Evaluation of Te Poutama Tau 2005*

We have had fantastic results from the Numeracy Project. All students have improved, with some year 3–6 students moving two stages. Students have had a complete turnaround in their attitude to maths. (Shona Hewlett, Principal, Otama School)

The success of this project can be seen in the stunning progress of our students, especially Māori students. (Bruce Crawford, Principal, Hikurangi School)

The project has been extremely valuable in our school. It was shocking at first to see how far behind the students were and, in a short space of time, how much improvement they made. A very worthwhile professional development for all involved. (Charis La Master, Principal, Rawhitiroa School)

RESEARCH FOCUS FOR 2006

Evaluation and research informs the ongoing policy development and implementation of the NDP.

Student Achievement

Researchers are investigating:

- the longer term impact of the NDP on student achievement;
- patterns of performance and progress in students of different gender, ethnicity, and socio-economic status, with a particular focus on multiplication, division, and basic facts in years 5–9;
- the impact of students' perceptions and dispositions towards learning mathematics and pāngarau;
- the performance and progress of students in the Te Poutama Tau project;
- the influence of gender, ethnicity, and fluency in te reo Māori on Te Poutama Tau students;
- the performance and progress of students in the SNP and the impact this has on achievement in year 10;
- the differences between schools participating in the SNP for the first time in 2006 and second-year schools.

Professional Practice	Evaluators and Papers
The modelling book gives students additional information that is useful in building mathematical understanding, and it encourages collective enterprise in solving mathematics problems. Both the manipulation of materials and students' ideas about the mathematics are important.	**Joanna Higgins with Maia Wakefield and Robyn Isaacson** *Modelling Books and Student Discussion in Mathematics*
Facilitators who act as co-teachers are able to guide teachers' interpretations of the core principles of the NDP. Under a contextually responsive approach, it seems likely that shifts in teachers' practice will be sustained after facilitation ends.	**Joanna Higgins and Sandi Tait-McCutcheon with Raewyn Carman and Donna Yates** *Contextually Responsive Facilitation*
The teacher of this successful numeracy class used language to advance students' thinking and encouraged them to use similar language, but they did so selectively.	**Kathryn C. Irwin and Joanne Woodward** *Advancing Pasifika Students' Mathematical Thinking*
Most teachers reported a high level of confidence in the NumPA judgments they make. There was a high level of agreement between teachers' NumPA judgments and those made by experienced assessors.	**Gill Thomas, Andrew Tagg, and Jenny Ward** *Numeracy Assessment: How Reliable Are Teachers' Judgments?*
Success factors in kura kaupapa Māori include the leadership of the principal and lead teacher, close monitoring of student progress and teacher goals, a focus on student learning (including the development of positive attitudes), and close relationships with whānau and communities. In the kura that achieved positive outcomes, teachers collaborated regularly and built up an environment where they could share ideas and gain support.	**Tony Trinick** *Te Poutama Tau: A Case Study of Two Schools*

The goal is the development of robust and flexible concepts about number. (Lead teacher)

Teacher confidence and competence improved noticeably. (Anne Stead, Principal, Mangakahia Area School)

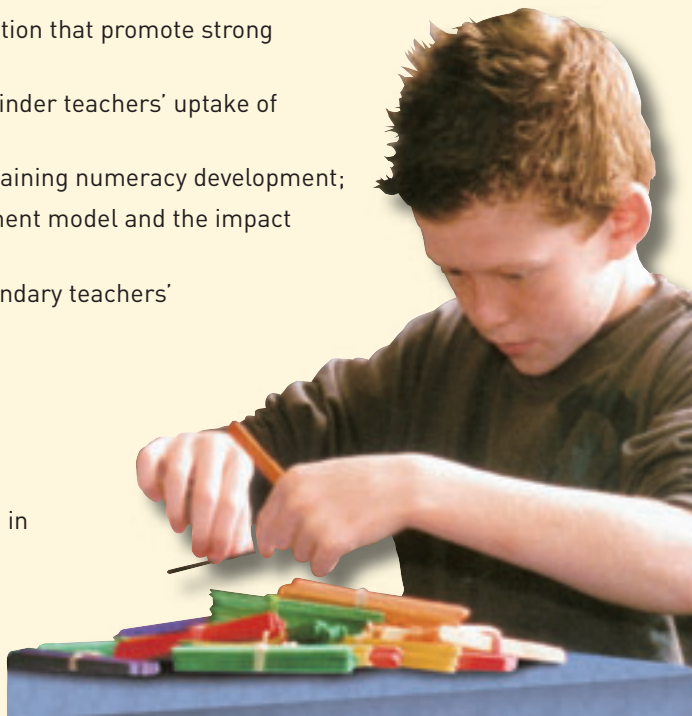
Teachers are all talking the same language. (Chris Worsley, Principal, Pomare School)

RESEARCH FOCUS FOR 2006

Professional Practice

Researchers are investigating:

- the organisational structures in small-group, teacher-led instruction that promote strong achievement gains for all students;
- how the structures of in-class sessions with facilitators help or hinder teachers' uptake of mathematical knowledge and practices;
- the organisational dynamics of schools that are successfully sustaining numeracy development;
- regional similarities and differences in the professional development model and the impact these may have on student achievement and teacher learning;
- the relative impacts of external and in-school facilitators on secondary teachers' development of subject and pedagogical knowledge.



Sustainability

Researchers are investigating:

- the effectiveness of the 2006 sustainability initiatives;
- the extent to which students maintain their levels of achievement in numeracy as they transfer from primary to secondary school.

Sustainability

	Evaluators and Papers
Schools and teachers identified ongoing facilitator support, lead teacher leadership within schools, and principal support as central to sustaining and developing effective numeracy teaching and learning. Barriers included the challenge of new staff who are not NDP trained and the lack of time for teachers to plan, teach, and assess. Schools appear to be developing numeracy communities of practice, with teachers reflecting on their own practice, collaborating with other teachers, and using student achievement information to identify learning needs, develop programmes, and measure progress.	**Gill Thomas and Jenny Ward** *Sustaining the Numeracy Project: The Lead Teacher Initiative 2005*
Enthusiastic lead teachers who take responsibility for carrying on the NDP in their schools are a key factor in sustainability. Change in individual teachers' practice appears to be a prerequisite for sustained school-wide change. Further investigation is needed to see if teachers are able to sustain the depth of insight and interaction needed as their students progress.	**Fiona Ell and Kathryn C. Irwin** *Sustained Numeracy Project Practices in Two Schools*

The Numeracy Project has made a significant impact on the teaching of maths in our school. We view this as a long-term process of change, which will be built on in the next few years. (Carol Mollard, Principal, Wiri Central School)

Numeracy has been the catalyst for teacher change. (Chris Worsley, Principal, Pomare School)

We are very excited by our results after the first year of involvement with the Numeracy Project. All the teachers were enthusiastic about the project, and there was much discussion in meetings and in the staffroom about what was happening for children and their learning. (Barbara Hay, Principal, Koraunui School)

PROFESSIONAL DEVELOPMENT FOCUS FOR 2006

The Numeracy Development Projects aim to improve student performance in mathematics through improving the professional capability of teachers. Quality teachers have a thorough understanding of the mathematics they teach, how students are likely to learn it, and the difficulties and misunderstandings that students are likely to encounter.

Aims for 2006:

- To help students progress to the higher stages of the Number Framework.
- To further reduce the achievement gaps between European, Māori, and Pasifika students.
- To encourage students in years 6–10 to develop strategies for dealing with large numbers and more complex calculations.
- To raise student achievement in the knowledge areas of basic facts, multiplication, division, fractions, and decimals.
- To help schools that have been through the NDP to meet the needs of new staff who lack numeracy training.
- To help schools balance the needs of students, the demands of teaching, and the many other requirements of school life.
- To provide opportunities for pre-service teacher educators to discuss numeracy and mathematics issues.
- To encourage all schools to provide sufficient time each week for the teaching of mathematics.

	Evaluators and Papers
Student Performance and Progress	
Students made progress in all strategy and knowledge domains. Significant shifts occurred in the proportion of the students in the top two stages of the additive, multiplicative, and proportional domains. More New Zealand European students than Pasifika and Māori students were at higher initial and final stages across all three domains. Male students generally performed better than female students, and the decile rankings of schools were a factor.	**Andrew Tagg and Gill Thomas** *Performance on the Number Framework*
Impact on Teachers and Facilitators	
The model of in-school facilitation was generally seen as successful. Many teacher participants saw the first year of the project as successful, measured by its impact on teachers' and facilitators' knowledge, skills, and practice. Teachers confirmed that a sound understanding of number is the most important requirement for students coming into year 9. Teachers identified time for teaching and preparation as the greatest limiting factor.	**Roger Harvey and Joanna Higgins with Lynne Jackson** *Evaluation of the Secondary Numeracy Pilot Project 2005*
Assessment of Number Knowledge	
The SNP uses a written test to assess the four knowledge domains. Research on this knowledge test revealed that the assessment tool was sufficiently robust to show student progress, and that the items were generally ordered from easiest to most difficult within each domain.	**Andrew Tagg and Gill Thomas** *Secondary Numeracy Project Knowledge Test Analysis*
The CAS Pilot Project	
Most teachers in the study believed that the pilot had led to students having a deeper understanding of mathematical concepts. Teachers moved away from rules and a procedural style of teaching towards an exploratory and constructivist approach, based on understanding.	**Alex Neill and Teresa Maguire** *An Evaluation of the CAS Pilot Project*

I used to assume that the students arrived from year 8 knowing more than they do!!! (Secondary teacher)

Emphasise number skills, a feel for number. Little else can be taught in mathematics without an understanding of number. (In-school facilitator)

Students need to know why they do things, not just how to do them. If they know why, the how comes naturally. (In-school facilitator)

The way I teach algebra has changed. Now I teach it based a lot more on number. Students take to it better this way and have better understanding. (Secondary teacher)

Students can focus on the mathematical concepts rather than just on the manipulative details. (Secondary teacher involved in the CAS project)

What's new online?

New online material can be sourced from:

Numeracy Project Resources
www.nzmaths.co.nz/numeracy/index.aspx
www.nzmaths.co.nz/maori/index.aspx

Mathematics/Pāngarau Learning Objects
www.nzmaths.co.nz/LearningObjects
www.nzmaths.co.nz/maori/lo/default.aspx

Mathematics/Pāngarau Units of Work
www.nzmaths.co.nz

TKI
Literacy and Numeracy community:
www.tki.org.nz/r/literacy_numeracy
Mathematics community:
www.tki.org.nz/e/community/maths

Other 2006 Ministry of Education resources include:

New **Figure It Out** student books, together with *Answers and Teachers' Notes*:

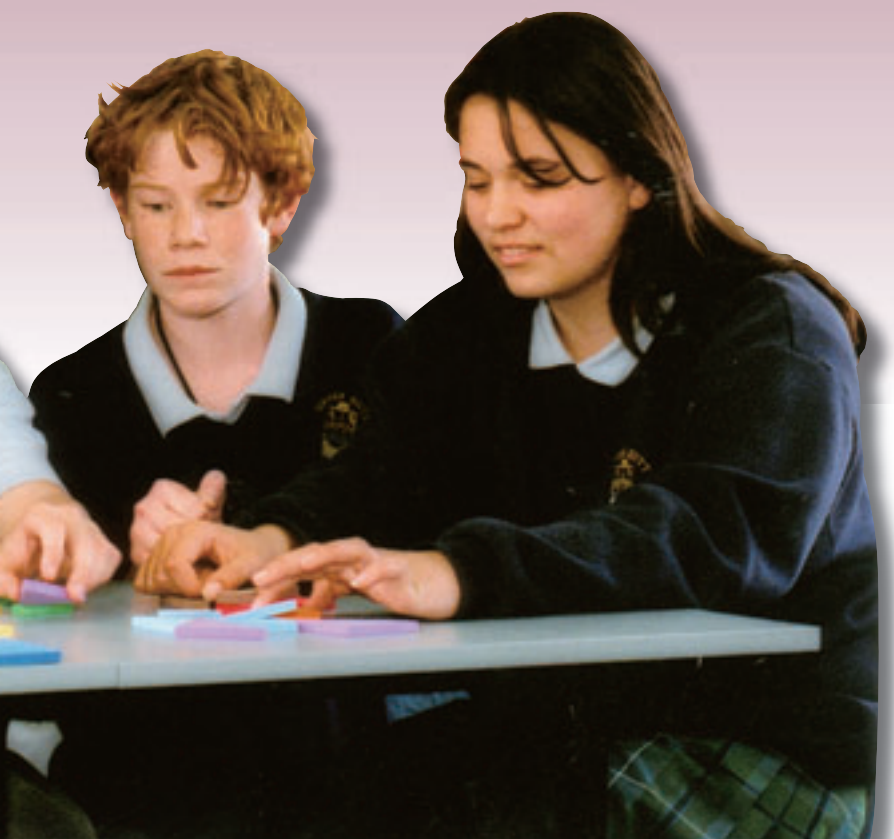
Proportional Reasoning (levels 3+ and 3–4+ [two books])
Geometry and Measurement (Link, for years 7–8)
Multiplicative Thinking (October 2006, levels 2–3, 3, and 3–4)

Three series for teachers in the Māori medium:

Pipi Pāngarau
He Tau Ano Te Tau
He Pūtahi Pāngarau

Evaluation and research reports: go to www.tki.org.nz/e/community/maths, then click on "Pedagogy and professional support" and then on "Research". Alternatively, go to www.nzmaths.co.nz/numeracy/References/compendium05.aspx

The ***Best Evidence Synthesis in Mathematics*** draws together available research evidence about what pedagogical approaches work to improve student outcomes in pāngarau/mathematics. It identifies, evaluates, analyses, and synthesises what the New Zealand evidence and international research tell us about quality mathematics teaching. It shows us how different contexts, systems, policies, resources, approaches, practices, and influences all impact on learners in different ways. Importantly, it illuminates what the evidence suggests can make a bigger difference to outcomes for diverse mathematics learners. This publication will initially be available online at www.tki.org.nz (late in 2006).



Further information relating to the contents of this pamphlet can be obtained from your nearest Numeracy Project co-ordinator. For names and email addresses, go to www.tki.org.nz/r/governance/prof_learn/numeracy_e.php

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Additional copies of this pamphlet are available free on request. Call Customer Services on freephone 0800 800 565. Send orders to freefax 0800 800 570 or email orders@learningmedia.co.nz

This pamphlet is also available online at www.tki.org.nz and www.nzmaths.co.nz

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