

# Keeping children engaged and achieving in **mathematics**

TEACHING APPROACHES AND STRATEGIES THAT WORK He rautaki whakaako e whai hua ana

**FEBRUARY 2018** 



#### Teaching approaches and strategies that work

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Keeping children engaged and achieving in mathematics

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New Zealand Government

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# Teaching approaches and strategies that work

KEEPING CHILDREN ENGAGED AND ACHIEVING IN **MATHEMATICS** 

### Introduction

This Education Review Office (ERO) report is one of a series of reports on teaching strategies that work. It features strategies and approaches that we observed in 40 primary schools selected from across New Zealand. These schools came from a database of 129 schools, all with rolls of 200 or more, in which the proportion of students in the upper primary years (Years 5 to 8) achieving at or above the national standard had increased. In each case achievement levels were also above average for the decile.

We asked leaders in each school what they saw as the reasons for their school's positive achievement trajectory and then investigated the teaching strategies that had been implemented, and the outcomes.

This report shares some of the strategies and approaches used by schools that had focused on improving achievement in mathematics. It also shares some of the simple strategies used in classrooms where achievement in mathematics had been accelerated.

# Why did we focus on mathematics in the upper primary school?

Recent National Monitoring Study of Student Achievement (NMSSA) reports have found that many more Year 4 than Year 8 students are achieving at the expected curriculum level. The most recent report, NMSSA mathematics and statistics report, 2013, found that while 81 percent of Year 4 students were performing at Level 2 as expected, only 41 percent of Year 8 students were performing at the expected Level 4. The report also found that Year 8 students were less positive about mathematics than Year 4 students. The box-and-whisker chart at right highlights this decline in positive dispostion.



Assessment Tools for Teaching and learning (**asTTle**) norm data also indicates the need for many children to progress through the levels more quickly in the upper primary school. If most children were progressing well, our national norms would show changes of about three sublevels every two years. However, data for the mathematics asTTle norms for the 2010 cohort indicated that the achievement trajectory does not ensure most children will reach Level 4A by the end of Year 8.

These concerns, based on primary school data, are reinforced by Programme for International Student Assessment (**PISA**) testing of high school students. PISA reports that New Zealand is one of very few countries in which the mathematics and science achievement of 15-year-olds is on a trajectory of accelerated decline.

Further, **PISA data** show that within the same school young people can experience widely divergent opportunities to learn. This within-school disparity, one of the highest in the participating countries, means that within-school variation in student achievement is very large compared with that of countries in a similar position on the table.

PISA data also show that New Zealand has one of the highest proportions of students attending schools where they are grouped by ability across and within mathematics classes. And, in New Zealand, the impact of these four factors on mathematics achievement is particularly significant:

- > exposure to formal mathematics
- > teacher-student relations
- > disciplinary climate
- > truancy.

Quarter	Year	Mean Score	Mathematics: Mean Curriculum Levels
1	4	1358	2P
2	4	1364	2P
3	4	1375	2P
4	4	1389	2A
1	5	1400	2A
2	5	1410	2A
3	5	1420	3B
4	5	1430	3B
1	6	1441	3P
2	6	1451	3P
3	6	1460	3P
4	6	1466	3P
1	7	1472	3P
2	7	1479	3A
3	7	1489	3A
4	7	1500	3A
1	8	1512	4B
2	8	1521	4B
3	8	1529	4P
4	8	1535	4P

The 2014/15 Trends in International Mathematics and Science Study (**TIMMS**) found that "although New Zealand's mean achievement in mathematics has increased since 1994/95, many other countries have increased by more. New Zealand Year 5 students' mean mathematics achievement was significantly higher than 13 countries, but lower than the mean score of 33 countries, including all the other predominantly English-speaking countries who participated."

The TIMSS test contained questions that went beyond what the New Zealand curriculum requires of Year 5 students, but even when these were removed, the mean outcome was that students correctly solved fewer than half the items. Six percent of the tested students were classified as 'advanced' performers while 16 percent were classified as 'below low', unable to perform simple mathematical tasks. This wide range of achievement was greater in New Zealand than in other high performing countries and in the predominantly English-speaking countries.

The TIMMS report found that, compared with Year 5 teachers in other countries, New Zealand teachers made less use of whole-class teaching and more of group activities. They frequently used ability grouping and more often had students work on problems, individually or with peers, while they occupied themselves with other tasks. In New Zealand classrooms, activities that involved the teacher explaining new mathematics content or how to solve problems or asking students to memorise rules, procedures and facts were less likely to be part of nearly every lesson.

Although New Zealand teachers reported that at least eight in every 10 students had been taught all the topics tested, some specific strengths and weaknesses were revealed in the results. Students did significantly better at *applying their knowledge and reasoning*, compared with the cognitive behaviour of *knowing* (a consistent pattern since 2006/07). They did best on *data display* questions, which was the curriculum area most likely to be covered by their teachers. The topics least likely to be covered in class were *comparing and drawing angles* (40 percent); *concepts of decimals*, including place value and ordering, and adding and subtracting with decimals (62 percent); and using *informal coordinate systems* to locate points in a plane (67 percent).

Although just over three-quarters of New Zealand Year 5 students said they 'liked' learning mathematics, the score on this indicator was less positive than the mean for all participating countries. More students described themselves as 'not confident' and fewer as 'very confident' in mathematics. They were positive about how their teacher engaged with them in the mathematics classroom, but fewer found their mathematics lessons 'very engaging' compared with the international average.

# What does ERO already know about mathematics in primary schools?

## Mathematics in Years 4 to 8: Developing a responsive curriculum (February 2013)

This report identified the need for more schools to use their achievement information as a basis for regularly reviewing and adapting their mathematics curriculum to make sure it responds to the strengths and needs of all students.

Most schools were able to identify those learners who were not achieving at the relevant national standard but many persisted with the same teaching strategies, programmes and initiatives instead of using the information they had to develop or replace them in response to known needs.

Most teachers used ability grouping within or across classes and many were relying on teacher aides to accelerate the progress of priority learners. Few had evidence that such strategies were actually working to enhance learning or achievement. ERO cautioned against the use of inadequately qualified adults to work with those learners who most needed expert teaching. A key finding of the report was that grouping by 'ability', whether in-class or across classes, disadvantages students.

#### Raising achievement in primary schools: Accelerating Learning in Mathematics (ALiM) and Accelerating Literacy Learning (ALL) June 2014

This report shared how some primary schools were using the Ministry-funded support projects Accelerated Learning in Mathematics (**ALiM**) and Accelerated Learning in Literacy (**ALL**) to enhance learning and raise achievement.

The report found that, in schools where teachers' involvement in the ALiM and ALL projects had accelerated children's progress,

- > students were active partners in designing their own learning plans; they were supported to monitor their own progress; they knew what they needed to learn next; and they were able to provide feedback about the teaching actions that worked for them.
- > parents and whānau were formally invited to be part of the process; they were involved in workshops to develop home activities and in frequent, regular, three-way conferencing in which teachers emphasised progress and success.
- > teachers knew they were expected to critique the effectiveness of their practice and to make changes; they had a willingness to seek both positive and negative evidence of progress; and they were open to new practices that make a difference.

#### **Raising Achievement in Primary Schools June 2014**

In this June 2014 document ERO described how strategic and successful schools had a long-term commitment to improvement through deliberate, planned actions designed to accelerate student progress. These effective schools were highly strategic and evaluative when trialling new approaches and innovations.

The report found that, for schools to be effective in accelerating student progress, they needed:

- > leadership capability
- > teacher capability
- > leaders and teachers with assessment and evaluative capability
- leaders with the capability to develop relationships with students, parents, whānau, trustees, and other teaching professionals
- > leaders and teachers with the capability to design and implement a curriculum that engaged students.

These schools also had a focus on equity and excellence.

### What did we find overall?

In schools where mathematics achievement was improving, and leaders knew the reasons for this improvement, teachers had usually participated in well-planned and targeted professional learning and development (PLD). Leaders had identified each teacher's strengths and needs and then organised internally or externally facilitated PLD to respond specifically to those needs. They carefully selected teachers from within the school who could lead development work successfully with their colleagues to spread the agreed practices. They made time available for these selected leaders to increase their own knowledge and to work with others.

Many of the 40 schools we visited had successfully identified the children who needed additional support in mathematics. What made the difference in the schools that had succeeded in accelerating achievement was that they had employed two complementary approaches: initial short-term interventions that focused on identified students and longer-term PLD designed to improve mathematics teaching school-wide. These schools moved from an intervention model aimed at 'fixing the children' to a collaborative model where teaching professionals assumed collective responsibility for improving teaching, thereby reducing the need for future interventions. They refused to accept that so many children were simply not good at mathematics.

The PLD could not be rushed because it often took teachers time to come to terms with the fact that they needed to teach the whole mathematics and statistics curriculum. They gained confidence to do this as they grew their knowledge of all the strands and looked in detail at what children should be learning at each of the first three or four curriculum levels. Some schools integrated number concepts across the strands and/or collaboratively documented the specific knowledge and skills children needed to acquire at each level.

In other schools, the changes were triggered by the practice of teaching as inquiry. Either individually or in groups, teachers recognised that they needed to do something different if they were to accelerate the progress of particular students. They researched best practice, tried something new, and then checked its impact on the students concerned. As a further step, they worked collaboratively with other teachers to spread practices that proved effective.

PLD and inquiries usually focused on both content knowledge and teaching practice. Teachers examined their assumptions about what children need for success in mathematics – particularly their own assumptions about their teaching for children who needed additional support.

Most of the schools that had improved achievement in mathematics had reviewed and completely changed the way they taught students. Some had previously paid little attention to or even omitted sections of the curriculum and now wanted to ensure that their students engaged with the whole curriculum. Teachers revised their long-term plans and guidelines and/or extended children's opportunities to learn by integrating mathematics into other curriculum areas. They recognised that although number and algebra are vital, if students are to be successful in mathematics they must also engage fully with learning in geometry, measurement and statistics.

For many of the schools the most fundamental change was the implementation of mixed-ability group instruction within an authentic and rich curriculum. Teachers realised that their previous practice of grouping by ability within or across classes seriously disadvantaged children in the lower groups, who were denied access to the whole curriculum and had negative perceptions about their mathematical ability reinforced. Streaming children into different classes for mathematics separates mathematics from the rest of the curriculum. By abandoning this practice, teachers found they were able to more effectively integrate mathematics into authentic contexts that they were using in their classrooms.

As a first step teachers usually tried mixed-ability grouping for some of the time while they monitored outcomes. They used strategies such as *talk moves* to deliberately teach the children how to engage in problem-solving discussions with peers, facilitating workshops with groups of children who needed to practise particular processes or skills.

talk moves	
Teacher move:	What a teacher does:
Revoicing	Repeats some or all of what the student is saying and then asks the student to respond and verify whether it is correct
Repeating	Asks students to restate someone else's reasoning
Reasoning	Asks students to apply their own reasoning to someone else's reasoning
Adding on	Prompts students for further participation
Waiting	Waits in silence

One of the principles of '*talk moves*' is to carefully orchestrate talk to provide for equitable participation by all learners.

Over time, teachers saw that mixed-ability grouping practices also had benefits for more able mathematicians, who, when working with peers, had to think deeply about alternative solutions. Teachers found that children in mixed-ability groups had greater understanding of their learning, were better able to recognise achievement and progress, and knew what they had to do to improve. Many of those who had previously been in 'bottom' groups talked to us about how their confidence in and enjoyment of mathematics had increased since working in flexible, mixed-ability groups.

When introducing new approaches and strategies, the teachers in some schools worked closely with parents and whānau. This was particularly important for schools abandoning the practice of cross-grouping. At special mathematics evenings, leaders in some schools provided parents with group problem-solving activities to help them understand the benefits of working in mixed-ability groups. Other schools focused on communicating regularly with the parents and whānau of children in need of additional support so that they were kept fully aware of what was working for the child and what progress they were making.

Some schools, which had been involved in the Ministry of Education's ALiM, had triggered the need for more extensive PLD. For others, it had involved replacing withdrawal-type interventions with in-class interventions, where ALiM leaders supported teachers to provide children with additional assistance while they continued to learn alongside and with their peers. The ALiM teachers were able to introduce collaborative reflection and sharing of practices that extended into other areas of the curriculum. Some approaches were so successful that the board of trustees in two schools allocated resources to enable them to be introduced more widely.

Leaders played a crucial role in ensuring a coherent approach to professional learning. They identified and developed internal expertise. They accessed external expertise that was relevant to teachers' needs and aligned with the school's vision and values. They actively involved parents and whānau, seeking their perspectives and communicating changes. They identified teachers who needed extra support to implement change and they provided the necessary support in innovative ways. They made time available for teachers to look deeply into their own content knowledge and pedagogy. These were all factors contributing to positive achievement trajectories for students.

# Mathematics approaches and strategies that worked

In the following pages we share the narratives of eight schools. The first four describe the school-wide development of effective approaches to mathematics teaching, and some teaching strategies. The final four describe strategies that were implemented in parts of the schools concerned.

# 01

Using both long-term and short-term strategies to improve outcomes

ABERDEEN SCHOOL HAMILTON

- Focused professional learning and development
- Managing improvements across the school
- Working with individual children and their parents

# 02

Adapting ongoing mathematics professional development

HOON HAY SCHOOL CHRISTCHURCH

- > Strategically managing change
- > Trialling and spreading the new mathematics approached
- > Working with parents
- > Ongoing review and development

# 03

Developing and implementing a well-structured curriculum

HOKOWHITU SCHOOL PALMERSTON NORTH

- Reviewing and developing curriculum content
- Outlining expectations about teaching practices
- Successfully implementing new approaches

# 04

Improving outcomes for Māori and Pacific students

ROSCOMMON SCHOOL AUCKLAND

- > Identifying children's and teachers' development needs
- > Accessing relevant PLD
- > Developing Mathematical Inquiry Communities

# 05

Using multi-ability instruction for children

SELWYN RIDGE SCHOOL TAURANGA

- > A multi-ability mathematics lesson
- > Children supporting each other to learn
- > Impacts for children

# 06

Improving achievement by working closely with parents

EAST TAIERI SCHOOL OTAGO

- > Working with parents and whānau
- > Engaging in authentic mathematics tasks
- Developing children's confidence to share their strategies and learning

# 07

Providing explicit instruction to increase student agency

MARIST SCHOOL MOUNT ALBERT AUCKLAND

- > Introducing mixed-ability instruction
- Helping children to understand their learning
- > Using digital technologies

# 80

Building teacher capacity through Teaching as Inquiry

WAIPAHIHI SCHOOL TAUPO

- Increasing children's understanding of their learning
- > Improving teaching practices

#### TEACHING STRATEGY

Using both long-term and short-term strategies to improve mathematics learning and achievement

ERO's 2014 report **Raising Achievement in Primary Schools** identified that a quarter of the schools in the sample had strategically trialled and introduced new approaches to raise achievement. These schools implemented short-term strategies to improve achievement for groups of children and long-term developmental strategies to reduce achievement disparities.

Leaders at **ABERDEEN SCHOOL** managed successful professional learning for teachers through the use of a variety of strategies to cater for their strengths and needs. They recognised, also, that they needed to do something immediately for children who had not been succeeding in mathematics under previous teaching practices. As a result they provided targeted support for these children, which successfully raised their achievement. These interventions led to the trialling of some approaches that were subsequently introduced across the school.

This narrative highlights the steps this school took to support the mathematical learning of teachers and students. Leaders used both outside expertise and the strengths of their own teachers to bring about improvement. They worked collaboratively with staff to get buy-in and they made well-considered adjustments to professional learning and development (PLD) in response to the very variable outcomes.

Leaders in this large school wanted to increase the number of children succeeding in mathematics, especially in Years 4 and above. They had identified that more and more children were requiring additional support as they moved through the year levels and they were determined to halt this negative trajectory.

### Focused professional learning and development

At the same time as they were beginning to redevelop their mathematics programme, leaders were also reviewing the impact of previous PLD designed to improve students' writing. They observed that there had been a considerable time lag between identifying the challenges and implementing changes in the classroom. Leaders wanted to ensure that new mathematics practices were put in place more quickly, in all classes, so that the children could start benefiting from them.

When introducing new strategies, the leadership team found it helpful to think of the teachers as if they were learners in their classroom. Some were early adopters, some would be swept along with the momentum, and the remainder would lag behind. All were on a learning continuum, with some requiring more support than others. Leaders noticed that sometimes less-experienced teachers were more open to new learning, especially when it was tailored to their needs. Leaders had to work differently to get teachers who were uncomfortable with change to adopt new ideas and build on existing successful practice. This meant understanding these teachers' needs, and, sometimes, working one-on-one with them.

> "Relationships with our staff are as important as the relationships that they have with students. We model that. It's about knowing your learners. Being a team leader enables you to get to know your staff really well."

"When we started to see our teachers as learners, things changed. We reflected on that. We've seen that a one-size-fits-all model doesn't work."

Leaders

Leaders and teachers worked closely with external PLD facilitators to improve mathematics teaching and learning. The facilitators extensively modelled new teaching strategies and supported improved leadership practices. Facilitators always took a team leader with them when they observed a teacher, and then reflected on their practice with them. Over the two years of the mathematics PLD, every observation was followed by a reflection in which the focus teacher was a full participant. Some teachers initially found these two-person observations and reflections challenging because they were not used to their practice being under the spotlight in this way. But it was by being involved at this level that team leaders came to understand the strengths and needs of each teacher and provide ongoing, responsive PLD. At the same time, leaders had numerous opportunities to develop their own coaching and mentoring skills, which helped strengthen the sustainability of the new directions. In the first year of the PLD mathematics achievement in some classes and levels did not improve as hoped. However, because the school leaders had worked so closely with individual staff they knew which teachers were not confident with the changes, and were able to provide them with additional support. Leaders were also aware that that they needed to overcome any change-induced confusion before the new approaches could be embedded and have a lasting positive impact on the children's learning. Leaders strategically partnered confident teachers with those who were less confident for the purpose of observing and supporting each other's practice. In many cases the benefits were reciprocal.

#### Examining assumptions about mathematics teaching

Teachers changed their assumptions about mathematics teaching and altered their practices in response to what the research was telling them.

Year 4 to 6 mathematics programmes had previously been structured to support the linear acquisition of discrete bits of mathematics knowledge and discrete skills. Teachers had streamed students across the teaching teams based on what they had mastered. Mathematics was taught separately from the rest of the curriculum to allow for this streaming.

Following discussions with the PLD facilitators about the pros and cons of this practice, and possible alternatives, teachers recognised that streaming had been disadvantaging children in the lower mathematics class. Not only were these children unlikely to experience the whole mathematics curriculum, they were unlikely to develop positive attitudes towards mathematics. It was decided therefore that, as from the beginning of 2016, teachers would teach mathematics to all the students in their own class.



Prompts remind children of strategies to use

After making this change, teachers generally grouped their children by ability within the class when teaching mathematics. Because mathematics was no longer isolated from the other learning areas, teachers were able to integrate mathematics learning across the whole curriculum.

Teachers also saw that children who were previously in the lower group class were beginning to experience a wider variety of mathematics strategies with their peers. As a result, teachers in some classes were starting to experiment by working with mixed-ability groups and were using more authentic mathematics tasks linked to learning from other curriculum areas.

#### Managing improvements across the school

Analysis of whole-school data showed school leaders that knowledge gaps become more apparent as the children moved through the year levels. They decided to approach this challenge in three ways.

- 1. They set more specific charter targets.
- 2. They worked on a longer-term goal to improve mathematics teaching at all year levels, to develop a more positive mathematics achievement trajectory for their children.
- 3. They introduced a short-term strategy that focused on children in Years 4 and 5, where the most gaps were identified.

#### Setting more specific charter targets

During the first year of the PLD, the school's charter target was for 85 percent of children to meet the national standard for mathematics. Such general targets are of limited use because they do not make it clear what teachers should focus on to accelerate the progress of identified children or groups. In the second year, when the anticipated progress had not been made, leaders established much more specific targets, identifying the year levels, groups of students and **operational domains** they should focus on. These new targets provided much clearer direction and less incentive for teachers to concentrate overly on aspects of the curriculum where the children were already succeeding.

#### Working collaboratively to develop school-wide mathematics programmes

All teachers were involved in developing the school's 2016 Curriculum and Achievement Plan, which outlined actions that had been agreed in response to the new charter targets. This plan will be reviewed and further developed into the future. The plan identified what children should know by the end of each of the Years 1 to 6. It described how to identify who was in need of additional support and how to provide responsive programmes for them. Teachers of Years 1 to 3 focused on what they needed to do to ensure that children understood each of the specified concepts and were ready for the more advanced learning they would encounter in Year 4 and beyond. By working collaboratively on the progressions and actions, teachers deepened their own understanding of the curriculum and the kinds of teaching and assessment that promote children's conceptual understanding.

Instead of waiting until a child was confident with every concept before moving them to the next level, teachers moved them to the level or stage appropriate for their age and then taught them what they needed to know to succeed at that level or stage. This gave teachers a greater sense of urgency and required more responsive teaching. This more responsive teaching meant teachers had to clearly understand the children's strengths and gaps, so they could anticipate and plan for any misconceptions children may encounter with a new concept.

Leaders reviewed assessment processes used for moderation and programme planning purposes, and teachers made sure that they were now assessing learning across all the mathematics strands. Accepting that it was not enough just to know which stage a child was at on the number framework, teachers now assessed how confident they were on each of the three operational domains.

Teachers recognised that it can be hard to make overall teacher judgments (OTJs) about children's achievement in relation to some **Mathematics Standards** after teaching just one strand of the curriculum for a few weeks – some standards require performance to be evaluated across numerous curriculum **achievement objectives**. They decided therefore to integrate the strands and be more specific about what children can do and what they need to work on.

By looking in greater depth at children's mastery of skills and concepts, teachers were able to change the way they grouped children for targeted instruction. They became more selective about who needed to attend a particular teaching session. Improved analysis of assessment data helped them identify that sometimes, by focusing on a particular domain, they could see considerable gains in the children. Teachers changed from planning and teaching that matched the strand they were to focus on, to thinking more about what could be done to set children up for success.

#### Focusing on a short-term strategy to accelerate learning

A mathematics support teacher was selected to help achieve improvement across all the year levels. Her role was to lead an intervention programme for Years 4 and 5 children and help teachers try the new approaches advocated by the PLD.

This teacher was a keen learner and enjoyed good relationships with other staff, including those who were hesitant to make the required changes. However, she was not particularly confident with mathematics. To increase her confidence she undertook a university mathematics paper. She became excited about mathematics teaching and enthusiastically shared what she was learning with colleagues. This teacher's ability to learn new skills and work successfully with children and teachers, and her empathy for those who were struggling, were crucial when it came to supporting teachers to engage with new approaches and strategies and try them for themselves.

As well as undertaking some co-teaching, the support teacher ran the intervention programme, which was mostly for Year 5 children. This programme focused initially on improving attitudes towards mathematics. She taught the children how to try different approaches and to view mistakes as a resource for learning rather than evidence of their failure.

Throughout the programme the teacher used a **Teaching as Inquiry** model to formally reflect on what was working for both children and teachers, and for whom it wasn't working. This process helped her identify approaches and strategies that were effective in



Discussion prompts

accelerating the progress of children who had previously been struggling. These approaches and strategies included:

- > making connections between prior knowledge and new learning
- > using equipment and visual representations to aid conceptual understanding and support discussion
- > introducing purposeful tasks that connect mathematics with real life
- > sharing and discussing mathematical thinking with peers
- > using the **Growth Mindset** approach to increase confidence and self-efficacy.

The strategies that proved most successful in terms of embedding changes in the classroom were:

- > collaboratively developing a Curriculum and Achievement Action Plan. As a result of this process, all teachers understood their responsibilities for getting children to achieve to expectations and helping those who needed additional support.
- > recognising and celebrating evidence that children who had not previously been succeeding were now making accelerated progress

- > listening to and understanding teachers' difficulties and successes with mixed-ability groups
- > using more equipment and visual representations
- > using rich tasks and integrating the mathematics strands across the curriculum.

Implementation of these strategies required the combined efforts of the PLD facilitators, the mathematics support teacher and individual teachers. Together they made a real difference for most of the target children.

At the beginning of the year, 27 Year 5 children were identified as 'below' or 'well below' national standards for mathematics. At the end of the year, six children were assessed as 'below' or 'well below' the relevant standard while 18 were assessed as 'at' the standard and three 'above'.

	February 2016	July 2016
Child A	I don't like maths. I like plusses and take aways. Maths is boring. You just sit and answer things.	I want to learn maths now. I like that there is lots of ways to work things out. Maths is doing problems that might be division, you get your answer by using strategies.
Child B	I don't like maths, take aways, times tables and division are too hard to solve. I want to get better at maths in case I get a job as a teacher.	Maths is more interesting and fun. I like explaining to the group how I got my answers I know that making mistakes is learning. I like working with a group so we can help each other and see what different answers we get. Having a buddy and drawing pictures about my thinking helps me learn to do maths.
Child C	I don't like maths. I find it hard. Maths is adding and taking away numbers.	I feel more excited about maths now. I've learned lots of different ways to do maths. Maths is thinking about how to solve problems, like real-life problems. New strategies, sharing my thinking with others and using cubes equipment help me to learn maths.

As these comments show, the attitudes of the target children to mathematics had also improved:

### Working with individual children and their parents

At mid-year the deputy principal noticed that not enough Year 4 children who had previously been at the expected level were making sufficient progress for the school to meet its targets for mathematics. She analysed the data to determine which children were not progressing, and in which domains. She then took this information to the teachers of Year 4 children and asked for their suggestions on how to address it.

The teachers worked with the deputy principal on strategies to reduce the number of children in the 'below expectations' category by the end of the year. They saw that while the children were generally confident with addition/subtraction and multiplication/division, they were not confident with proportions/ratios. They immediately adjusted their programmes to address this. They also recognised that, when working with the 22 children who were below the expected level, they could increase the impact of their teaching by involving the parents.

> "We contacted the parents and said something like, 'Your child has the potential to reach the standard if we work together.' They wanted to know how they could help. We said we would give the children things they needed to work on, and gave the parents really specific examples of how to help. The parents were all on board and were really pleased we were doing something."

**Deputy principal** 

Before the school holidays, the teachers met with the target children. The children talked about what they needed to do to achieve the expected level and how they could take more responsibility for their learning. The teachers gave the children carefully chosen, manageable mathematical tasks to do at home in the holidays. They made personalised books for the children in which every activity was included for a specific purpose. They didn't want to overload the children so some of the tasks consisted of family games and activities. The children responded really well to the extra mathematics. They enjoyed working with their parents and grandparents. They told ERO evaluators that they were keen to continue during the upcoming Christmas holidays.

"I've been learning lots and lots at school, and lots and lots at home. We did some holiday maths so that we could get onto Level 2. I got a lot of help because some was pretty hard and Grandad said, 'I'll come and help you.' Since I kept practising, I moved up a level. Grandad was really proud of me."
"I got really, really better. It was awesome. You got to learn stuff that was easy but the right level. Everyone got the right level for them."
Year 4 students

At mid-year interviews the teachers shared the children's successes with their parents and outlined next steps.

Leaders established that it was a variety of strategies, not just one thing, which had made the difference for these children. The most effective strategies were:

- > closely scrutinising the achievement data
- > working in partnership with parents
- > being vigilant and working with children every day in a targeted way, breaking down mathematics tasks as required to support their learning.

"Rather than just saying 'this student is below', it was about finding the one or two areas and realising that [success] is achievable. The information was framed to parents as: 'Your child has the potential to get there. If we all work together, we can achieve this.'"

Leaders

TEACHING STRATEGY

12

Adapting ongoing mathematics professional development to foster and sustain improvements

ERO's 2016 report **School Leadership That Works** explains how effective leaders focus on a small number of priority improvement goals that are based on an analysis of student data and information about teaching practice. They analyse how school practices may be contributing to the current situation and consider research evidence about what is effective in raising student achievement. Effective leaders introduce improvement strategies supported by a coherent change management approach that interweaves pedagogical change, organisational change, and the building of leader and teacher capability.

The leaders at **HOON HAY SCHOOL** carefully trialled new approaches before spreading those that were successful across the school. This narrative shares the change management strategies that supported teachers to look deeply into their existing practices and make changes that were necessary for raising student achievement.

At Hoon Hay School the mathematics programme had been a priority for many years. It was, however, only after trying a variety of approaches that led to short-lived achievement gains that leaders and teachers finally introduced strategies that were both successful and sustainable.

### Strategically managing change

Changes to mathematics teaching occurred over many recent years as they trialled and implemented new approaches and strategies.

Year	Actions and approaches
2011	Leaders made use of research to determine the best practices for teaching the most able mathematicians.
	<ul> <li>Two key ideas emerged:</li> <li>What is good for the most able mathematicians is good for all mathematicians.</li> <li>Streaming is detrimental for the majority of students.</li> </ul>
2012	This year was focused mainly on short-term gains.
	Mathematics was the focus of professional learning and development (PLD).
	Lifting school-wide achievement and removing the disparity in Māori and non-Māori achievement were made charter targets.
	Teachers stopped streaming. Each teacher now had a number of target children whose mathematical progress they were responsible for accelerating.
	Mathematics evenings were held for parents.
	By the end of the year, 94 percent of all children and 94 percent of Māori children were achieving at the expected level.
2013	Leaders started an inquiry to answer the question: 'How can we create sustainable, quality mathematics provision that sees all our children succeeding with and enjoying mathematics?'
	Two mixed-ability classes introduced mathematics talk, using different approaches. The effectiveness of the two approaches was then evaluated.
2014	Teachers introduced a mixed-ability, problem-solving approach in Years 5 and 6.
	The introduction of the new approach was supported by teacher modelling and by observations and reflection.
	The approach was the focus of PLD on a teacher-only day.
2015	Teachers introduced the approach to Year 4 children.
	Leaders developed mathematics teaching expectations with teachers.
	A student survey identified that mathematics was the second favourite school subject of seniors (behind physical education).
2016	The school provided release for teachers of Years 1–3 to work with the deputy principal on the new strategies and approaches.
	Year 1 to 3 teachers used some of their classroom release time (CRT) to observe Year 5 and 6 mathematics lessons.

#### **Timeline for change**

From the beginning, the deputy principal played a key role in supporting teachers to change their mathematics teaching practice.

During study leave, she visited other schools and examined research to learn more about programmes for gifted and talented students. It struck her as inequitable that very able children often had much greater opportunities to experience rich and authentic learning and leadership. In some schools, giftedness entitled students to better programmes and teaching ratios, which she considered was a form of elitism.

> Our deputy principal and I found that really hard to understand as we had a philosophy that every child should have a chance to shine. I am always asking, "Who in your class hasn't had a chance to shine?' I'll work with that child. It takes away the hierarchy of learning.

**Principal** 

The deputy principal recognised that, when working with gifted and talented students, teachers focused on what they could do and built on that, but when working with 'bottom' students they tended to focus on what they could *not* do. This meant that some children never got the opportunity to solve real problems or engage in the rich mathematics activities that their gifted and talented peers experienced. To change this, teachers need to promote a 'not yet' attitude when working with target children, so that children habitually tell themselves, 'If I don't get it, I need to try a different approach.'

"A competent mathematician is one who knows what to do when they don't know what to do."

**Deputy principal** 

In 2012 the board of trustees made improving mathematics achievement a target – too many children had 'switched off' mathematics. The school introduced a variety of mostly short-term strategies to help those who were not achieving well. The deputy principal took on the role of mathematics specialist teacher (MST), withdrawing children from Years 4 to 6 for additional mathematics, and the associate principal took extra mathematics sessions with children in Years 2 and 3. The practice of cross-grouping in Years 4 to 6 was abandoned, with the result that all teachers became responsible for teaching mathematics to all the children in their class. Every teacher now had a group of target children to focus on and monitor. Progress was rapid, attributed in part to the extra teaching provided by the MST and the associate principal. The following year the focus shifted from helping children who were not succeeding to improving teaching. The MST worked with groups of children in the classroom so that teachers could observe her practice.

One surprise consequence of dropping the many out-of-class interventions and bringing all mathematics teaching back into the classroom was an initial dip in achievement.

> "As trustees we were shocked. We thought the maths data might drop a bit after we stopped the interventions with children and it did. Then we had to rethink and do something with all the staff and the leaders said we should start with the Year 5 and 6 team."

**Trustee** 

Introducing the best practices that the deputy principal had brought back with her following study leave required careful change management. Leaders decided to work first with teachers of Years 5 and 6 because this would enable them to use the available expertise while not overly extending their ability to grow capacity.

Leaders worked on building teachers' confidence with the new strategies

	otationo naro onangoa
In the past	Best practice today
ilently work through a worksheet' or page of he book	Talk about maths Work collaboratively constructing and sharing reasoning
/ork individually at own esk	Learn with, and from, each other
ocus on the answer – ither right or wrong	Focus on the reasoning and process

before changing too much in the classrooms. They also reviewed their data regularly to see if the new practices were actually working for the children. Finally, they wanted teachers across the school to see the impact and usefulness of the changes. As an overarching aim they were looking to create a climate where teachers would be continuously looking deeply into their practices to determine their impact on children's achievement.

The change management process consisted of seven distinct phases:

- 1. examining the research
- 2. sharing the research and proposed approach and strategies with one teaching team
- 3. trialling the approach and strategies in that teaching team
- 4. examining the gains for students in the trial classes; comparing these with results under the previous regime
- 5. working with teachers to fully implement the approach and strategies across the teaching team
- 6. extending the approach and strategies across the whole school
- 7. setting shared expectations about how mathematics will be taught in the school.

# Trialling and spreading the new mathematics programme

Work with the Year 5 and 6 team began in 2013. The deputy principal shared her research with team members and they discussed what they might be able to trial.

The outcome was a 'maths talk' trial, carried out in two classes. The first class ('the trial group') focused on maths talk and problem solving in mixed-ability groups. The second class, taught by a capable mathematics teacher, was given a more traditional programme in which children were assigned to groups that matched their stage on the number framework.

The mathematics Progressive Achievement Test (**PAT**) was used to measure and compare the progress of the two classes over the year-long trial period, with a movement of two or more stanines being interpreted as accelerated achievement. In the trial class 41 percent of children made a shift of two or more stanines; in the more traditional class 17 percent of children made a comparable shift.

Children in the trial class said they:

- > enjoyed maths
- > liked working in different groups
- > enjoyed the 'maths arguing'
- > listened to each other and addressed their statements and questions to each other.

#### Spreading the practice across the school

After the trial, the data was shared more widely across the teaching team. The deputy principal spent a day with the Years 5 and 6 teachers before the teacher-only day in January 2014. During that day, initial strategies were shared about:

- > talk moves and the importance of giving children 'wait time' to decide on problem-solving strategies
- > prompts and strategies for children who were reluctant to be involved in mathematical discussions
- > managing instructional lessons or workshops where children were invited to join the group lesson, or teachers worked with an intentionally mixed-ability group of children



> selection of tasks with different levels of complexity so that all students have a measure of success and confident mathematicians are fully challenged

- > the need for explicit instruction in problem-solving strategies and the language of mathematical discourse
- > the advantages of collaborative planning and team teaching
- > the case for 'no hands-up' classrooms in which any student can be called upon to explain why their group used a particular strategy and how they arrived at their solution or conclusion.
- > prompts that children can use to reflect on their learning and how they are working with others.

The expectation was established that every member of the team would incorporate two 'maths talk', problem-solving lessons into their weekly programme. Teachers were



ians use 'precise language' so they c maths reasoning and thinkin

supported by the deputy principal, who modelled approaches, observed teacher practice and contributed to reflective discussions and planning.

Throughout the initial trial and ongoing development of the new approach and strategies children were asked for feedback, which was then shared with teachers, board members and parents.

When we spoke to children about their mathematics programme they told us they preferred working in pairs or small groups rather than as individuals.

ERO observed mathematics teaching in three classrooms across the year levels and saw children highly engaged in instructional groups and working in pairs or in small groups.

In a Years 5 and 6 class, we saw children excited about a new problem they had to solve. Before they rushed off to attempt the problem, their teacher reminded them that if it seemed too hard they were to talk and listen to each other, and think about what they already knew that could help them to solve the problem.

The teacher had paired or grouped children with different mathematical abilities as buddies. In one pair a child prompted another to help them recall a potentially relevant strategy. Sophie: Okay Olivia what is 8+6?
Olivia: 14
Sophie: What's 30+14?
Olivia: I can't remember
Sophie: Can you remember how to add tidy numbers or numbers to a 10?
Olivia: Yes, 30+14 is 44.

In other groups, the buddies deliberately extended their thinking as they tried to find different strategies to solve to a problem or used equipment to demonstrate their strategy. Children practised explaining their strategies before returning to the larger group. They clearly understood that everyone would be expected to be able to contribute to the larger discussion. When the children joined the larger group, only two groups shared their strategies but many more contributed to the discussions, by starting with such comments as:

- > can you prove it using equipment...
- > I am noticing...
- > I agree because...
- > I disagree because...
- > they are the same because...
- > they are different because...

The teacher prompted the group to:

- > think about the part their group did first
- > discuss place value further
- > think about what you could do differently if you didn't know 70+50
- > share a different strategy to the one the first pair shared.

Two children told us they liked working with a buddy because being able to talk with each other stretched their thinking. They explained that by working in pairs they could also do more challenging problems and they liked it when the problem was hard.

### Working with parents

At mathematics evenings for parents, school leaders explained the changes that their children were experiencing and the reasons for them. During these parent evenings leaders shared:

- > how their children's mathematics programme was similar to/different from what they may have encountered when at school
- > how to help their children with their mathematics learning at home
- > how to look for mathematics in the everyday environment
- > some of the strategies and visual representations that the children use in mathematics.

They were also shown the useful mathematics link we have shared below.

To help parents understand the different roles their children took on when working in pairs or small groups, and some of the strategies used, they were paired with another parent and given problems to solve. This proved particularly useful for the parents of capable mathematicians, who could see that working collaboratively and having to explain and clarify their thinking for others would deepen their own child's understanding.

As the result of the parents' new enthusiasm for problem solving, teachers started sending a mathematics problem home each week instead of basic facts lists. (Basic facts were, however, still viewed as very important and songs for learning them, together with guidance, continued to be provided on school blogs.) A parent trustee told us that, in their home, they would sometimes have dinner-time conversations with their child about strategies that could be used to solve that week's problem.



#### Why a variety of strategies might be better ...

With the person beside you, discuss how you would solve these number sums.

- Jill has a paper run after school. On the first week, Jill is given 673 papers to distribute after school on te R\u00e4hine (Monday) and te R\u00e4tu (Tuesday). On te R\u00e4hine Jill distributes 498. How many more does she need to distribute on te R\u00e4tu?
- Last week Kevin sold off some old furniture. He sold 6 bookshelves for \$39 each. How much money did Kevin make?
- HHS was preparing for a massive fundraising event. They had 256 replies saying people were going to attend. They needed to seat people equally around 16 tables. How many at each table?

### Ongoing review and development

When ERO visited, the implementation of the new approaches and strategies was still variable across the school. Leaders were continuing to review and develop them to help clarify teaching expectations. Leaders, and teachers had developed a set of agreed expectations for mathematics teaching in their school. They referred to these as their 'must dos':

## How the mathematics and statistics curriculum is taught in our school

The expectation is that all children will have the opportunity to engage in challenging maths tasks, have their mathematical thinking heard and valued, believe in themselves and experience success.

In every class, every day, all children will have:

- > the opportunity to be challenged, to struggle, to persist
- > opportunities to engage in mathematics discourse to clarify their maths thinking and reasoning and build upon other children's explanations
- > a combination of flexible grouping options including whole-class, small-group, pair or individual.

Teachers will:

- > be positive maths role models and use affirming language
- > use formative assessment information and knowledge of the learner to plan their teaching
- > have high expectations of all children
- > develop in children positive attitudes to maths and a willingness to take risks when solving problems
- > provide frequent opportunities for children to use 'maths talk' to enhance learning
- > take account of children's diverse cultural and linguistic backgrounds
- > build school and community partnerships
- > use flexible grouping options to ensure children experience all aspects of the mathematics curriculum
- > use authentic contexts to engage children in maths learning
- > question children to develop a greater understanding of their strategies and thinking.

Leaders acknowledge that the new practices were still developing, especially in the junior school. Leaders and teachers look separately at mid and end-of-year data for Years 1 to 3 and Years 4 to 6. They then collectively determine and document:

- > What they are noticing from the data
- > Things that are going well
- > Things for further consideration
- > Things that will make a difference.

The school's long-term improvement strategy had considerably reduced the need for out-of-class interventions. The shift in emphasis from providing support for children who were not succeeding to improving teaching practice had benefitted more children and was more sustainable.

#### TEACHING STRATEGY



Working collaboratively to develop and implement an agreed mathematics curriculum and consistent, high quality teaching practices

ERO's 2014 report **Raising Achievement in Primary Schools** identified that, in many schools, the processes for reviewing the mathematics curriculum and assessing teaching and learning were not well connected. Some used the same long-term plans each year without analysing or responding to their assessment information. Many lacked a deliberate and relentless whole-school focus on improving student achievement.

This narrative shares what leaders and teachers at **HOKOWHITU SCHOOL** in Palmerston North did to understand, review, develop and introduce a carefully structured mathematics and statistics curriculum. New teaching guidelines synthesised the curriculum strands, characteristics of the **mathematics standards** and aspects of the earlier **Numeracy Projects**. Agreed teaching approaches were established and implemented to provide consistent strategies for children across year levels.

When ERO visited Hokowhitu School, it had recently experienced major leadership, teaching and environmental change. Leaders and teachers had introduced flexible learning spaces, which gave children greater choice about how and what they would learn. Most teachers now worked collaboratively in groups of three in the new spaces, leading workshops and acting as learning coaches. In this latter role they reinforced workshop learning or coached children while their colleagues led workshops.

### Reviewing and developing curriculum content

Leaders wanted teachers to fully understand the learning progressions for Years 1 to 6. Working collaboratively with the professional staff, they developed a set of expectations and practices to be consistently applied school-wide so that when children transitioned from one learning space to another they would know what to expect. They also put in place a policy of moving one of the three teachers in each learning space to a different learning space at the start of each new school year so that they would understand the curriculum requirements at different levels. This policy underscored the importance of teachers knowing what prior learning children were bringing with them.

Leaders and teachers closely reviewed the school's mathematics programme and teaching practice and made many changes as a result. Over a period of three years teachers worked with an outside expert to:

- > look in depth at the knowledge and strategies children should be taught for each of Levels 1 to 4 of the mathematics and statistics curriculum
- > make sure that teachers were confident to teach not only the number and algebra strand of the curriculum, but also the geometry and measurement and statistics strands
- > bring the strands together by integrating number into algebra, geometry, measurement and statistics topic overviews
- introduce the expectation that no child would be classified as 'no good at mathematics' (this has sometimes meant changing parents' own expectations of their children)
- identify, understand, introduce and establish clear expectations about effective teaching practices.

Leaders developed topic overviews for the first four levels of the mathematics and statistics curriculum. Each of the algebra, geometry, measurement and statistics overviews:

- > explained the percentage of teaching time that teachers should allocate to each strand
- > brought together what children should learn by combining detail from the relevant number strategies from the Numeracy Projects and the national standards
- > provided indicative examples of what should be seen and heard in the classroom.

The overview included progressions for Levels 1 to 4. The Level 1 overview called for investigations that focus on 'all about me', which children would do as a class. The Level 4 overview called for investigations that required multiple displays and analyses of data on relevant newsworthy issues.

The excerpt below shows the progressions from Level 2 and 3 statistics overview.

Level 2 In class you will see and hear:	Level 3 In class you will see and hear:		
Statistical investigations about my class/my school, as groups or individuals following teacher model	Statistical investigations about our community		
<ul> <li>Vertical and horizontal bar graph</li> <li>Strip graphs (bars end to end)</li> <li>Pie graphs from strip or cubes and string</li> <li>Pictograph 1:2 or 1:5 or 1:10</li> <li>Single dot plot</li> <li>Present and interpret data in table format</li> <li>Mark axis in ones/twos/fives</li> <li>Include key where appropriate</li> <li>Use a sample</li> <li>Collect data before deciding on presentation</li> </ul>	<ul> <li>Multiple bar graph (vertical or horizontal)</li> <li>Line graph (to join continuous data)</li> <li>Stem and leaf</li> <li>Scatter plot</li> <li>Dot plot – back to back</li> <li>Pictograph (1 to many)</li> <li>Present and interpret data in table formats</li> <li>Mark axis in chunks</li> <li>Use lots of number data</li> <li>Ask/present own survey question</li> <li>Use the enquiry cycle independently</li> </ul>		
Statistical Literacy	Statistical Literacy		
<ul> <li>Accurate transfer of data to presentation</li> <li>Present same data two ways</li> <li>Identify best categories</li> <li>Identify the most appropriate axis marking</li> <li>Mark even lines – not spaces</li> <li>Talk about most/least from combined bars</li> <li>Discussion of obvious outliers and clusters</li> </ul>	<ul> <li>&gt; Choose own (appropriate) data display</li> <li>&gt; Numerical analysis using fractions</li> <li>&gt; Range, spread, average, outliers and clusters</li> <li>&gt; Inferences, predictions and trends beyond literal statements of the raw data</li> <li>&gt; Evaluate statements others make about data</li> <li>&gt; Present same data several ways</li> </ul>		
Probability	Probability		
<ul> <li>&gt; Likely, certain, possible, impossible, maybe, almost always</li> <li>&gt; 'Shades of grey' statements</li> <li>&gt; Find possible outcomes (tree diagrams)</li> </ul>	<ul> <li>Certain, good, even or poor chance, possibility, impossibility</li> <li>Fair testing</li> <li>Interpret frequency tables</li> </ul>		
<ul> <li>&gt; Find possible outcomes (tree diagrams)</li> <li>&gt; Order events – flow charts</li> <li>&gt; Use unequal spinners, cards and dice</li> </ul>	<ul> <li>Find possible outcomes (tree diagrams) – discuss with simple fractions</li> </ul>		

While the overviews unpacked the mathematics and statistics achievement objectives from **The New Zealand Curriculum** it was not intended that they be used as assessment checklists. Rather, leaders saw them as a means of ensuring that all children experienced the whole curriculum and as a tool for increasing teachers' content knowledge. By describing which **mathematics standards** related to each of algebra, geometry, measurement and statistics topics, the overviews provided a range of opportunities for teachers to make overall teacher judgements in relation to each of the mathematics national standards. Although the overviews took time to develop, leaders considered it was time well spent to ensure that teachers fully understood how children's mathematical learning should progress. Equally important, the overviews would help ensure that children were exposed to the full curriculum and experience less repetition of already-familiar concepts. The overviews encouraged high expectations and provided a wide variety of content to keep children engaged and achieving.

### Outlining expectations about teaching practice

#### Instructional strategies include:

- > Using a context (story word problems)
- > Modelling
- > Class starters
- > Teacher think alouds
- > Use of the most appropriate equipment
- > Grouping (ability and flexible)
- > Rotations
- > Discussions, sharing and justifying.
- > Deliberate acts of teaching
- > Making explicit links between mathematics and real life

In addition to the overviews, the school's leaders also developed additional teaching guidelines they called 'essence statements'. For mathematics, these statements highlighted:

- > what should be present in the learning environment
- > what teachers should know
- > what the learning space programme must include
- > instructional strategies to be used
- > what teachers should say and do
- > what effective pedagogy looks like.

#### Successfully implementing new approaches

We observed mathematics lessons at different year levels where children were working in a mix of mixed-ability and streamed groups. Leaders told us that they were gradually moving to mixed-ability groups, and that, from 2017, all children would be in mixed-ability groups for at least part of their programmes.

In the Year 4 to 5 learning space we observed two workshops being led by two teachers while the third worked with individual children, checking, carifying and encouraging their efforts. Children had selected which of the workshops they

would attend based on what they believed they needed to learn. The workshops had short, specified timeframes. The teacher leading the workshop either demonstrated strategies or got children to demonstrate and explain their use of a strategy. Teachers also encouraged those who were still developing the confidence share their ideas to verbalise their thinking to the group.

Our mathematics programmes are enriched through the use of rich tasks that support open-ended thinking skills and the key competencies

The tasks include:

- > Using a context (story word problems)
- Thinking with what you already know (link to numeracy knowledge and strategies)
- > Connected concepts (cross-strand mathematics)
- > Problem solving (using multiple strategies, approaches and tools
- > Investigations
- > Cross-curricular links

**Class starters** are used for 'front loading' and 'backfilling' of key concepts, strategies and strand-based teaching. The purpose of starters is to ensure students are exposed to a variety of types of questions and thinking tasks.

Monday: Modelling using different types of equipment

Tuesday: Tick a box (multi-choice)

Wednesday: Word problems

Thursday: Thinking skills problem solving/application

Friday: Fast and furious – quickfire questions.

The children not in the workshops were highly engaged in activities that they were working on either independently or in pairs. They had been given nine activities on 'must do' sheets and were required to complete four. The sheets were designed for four different ability levels. Some children told us they were striving to move up to a harder level.

Some children were very aware of and supportive of others near them. One asked the girl next to her if she needed help, and the two then worked together to solve the problem. Some children were accessing world population data on digital devices as an authentic activity to practise comparing very large numbers and sorting them into numerical order. All were motivated and keen to make progress.

As a result of collaboratively reviewing and developing their mathematics and statistics curriculum, the leaders and teachers of Hokowhitu School had ensured that their students came into the upper primary school well set up to progress, confidently apply strategies to solve problems, and achieve.

TEACHING STRATEGY



ERO's June 2010 report **Promoting Success for Māori students: Schools' Progress** highlighted the importance of good classroom teaching and better relationships for raising achievement expectations and enhancing outcomes for Māori students.

The students at **ROSCOMMON SCHOOL** are mostly Māori and Pacific; historically, many had experienced little success with mathematics. Teachers enjoyed good relationships with the students but realised that this was not enough: they needed to start expecting more of them mathematically. They saw that it was only by changing and/or improving their teaching practices that they were going to raise mathematical achievement.

This narrative describes how the school improved the effectiveness of its mathematics teaching with the support of an extensive professional learning and development (PLD) programme. We show how the leaders worked with the external providers to ensure that the PLD matched the strengths and needs of teachers, and how they monitored what was and was not matching a teacher's needs or working for children. Finally, we share observations from mathematics lessons and include children's perspectives on the strategies they had been newly introduced to.

In discussions about classroom practice, leaders and teachers agreed that they wanted to put in place teaching practices that would more effectively engage students in problem solving, deep thinking and learning. These aims were to become major emphases in a redevelopment of the school's mathematics programme.

### Identifying children's and teachers' development needs

During staff meetings leaders asked teachers to look at mathematics achievement data and identify children's strengths and weaknesses. They were then asked to think about possible reasons for the weaknesses they had identified. This challenged teachers to think about how their own teaching practices could be a contributing factor in underachievement.

Careful scrutiny of the data revealed that, while some parts of the **number strand** were evidently well covered, many children had little understanding of geometry, fractions and algebra. Teachers revealed that these topics were in their long-term plans, but often near the end of a term, so they would run out of time to teach them.

Sensitive questioning by leaders supported teachers to think more deeply about their practice. Many had the courage to recognise that they had not been taught mathematics well themselves and, as a result, avoided some parts of the curriculum or rushed through concepts without appreciating connections that children needed to make for their future understanding. Following honest and challenging discussion, teachers and leaders identified three priorities:

- > Teachers needed greater content knowledge to understand the learning progressions for the whole mathematics curriculum.
- > Students needed greater opportunities to experience the whole curriculum and to engage in problem solving, deep thinking and learning
- > Mathematics teaching and learning had to happen every day to ensure that no parts of the curriculum were left out.

# Accessing relevant professional learning and development

To improve mathematics achievement, the school applied for Ministry-funded PLD in numeracy. An associate principal, who had previously participated in Accelerating Learning in Mathematics (**ALiM**) PLD, argued what was needed was more intense, school-wide PLD that would simultaneously strengthen both content knowledge and pedagogical knowledge.

The leadership team worked closely with the external provider to ensure that the PLD would promote culturally responsive pedagogies. They discussed the strengths, needs, sensitivities and preferred ways of working of the different teachers, as well as cultural considerations to be kept in mind when working in a school with Māori and Samoan immersion classes. They stressed the importance of knowing the teachers as learners, just as teachers are expected to know their students.

"We had to build a trusting relationship with the PLD provider. We knew that it had taken a lot of courage for so many of our teachers to reveal that they weren't confident with mathematics so we wanted them to be supported to learn rather than be embarrassed by their knowledge gaps. Group work was key so teachers could use their combined knowledge to solve things and they could see how their children might like to learn in their classes."

"The first time the facilitator put a maths problem on the white board, almost everyone looked away. You could see that they didn't want to be chosen to answer it in front of their colleagues."

Leaders

In team and staff meetings, maximum time was spent on collective inquiry into the effectiveness of teaching practices. Teachers collaboratively analysed their student achievement data to see the impacts of their changes. They discussed the strategies they used that were working or not working for children.

Many staff meetings and teacher-only days became mathematics workshops for the whole staff. To meet the teachers' extensive content needs some workshops were held during the weekends or holidays. The PLD put the teachers in their students' shoes as they worked together to solve mathematical problems. They were shown strategies and approaches they could master and then use with the children. In time, mathematics leaders and school leaders were able to take some workshops without the help of external experts.

School leaders closely monitored the teachers' progress and confidence. At the end of each PLD session or workshop they discussed with the providers what was working and for whom, who was disengaged, what needed to change, and what the next steps were for teachers. This helped ensure that all teachers were getting to grips with the new strategies and approaches.

This practice of debriefing was also observed after sessions facilitated by teachers or school leaders. An algebra workshop led by school mathematics leaders highlighted for them some of their own less successful teaching practices. "It is interesting watching and being the learner in the workshops because we learn about content and teaching practices. Even last night, when we had a maths workshop as a staff, my own behaviour taught me something about how my students may feel. We looked at a problem and I had worked out a different way to solve it. I was just about to show my group when the teacher running the workshop came and told the group my different way. I almost felt angry because it was the way I was going to show and I didn't get the chance. It taught me about 'wait time' and resisting interfering too early when my kids are working on a problem."

Teacher

In the whole-staff workshops the teachers practised voicing their thinking, asking questions and expressing their ideas in mixed-ability groups – the very skills they wanted the children to develop.

Teachers did the bulk of their PLD as a whole staff, in their teams, or in house groups that included teachers from across the year levels. In staff meetings they were able to workshop new content and approaches. In team meetings they were able to reflect on and respond to assessment information. In house groups they were very aware of what had gone before for the students, and what they learned next.

#### **Developing Mathematical Inquiry Communities**

The PLD was also designed to give teachers the capabilities to develop **mathematical inquiry communities** (MICs). In MICs, children work in mixed-ability groups to discuss, negotiate and solve problems. Like the reading PLD that Year 5 and 6 teachers were already engaged in, MICs emphasise voicing thinking, asking questions and expressing ideas – pedagogies the teachers were keen to explore further.

The fact that the mathematics PLD involved a major financial commitment made leaders even more determined to make sure it would have a positive impact on achievement.

Leaders carefully managed the two different types of mathematics PLD occurring at the same time. In practice, this meant varying the time and resources allocated to the one or the other. While focusing on learning about the MIC approach, teachers would put less time and energy into building content knowledge.

Leaders and teachers elected to keep some of the practices that had been used previously. These had to be justified on the grounds that they were working well and having a positive impact on achievement. "We still do warm ups at the beginning of a lesson as a quick revision and sometimes we do rotations, where kids go to every teacher in the team. At first, the facilitator didn't like that but when we explained why we wanted to do it they said it was OK."
 "When we had done some work on fractions we checked how the kids were going and saw that many still didn't understand fully. So we went back and did more workshops and only gave them two problems to solve a day in their mixed-ability groups. We will see how that works."

Children learning mathematics through the MIC approach told us they understood what their friends knew and didn't know. They saw each other as learners and valued the opportunities to work together with other children. When solving mathematics problems with a buddy, they were happy for the teacher to come to them and help at times when they were at an impasse and needed 'just in time' teaching.

ERO observed a lesson where Year 3 and 4 children were working in twos or threes to solve problems. One group was working out how many containers they needed to make 18 cups of smoothies when their container held four and a half cups. When children felt they had an answer, others in the group reminded them to share what they did with the others.

The children explained they were still learning how to share and ask questions of each other and they showed us cards they had to help remind them (shown below).

They also told us they have to take responsibility for understanding things. "We have workshops and if you don't understand, you stay on the mat. The teachers will explain it again or get us to explain what we understand and then go over it with us."

Children explained the norms they practise every day. "We talk about how we did with it at the end of the lesson so you have to keep it in your head. Today's norm was 'when someone is talking we give them our full attention'."

Reminder cards the children used to help them question their peers.

- > I agree with your answer because ...
- > My strategy is the same as yours because....
- > Could you explain it another way...
- > So what I hear you are saying is...
- > I don't understand...

In another classroom, children told us they understood the teacher was there to help them with their learning. They also knew that their peers were there to help them and that they were there to help their peers. Teachers encouraged these mindsets by avoiding immediately offering solutions, asking children to explain their thinking so far, and reminding children to listen carefully to the ideas of others in the group. "I like explaining to others if they ask. This helps me understand and helps the other person."

> "Everyone is good at maths 'cause we work to their standard. They take risks and never give up. Our teacher encourages us to keep trying."

"If I don't understand I ask a question. I don't feel embarrassed."

"Teachers care about your learning. They want us to move up to a higher stage and want us to be at a better standard. They tell us to never give up – it doesn't matter if the answer is wrong as long as we have given it a go."

Year 5 and 6 children

When we visited the school, teachers were still consolidating new strategies and practices but many changes were already evident. Long-term overviews had been modified to make sure the children experienced the full curriculum. Concepts and skills that the children found hard to grasp with confidence (for example, fractions) were now taught several times during the year. Teachers varied the amount of direct instruction and ran workshops to address specific gaps while making sure the children had frequent opportunities to solve problems in mixed-ability groups.

TEACHING STRATEGY

Improving children's mathematics learning and achievement through the use of flexible, multi-ability grouping of children

ERO's February 2013 report **Mathematics in Years 4 to 8: Developing a responsive curriculum**, found many schools used practices such as ability grouping within and across classes without any evidence they improved outcomes for children. Research shows this particular practice seriously disadvantages those who find themselves in lower groups. Such children typically find themselves shut out of much of the curriculum, lose confidence in their ability to be learners of mathematics, and acquire deeply negative attitudes towards mathematics.

Teaching teams at **SELWYN RIDGE SCHOOL** undertook annual inquiries directed at improving teaching practices. Two teachers researched the impacts of ability grouping compared with the impacts of flexible, multi-ability grouping on teacher practice and children's learning. As a consequence, they decided to trial multi-ability grouping in their classes. Children self-selected the difficulty level of the problems they would undertake and used digital devices to access the resources they needed for working independently or in groups.

This narrative describes what ERO saw in one of the two classrooms during a mathematics lesson. Some of the children's perspectives are also shared.

The need for an inquiry became apparent when an analysis of data identified that mathematics achievement in Years 4 to 6 left a lot to be desired. Two of the teachers decided to work together (the children in their classes had similar needs) and put their own teaching practice under the spotlight.

One issue that they identified was that the way they ran their groups gave them little time to work with individual children. After reading research that highlighted the advantages of multi-ability mathematics groups for both children and teachers, they decided to trial multi-ability groups for themselves.

### A multi-ability mathematics lesson

We observed one of the teachers teaching a lesson to her Year 4 students, with 'time' as the focus. At first the students sat together on the floor doing small, hotspot revision activities and problems similar to those they may have encountered in earlier group or independent work.

The teacher then introduced the day's activities and asked the children to select the difficulty level and decide whether they would work on them independently or in a group. To cater for a range of capabilities the teacher had prepared 'packs' at three different levels of difficulty, ready for the children to download to their digital devices.

- 1. The teacher explained that the first pack was quite challenging and then used her device to provide a preview of the contents. The problem solving activities in the last section were the most challenging, she pointed out.
- 2. In previewing the second pack the teacher explained that it was easier than the first but also had some potentially challenging problem solving at the end.
- 3. The third pack was for children who still felt they needed help with telling the time. It contained no difficult problems.

The teacher asked the children to decide what pack they should attempt and then download it to their device. They rushed to do this. The teacher did not initially screen or try to influence the children' choices – each child was trusted to make the right decision. Some went off to work alone and others chose to work in twos or threes.

While the children were engaged with the tasks, the teacher spoke with or worked with individuals. On a clipboard she made notes about each child's learning. She suggested to one child that he should try a harder level.

The ERO evaluator checked which of the three packs the children had selected. About half had selected the most challenging pack; the others had selected the second-level pack. None had selected the easiest pack.

We noticed that after about 10 minutes fewer children were working alone. As they reached the more challenging problem-solving activities they gravitated together to solve them. All discussions focused on possible strategies and solutions.

### Children supporting each other to learn

Their teachers had clearly taught the children strategies to use when someone asked them for help: they were there to help their peers learn, not give them the answer.

The ERO evaluator observed a child who had been working alone suddenly go to another boy. He put his device in front of the boy, who was working with a friend, and said, "I'm stuck". As the boy was reading the problem, his friend reminded him that he was to help but not give the answer.

The boy thought for a while and then the conversation went like this:

Boy teacher: "Don't you understand what quarter of an hour is?"

Boy student: "No."

**Boy teacher:** "Okay, we can use my watch." He grabbed the boy's hand and made his finger touch the watch. "Can you start at the 12 and go a quarter way round?"

Boy student: "Yes, here", as he pointed to the 3 on the watch face.

**Boy teacher:** "OK, now touch every number and count in 5s". He took the boy's hand again and made him touch the digit while he said 5, 10, 15. Then he said "Do it again and you count in 5s this time."

Once the boy student had done this twice, the boy teacher asked how many minutes were in quarter of an hour. The boy student answered, 15, at which the boy teacher said "Off you go", and went back to working with his friend.

### Impacts for children

We talked to the student who had made most progress since the introduction of multi-ability grouping. He said:

"I used to be on stage 3 but now I am on stage 5 where I am supposed to be. Last year I was in the bottom group and that made me a little bit sad. This year's maths is really cool. You can challenge yourself and that is fun. We have mixed groups and that is cool. I also ask my friend sometimes because he knows how to help me."

Another child said he liked maths because he was not in a group. Before, when he was, he felt he didn't have enough time to practise; he was either rushing to finish something after mat time or waiting for the teacher.

End-of-year **GloSS** testing showed that many children had benefitted from the shift to learning in multi-ability groups (see chart below).



#### Bar graph showing Room 10 students end of year Gloss stage from 2015 to 2016

TEACHING STRATEGY

Supporting children's developing confidence with mathematics by establishing educationally powerful connections and relationships with families

New Zealand research shared in the School Evaluation Indicators: Effective Practice for Improvement and Learner Success identifies the benefits for children when teachers and leaders form educationally powerful partnerships with parents, families, whānau and communities. Such partnerships increase the range of resources available to support the learning of children; they enhance outcomes for all children, but especially those at risk of underachieving. Partnerships have the potential to achieve large positive effects for academic and social outcomes.

When **EAST TAIERI SCHOOL** leaders signed up for the Ministry of Education's ALiM (Accelerated Learning in Mathematics) intervention, leaders decided to start with small groups of children and then extend effective practices across the school.

By working with parents and situating mathematics learning in engaging and authentic contexts, teachers found they were able to accelerate the children's progress. The children gained the understanding and skills to fully explain their mathematical reasoning to peers, teachers, parents and whānau.

As a first step in the redevelopment of the school's mathematics programme, leaders released a specialist teacher from her normal class duties for a year to teach small groups of children. This teacher also worked with other teachers, provided advice about individual children, and led a learning team that met once a term to discuss curriculum development, learning progressions, and possible changes.

### Working with parents and whānau

As part of the ALiM intervention, teachers aimed to involve parents and whānau in authentic mathematics learning with their child. They were able to build on existing practices such as mathematics evenings for parents where the children ran some of the sessions.

"We run a maths evening every second year for our school community. It is very successful in terms of participation. We always have a large crowd: about 75 percent of our school community come. We have about six to eight children from our classes running knowledge or strategy examples sessions. If you have the children running it and doing the teaching, you get the parents. The children also value the leadership opportunities gained through displaying their skills to the adults."

"We transform our large shared space into junior, middle, and senior maths areas so parents and children can come to the evening and see the progression of our programme. They can see the foundations in the junior school and then the progression through the stages. They see the equipment used at different levels and how this is supported by the use of computer programs or apps."

Leaders

Teachers met with the parents of children who were selected for the intervention before, during and following their involvement.

Every second Friday the children in the intervention, together their parents, came to a Breakfast Maths session. Here, the children shared their progress and the strategies they were learning over a shared breakfast. By the end of the 10 weeks the children were able to explain to their families what they were doing and why.

At the conclusion of the intervention the teachers met with each child and their parents to try and ensure that the progress made would be sustained.



Children explain their maths strategies to parents at a Breakfast Maths session

They shared with the parents what the child had learned by way of knowledge and strategies, and gave them a toolkit of ideas to use.

### Engaging in authentic mathematics tasks

The children in the intervention group also went on a 'Maths Big Day Out', where, with their teacher, they visited parent workplaces to see mathematics in action. One parent was a builder; others worked in a café, the Post Office, the library, a supermarket and a travel centre. The children learned, for example, about the cost of sending mail, how to make and follow budgets, the importance of making a profit so you can pay the bills, how to design a holiday, and how library books are arranged.

Later the children used some of what they had learned from the visits to plan and run a cake sale to raise money for a child requiring expensive medical treatment. This involved:

- > conducting and analysing the results from a survey to find out what people would buy from a cake stall
- > calculating costs, price and profit
- > designing and constructing cones for popcorn
- > measuring ingredients, packages for small items, and the amount of popcorn required to fill a cardboard cone
- > handling money and giving change.

The cake sale was very successful and children were proud of their work. They liked counting the money into piles of tidy numbers as a first step to determining profit.

At the start of the intervention all the children had been achieving below the expected level. By the end of the intervention seven of the eight were achieving at the expected level.

# Developing children's confidence to share their strategies and learning

The teacher also undertook a mini inquiry while working with a small group of six children, in class, for five to 10 minutes, four times a week. Finding that three of the children were reluctant to share their ideas and that the others needed to slow down and think, she decided to introduce them to the '*talk moves*'. She began by going through each of the moves, explaining it and giving examples. This helped the children understand the complexity of the problem-solving process. They saw that they needed to take time to work out and explain their thinking. It also helped them to slow down, process the problem, and then decide which strategy they should try to solve it.

The teacher made a set of prompt cards for the children, to remind them of questions they could ask and ways they could share their thinking. These increased their confidence and gave them a wider range of strategies to use.

By using the cards the children provided insight into their thinking and areas of confusion. Over time the teacher found she was prompting the children less and less.

The teacher used other visual prompts to help the children approach problems. Three that proved useful were:

- > Read the question carefully. What is the important information?
- > Understand the question. What do you have to find out?
- Choose the right operation and strategy for your calculation.



Teachers could see that children who did not normally have the confidence to participate in group discussions were now wanting to share their thinking. Those who needed to slow down were using '*talk moves*' cards to check their ideas and solutions. The children were also more engaged. Instead of simply accepting that their answer was correct they wanted to explore why and to look at their methodology in greater depth.

As the children were learning to engage more in group discussions at school they were also acquiring the language and confidence to explain their mathematical reasoning to their parents. As a result, parents became better placed to help their children apply mathematical strategies in the context of the home.

#### TEACHING STRATEGY

07

Giving students explicit instruction about learning strategies helped them take control of their learning and developed their self-efficacy

ERO's February 2013 report **Mathematics in Years 4 to 8: Developing a Responsive Curriculum** found that many innovative schools had focused on inequity in student achievement. These schools had recognised the need to do something differently to improve outcomes for those who were not achieving well.

The leaders and teachers at **MARIST SCHOOL MOUNT ALBERT** reduced inequity by abandoning the practice of streaming Years 4 to 6 children based on their perceived mathematics ability and by supporting them to understand the strategies they needed to take greater control of their own learning.

This narrative describes the reasons for the changes and key actions taken by leaders and teachers. It also describes how digital apps were used to reinforce the children's mathematical learning and build their confidence to solve problems.

Over the past few years the teachers at Marist School, Mount Albert, have significantly changed how they teach mathematics. Most importantly, they have moved away from cross-syndicate streaming and have focused instead on increasing understanding through greater engagement and by teaching children to share their mathematical thinking. Many children now go on to achieve well in mathematics, particularly by the time they reach the end of Year 6.

### Introducing mixed-ability instruction

Following the arrival of the current principal teachers of Years 4 to 6 reviewed their mathematics programme and decided to drop the practice of cross grouping. Each teacher then taught mathematics to their own students, organised into in-class ability groups. It became clear to the teachers, however, that no matter how the bottom group was labelled, the children always knew it was the bottom group.

A significant percentage of Year 6 children were working below the expected level for mathematics, and nothing was happening to change this. Concerned, one teacher asked her students to complete a survey. The responses clearly showed the negative impacts of ability grouping. Many of the students had been in the lowest class or group for a long time and had acquired very negative attitudes towards mathematics. They admitted that they avoided doing anything that looked difficult.

To address her students' underachievement and negativity the teacher decided to focus on building the children's self-efficacy by increasing their number knowledge. She found that ideas encountered recently in **Growth Mindset** PLD were very relevant.

"Our principal had the bigger picture about maths grouping and what our grouping was doing for our children and wanted us to have more flexible grouping, where children could learn from each other or could participate in a teaching session targeted at what they needed to learn. We tried it and the sun continued to rise and the sky did not fall. The lowest kids made the most progress as they now had a more positive attitude to maths."

Teacher

Another teacher told us how she had been challenged to abandon the practice of putting her Year 5 to 6 class into ability groups for mathematics. With encouragement, and despite her misgivings, she moved to having the children work in mixed-ability pairs or groups and was astonished at how well they progressed. At first she thought that only those who had been in the lower groups would benefit but she found that even the most able mathematicians progressed because they were thinking more deeply about their strategies and searching for alternative ways to help their peers.

### Helping children to understand their learning

Teachers subsequently gave children increased opportunity to explore and understand the strategies they were using to solve mathematics problems. They introduced modelling books and reference charts that they developed collaboratively with the children.

Children negotiated success criteria for each lesson with their teacher, who recorded them on a chart. They then worked in mixed-ability pairs to solve a set of problems before coming back together to share their strategies and solutions. ERO observed that as the children worked they would refer back to the chart to see if they had met all the requirements. They understood that, to be successful, each partner had to be able to explain their solution and justify their reasoning.

Teachers developed the children's confidence with new strategies by having them teach their peers. In one classroom, the teacher asked six children who had completed problems without checking to teach some of the other children. It helped the six to have to think more deeply about what they were doing, listen to other children and try different strategies. The students took risks and used their errors to improve their learning when working in pairs or small groups.

form 2 2 1 WALHT use the written WHEN it is efficient ! "Show Me" to teach Using How will we know we've helped someone to understand written form of multiplication? We need to ~> \*tell why you \* talk about GII (I.A) Call the tens) Ploce volve . SR, S.C.S) why and how help (Ew) (7x8 10x8) why you and place



Children use the charts to see if they have met the success criteria

#### Using digital technologies

ERO observed children making good use of **Show Me**, an app with a voice-recording facility, to demonstrate their mathematical thinking. To extend the students' use of this tool the teacher showed the class a **YouTube** clip of another class using the app. The children had been experimenting with the app and had been able to discover many of its features for themselves, which reinforced their self-confidence as explorers and discoverers.

They told us they liked using ShowMe because when they were writing their problem-solving steps down they didn't have to try to keep them all in their head. The others in their group could see the steps too.

The move away from ability-grouping, along with deliberate teaching about applying strategies, considerably improved the children's attitudes towards and success with mathematics.

#### TEACHING STRATEGY

80

Undertaking an inquiry to build and extend teachers' mathematics teaching capabilities

ERO's July 2012 report **Teaching as Inquiry: Responding to Learners** found that, although many teachers were engaging in classroom-based inquiries, they were less likely to reflect moment by moment on how changes to their teaching practice were impacting on learning, or to adjust them accordingly.

Four teachers at **WAIPAHIHI SCHOOL** undertook inquiries into practices designed to accelerate mathematics achievement. They used a variety of strategies to improve their teaching approaches and outcomes for children.

In this narrative we describe the strategies that the teachers introduced and the children's responses to them. We also describe the processes used by the teachers for reflecting on and responding to the emerging outcomes. The collaboration between the four teachers enabled the practices to spread more widely across the school.

In Waipahihi School well over 85 percent of students meet the expected level for mathematics by the end of Year 6. This result follows improvements that can be attributed to the school's recent involvement in Accelerated Learning in Mathematics (ALIM) professional learning and development (PLD).

As part of their involvement in the ALiM PLD, four teachers undertook an inquiry into how they could accelerate the progress of some of the students in their classes. The target group for the intervention consisted of 20 children from across the four classes. Each teacher worked with their group of target students in the classroom for 30 minutes four times a week. By the end of the 11 weeks of the intervention all but two of the students had made considerable progress.

To accelerate achievement, two of the teachers introduced peer mentoring while the other two concentrated on increasing the children's ownership of their own learning. The teachers also explored ways to extend the use of visual aids and other technologies in their mathematics programmes.

### Increasing children's ownership of their learning

In the two classes that were working on peer mentoring, teachers used multi-ability pairs or small groups to ensure that each target child always had the support of a more confident peer, plus access to more sophisticated strategies. Simple measures such as requiring the two children to use only one book, worksheet or device meant they got used to working together and developed a shared sense of responsibility for the learning. As the children began to rely more on each other, teachers found they had more time to notice where children were succeeding and where they were confused.

To enhance the target students' ability to engage in mathematical discourse, the four teachers introduced them to the five 'talk moves'. Using this tool, the students sharpened their ability to think mathematically, explain their mathematical ideas and seek clarification of others' ideas. The teachers asked the children to repeat and rephrase each other's thinking to show they were actively listening. The teachers found that, by increasing 'wait time', they could reduce the anxiety experienced by children when asked to explain their reasoning or solve a problem. The children learned that they could not opt out of mathematical discussions when in a larger group with the teacher, so they listened more closely to their peers.

The peer mentoring worked well for both the target children and their mentors. At the end of the intervention the target children said they liked being taught strategies by their peers because they found it easier to understand their language. The mentors said they felt more confident to explain their ideas and strategies to others, and by the end of the intervention were enthusiastically offering to 'be the teacher'.





Children get direct instruction from online resources before working with teacher or peers

#### Using visual prompts and other technologies

Teachers used visual prompts such as sentence starters to explain a process that reminded children of the discussion and mathematical strategies to apply.

Using the 'flipped learning' principle, the teachers trialled making instructional videos available to students online. They found the website **www.teachertools.co.nz** to be a valuable source of videos that explicitly explain different mathematics strategies. The students would watch the selected videos before the lesson and then apply what they had learned in class with the teacher.

The teachers found apps such as **Explain Everything** and **Maths Shake** useful for getting children to identify the steps in a solution, manipulate digital materials and record thinking. The playback function was particularly useful when it came to reflecting on recent learning.

### Improving teaching practices

Early in the ALIM PLD the four teachers had formed an inquiry team, with the intention of meeting regularly and sharing their reflections. However, they had not always found time to meet. They knew they had to increase the level of collaborative activity and do more to sustain collective decision making.

In the second year, leaders gave them two hours of classroom release time every fortnight so that they could meet to plan and reflect. The team used the **Effective Pedagogy in Mathematics/Pāngarau Best Evidence Synthesis** to inform their changing practice, focusing particularly on the use of mathematical language and the implications of the 'ethic of care' principle. Over time the emphasis of their discussions shifted from their teaching to the children's learning.

The four teachers regularly communicated about changes they had observed in the children and about inquiry processes that had benefitted their learning. Prior to their regular meeting they would do short, formal observations that they could share with their colleagues.

Over the two years of the intervention, the level of collaboration, an integral part of the inquiry process, increased. Supported by regular coaching conversations, the teachers were able to:

- > plan effectively for their target group
- > guide each other through the challenges
- > reflect on their own professional learning.

Following the end of the ALiM intervention, the number of teachers working collaboratively in pairs to look at data and reflect on their teaching practices continued to increase across the school. With the encouragement of school leaders, '*talk moves*' and learning buddies in multi-ability groups became widespread classroom practices.

As they redeveloped their mathematics curriculum, the teachers looked closely at what they believed and whether their actions were consistent with their beliefs. If they noticed misalignments, they investigated how they could change their practice. Leaders also asked the children what they felt their teachers did that helped them with their learning. The end result was a curriculum that promoted more authentic learning and which was more seamlessly connected to the other learning areas of the curriculum.

By improving how teachers worked together and inquired into their teaching practice, the ALIM PLD improved outcomes for students.

# Linking the narratives to ERO's School Evaluation Indicators

The table below cross-references the eight narratives to the relevant indicators from ERO's **School Evaluation Indicators**. Leaders can use the table to facilitate discussion about the variety of effective practices found in the different narratives. Where leaders, teaching teams or teachers are currently focusing their attention on a particular domain, they can use the table to select narratives that feature effective practices in that domain.

Domain	School evaluation indicators	Narrative
Stewardship	The board scrutinises the effectiveness of the school in achieving valued student outcomes	2
Leadership for equity and excellence	Leadership collaboratively develops and pursues the school's vision, goals and targets for equity and excellence	1, 2
	Leadership ensures effective planning, coordination and evaluation of the school's curriculum and teaching	3, 4
	Leadership promotes and participates learning and development	1, 2, 3
	Leadership builds collective capacity to do evaluation and inquiry for sustained improvement	1, 2, 4
	Leadership builds relational trust and effective collaboration at every level of the school community	3, 4
Educationally powerful connections and relationships	School and community are engaged in reciporocal learning-centred relationships	1,
	Communication supports and strengthens reciprocal, learning-centred relationships	1, 2, 6
	Student learning at home is actively promoted through the provision of relevant learning opportunities, resources and support	1, 6
	Community collaboration enrich opportunities for students to become confident, connected, actively involved, lifelong learners	6

Responsive curriculum, effective teaching and opportunity to learn	Students learn, achieve and progress in the breadth and depth of <i>The</i> <i>New Zealand Curriculum</i>	3, 4
	Students participate and learn in caring, collaborative, inclusive learning communities	5, 6, 7
	Students have effective, sufficient and equitable opportunities to learn	1, 2, 3, 5, 7
	Effective and culturally responsive pedagogy supports and promotes student learning	1, 2, 3, 4, 6
	Assessment for learning develops students' assessment and learning-to- learn capabilities	3, 8
Professional capability and collective capacity	Systematic, collaborative inquiry processes and challenging professional learning opportunities align with the school vision, values, goals and targets	2, 5
	Organisational structures, processes and practices enable and sustain collaborative learning and decision making	1, 2, 3, 4
	Access to relevant expertise builds capability for ongoing improvement and innovation	1, 2, 3, 4, 5, 8
Evaluation, inquiry and knowledge building for improvement and	Collective capacity to do and use evaluation, inquiry and knowledge building sustains improvement and innovation	1, 2, 5, 8



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