

The New Zealand Curriculum

Update



In this issue:

02

Mathematics learning:
Three tiers of support

06

Materials to support accele-
rating learning in mathematics

08

Meeting diverse learning needs
in mathematics

Welcome to *The New Zealand Curriculum Update*

Curriculum Updates support school leaders and teachers as they work to design and review their school curriculum in line with the New Zealand Curriculum and with current knowledge and understandings about effective classroom teaching.

Curriculum Updates are published in the *Education Gazette* and are available online at:
http://nzcurriculum.tki.org.nz/curriculum_updates

This Update is for the school leadership team. It discusses initiatives designed to support student achievement in mathematics and illustrates how schools are addressing the needs of students who are not progressing as expected. It will help you as a team to review how your school currently addresses underachievement in mathematics.



Supporting mathematics learning

How effectively is your school meeting the mathematics learning needs of students who are not progressing as expected?

- Do you have evidence that all students in your school receive effective teaching in mathematics?
- Do you have evidence that students who are not achieving at expected levels (as described in *The New Zealand Curriculum Mathematics Standards for Years 1–8*) are receiving targeted and intensive teaching to narrow the achievement gap?
- Do the identities, languages, and cultures of students inform your school's approaches to mathematics teaching and learning?

This Update will help you to review the mathematics teaching in your school and implement initiatives to address underachievement.

It explores three tiers of support for mathematics learning and includes a case study describing one school's programme of targeted, intensive support for students who were underachieving in mathematics. It also discusses a range of materials and resources to support accelerating learning in mathematics.

It serves as a companion to Update 2, *Supporting Literacy Learning*.

The importance of leadership

The 2008 Education Review Office report *Schools' Provision for Students at Risk of Not Achieving* emphasises the importance of focused senior leadership in improving outcomes for students:

Principals and senior school leaders have a central role in guiding the school's practice for students at risk of not achieving. Most importantly they determine the rationale for the school's provision [for the type and range of support]. Asking the questions about how best to meet the needs of this group requires informed decision-making about the organisation and resourcing that will offer the greatest leverage in improving achievement outcomes for students in the context of their school.

page 1

All students begin school with the expectation that they will be successful learners. They bring with them many different strengths, needs and cultural backgrounds. To support students' progress, teachers need to recognise and build on their prior learning experiences, continually affirming their identity, language, and culture.

Supported by strong senior leadership and effective teaching, students will develop the mathematical understandings, skills, language, and confidence they need for learning across the curriculum and in their everyday lives.

Mathematics learning: Three tiers of support

We can view support for mathematics learning in terms of three tiers. The first and most fundamental tier is effective classroom teaching. For students who require additional support to reach the expected levels of achievement, there is the intensive and targeted support described as tier 2. The shape of the specialised support envisioned as tier 3 is currently being explored by the Ministry.

Tier 1: Effective classroom teaching

In effective classroom teaching:

- all students actively engage in well planned classroom programmes designed by observant, knowledgeable teachers
- teachers deliver appropriate, explicit mathematics instruction and provide plenty of opportunities for students to acquire and practise mathematical skills
- teachers devise meaningful tasks that enable students to connect new learning in mathematics with their prior knowledge and experiences
- teachers foster students' understanding and use of mathematical language and mathematical argumentation

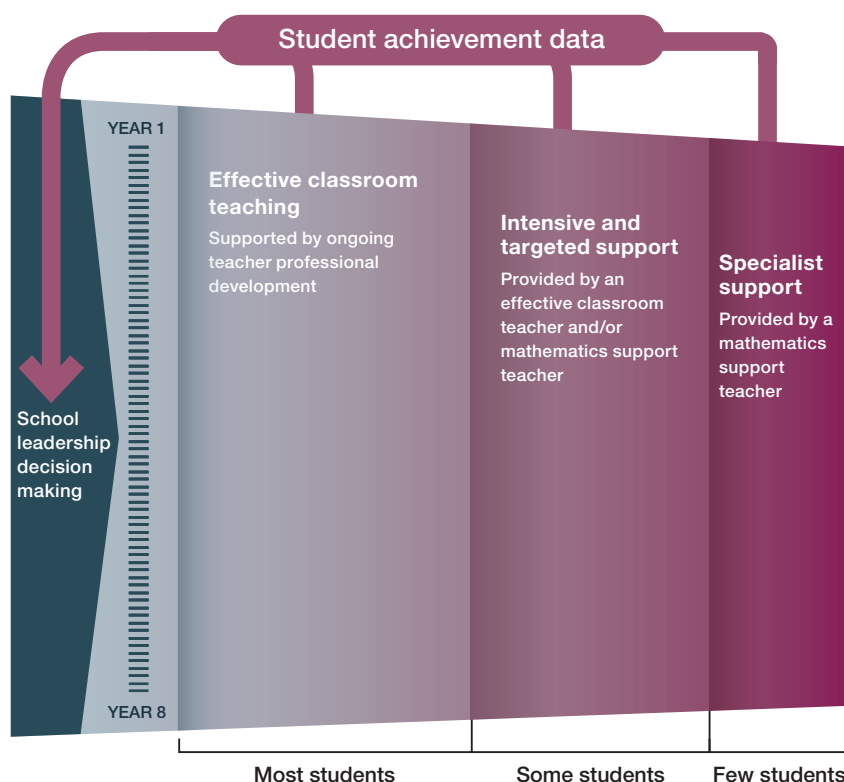
- teachers carefully monitor progress and ensure that their instruction is culturally responsive to the learning strengths and needs of all their students.

Classroom teaching is effective when students make the expected or accelerated progress in relation to the New Zealand Curriculum and the mathematics standards. For a variety of reasons, some students will need additional support.

Tier 2: Intensive and targeted support

This tier of provision aims to accelerate learning in mathematics by effective, intensive, and targeted support that is led by the classroom teacher or by a mathematics support teacher (MST). Within this tier there

Support for Mathematics Learning in New Zealand Schools





are two levels of support to meet the needs of groups of students who are achieving below or well below expectations.

Tier 2, level A

An Accelerating Learning in Mathematics (ALiM) programme led by a teacher.

This involves short-term, targeted instruction for small groups of students who are just below the relevant mathematics standards, with the aim of accelerating their progress in a short period of time.

Tier 2, level B

An ALiM programme led by a mathematics support teacher (MST).

This involves targeted instruction by the MST for individual students or small groups who are achieving well below the standard and/or making limited progress. Targeted instruction is planned and co-ordinated by the MST in close communication with the classroom teacher, other specialist teachers, and family or whānau.

Both levels of programme are effective when students make accelerated progress as measured against the mathematics standards.

Tier 3: Specialist support

Effective specialist support involves:

- deliberate, intensive, longer term support (two or more terms) designed by a specialist teacher for students who have specific learning needs and who are achieving well below the standard
- learning time with the specialist teacher, who works in collaboration with the classroom teacher.

In 2012, there will be an exploratory study that will involve six specialist teachers. The study will explore the type of support for mathematics learning required by students who are making limited or no progress during their school year. These teachers will be working across schools to support teaching and learning and provide specialist support for the identified students.

Ethic of care

Effective mathematics teaching is underpinned by the belief that:

- every student's identity, language, and culture must be respected and valued
- every student has the right to effective mathematics education
- every student can become a powerful learner of mathematics.

Glenda Anthony and Margaret Walshaw (2009) describe 10 pedagogical practices that have been shown to impact positively on students' achievement in mathematics. One of these is an **ethic of care**. Where such an ethic characterises all classroom interaction, students experience what Anthony and Walshaw describe as "caring classroom communities that are focused on mathematical goals that help develop [their] mathematical identities and proficiencies" (page 7). Many teachers have noted that students who struggle with learning mathematics can quickly start to doubt their ability and come to see mathematics as "too hard" and something "I'm not any good at". Caring classroom communities encourage students to develop self-belief based on evidence of their own learning.

... as soon as the children viewed themselves as being good at maths, and as being "mathematicians", they seemed to want to ... learn and were more willing to have a go at an answer, even if they weren't sure if it was right. Building the environment and "climate" in which the children felt safe to take these risks was also very important from the beginning.

Teacher, Awapuni School

http://nzmaths.co.nz/theme-1-ethic-care-nurturing-mathematics-learning-environment-0?parent_node=

The classroom teacher has primary responsibility for creating this caring community of mathematical practice. When targeted intensive support is required in addition to effective classroom teaching, a close working relationship between the mathematics support teacher and the classroom teacher is essential to ensure that the student receives support from both teachers. The roles and the work of the two teachers must complement and inform each other.

Tier 1: Effective classroom teaching

What evidence do you have that mathematics teaching in your school is effective for the students?

Numeracy Development Project Book 3, *Getting Started* (pages 3–4), outlines the dimensions of quality mathematics teaching, based on current research. The table on the right puts each of these dimensions alongside one or more reflective questions for teachers. A review team could use these questions to compile an evidential base for practice across the school.

In order to address each of these dimensions effectively, teachers need to have a strong foundation of *pedagogical content knowledge*:

It is essential that you know the mathematical content that you are teaching and understand the conceptual difficulties that your students may have in learning this mathematics. This is central to your ability to create coherent, targeted planning to assist this learning.

NDP Book 3, page 4

If the evidence is that mathematics teaching in your school is not as effective as it should be, a programme of professional learning may be the first step. A second step may be to ensure that teachers can identify students who need further support.

Quality teaching dimension	Reflective question(s)
Inclusive classroom climate	Do we have students (or groups of students) who are not actively engaging in mathematics learning? If so, how are we addressing this issue?
Focused planning	How are we using assessment evidence to plan teaching – e.g., to identify gaps in understanding and to sequence learning experiences?
Problem-centred activities	How are we ensuring that all our students are challenged by worthwhile mathematical tasks that build problem-solving confidence?
Responsive lessons	How do we ensure that planning is flexible – that it allows for (and expects) teachers to respond to daily feedback about what is and what is not working?
Connections	How do we link learning in mathematics to the interests and the wider lives of our students? How do we form alliances for learning with families and whānau?
High expectations	How do we convince all our students that we see in them the potential to become powerful learners of mathematics?
Equity	How are we ensuring that all our students are resourced to achieve and that factors such as language or cultural background do not become excuses for underachievement?

Tier 2: Intensive and targeted support

The intensive, targeted support in tier 2 is not separate from effective classroom teaching – it is designed to complement it and to accelerate the progress of students who are not achieving as expected.

The two scenarios given below illustrate the two levels of support that are possible at tier 2.

Level A scenario:

A classroom teacher-led ALiM programme

Three students within a year 4 class are having difficulty in applying their place-value knowledge to combine and partition whole numbers in problem-solving contexts.

Their teacher devises an eight-week programme of targeted support in which they receive an extra 15-minute group lesson four days a week while the rest of the class practise basic facts in pairs.

The target students work on a daily problem, modelling the calculations with place-value equipment and learning a new place-value game that they take home for practice.

Level B scenario:

A mathematics support teacher-led ALiM programme

The MST, who is also the teacher in charge of mathematics, is released to run a programme of targeted support for year 7–8 students who are achieving well below the standard in applying additive strategies to decimals.

The MST works with the classroom teachers to devise a targeted programme of strategy development that is related to the syndicate's units on measurement and science for the term.

Six students meet with the MST for 45 minutes four times per week to work together on their understanding of place value and decimals through problem-solving tasks.

The MST observes the students in class, gives the teachers feedback, and suggests further ways to support the students' understanding of decimals when they are working in small groups.

The success of tier 2 programmes is strongly influenced by the support and involvement of the school's senior leadership and the degree of engagement with family and whānau:

The support of parents and the principal ... was immensely appreciated. Both parties ... often checked in with the students about their progress. I also had an open-door policy and the parents were in touch with the teacher to discuss progress over the course of the intervention. The students were encouraged to share their learning with their parents and had follow-up work that they could do at home. The principal also checked in with the students, who were very proud to talk about their learning. This level of care and genuine interest in student learning ensured that all students knew how important their learning was to us all.

ALiM report, Sylvia Park School
<http://nzmaths.co.nz/sylvia-park-school-alim-report>



► CASE STUDY

Carterton School, Wairarapa

It is the expectation of our school that all children are able to use and understand mathematics. We believe that some children may benefit from specific interventions to accelerate their learning when they experience difficulty.

Alison Woollard, Principal¹

In 2010, Alison Woollard and her senior management team at Carterton School devised a plan to raise student achievement in mathematics by improving teaching practices across the school. The board of trustees appointed a respected teacher and facilitator as part-time co-teacher of mathematics to implement a school-wide professional learning programme, using the school's teaching-as-inquiry coaching model. The co-teacher worked alongside classroom teachers and school leaders to develop effective differentiated practices in mathematics across the school.

A mid-year analysis of school data showed that some students were not making the expected progress. As a result, two teachers undertook further professional learning in initiatives designed to be implemented alongside everyday effective teaching practice.

Targeted and intensive support

In term 3 of 2010, Carterton School trialled two ALiM programmes.

1. Mathematics support teacher-led ALiM trial

The co-teacher worked as an MST to provide targeted in-class support for twelve year 3–8 students with weak place-value understanding who had been referred to the school's special needs committee.

(This programme is described in Carterton School's ALiM story at <http://www.nzmaths.co.nz/carterton-school-alim-report>)

2. Classroom teacher-led ALiM trial

A classroom teacher ran a programme targeted specifically at five year 5 students in her class, and reviewed its effectiveness and feasibility.

The assessments from these two programmes showed accelerated student achievement. The feedback from students, parents, and classroom teachers was very positive.

[I learned about] Tens and ones and hundred. I didn't know how that worked before. I thought the big numbers were just lots of zeros.

Year 4 Carterton student

Now when we buy something I can sort it out, I know it in my head.

Year 4 Carterton student

The data was used to inform the school's next steps.

Deciding on next steps

In 2011, Alison asked her teachers what would make the biggest difference to the students who were underachieving in mathematics at the school. The teachers responded with a range of suggestions, including short-term programmes by an MST for targeted groups and the employment of a teacher aide to support the classroom teacher.

The school's mathematics committee presented these two recommendations to the board as part of their regular achievement report. The board approved funding for a part-time teacher to deliver a specific mathematics programme of three 30-minute sessions a week for each of four groups of students during one term. Mid-year data showed that this ALiM programme was very successful for 14 of the 17 students involved.

A teacher aide was employed for one term to support students working independently while their classroom teachers worked with targeted mathematics groups. So far, feedback on this from teachers has been enthusiastic:

I am really excited about what I'm seeing this [targeted] group do this term. Having my undivided attention even for 30 minutes twice a week has been so important for their learning. I am very explicit about what we are working on during these times. They get that this is valuable time.

I'm encouraged that the teacher aide support for my other students during the targeted group times has meant that they are learning to be more self-managing.

My "untargeted" groups are starting to lobby for "targeted" time. I think they sense the kind of attention these kids are getting is exciting.

Throughout these initiatives the focus for mathematics teaching in the school has been on effective classroom teaching first and foremost, with underachieving students receiving support in targeted groups as part of their regular classroom programme.

¹ Comments by the Principal and teachers are quoted from interview transcripts. Comments by students are quoted from the school's ALiM story at: <http://www.nzmaths.co.nz/carterton-school-alim-report>

Materials to support accelerating learning in mathematics

In 2010 and 2011, schools were invited to participate in ALiM and MST pilot studies. These studies have been used to develop support materials that are available to all schools.

You can access resources, including school and theme stories, and teachers' and principals' insights, at the NZ Maths website (<http://nzmaths.co.nz/accelerating-learning>) under the headings "Intervention resources", "School stories", "Themes for success", and "Teacher lightbulb moments". This part of the Update briefly describes the resources that are contained in each of these sections.

ALiM resources

A series of ALiM teaching brochures has been developed to address common barriers to students' progress in mathematics (two pages of one brochure are shown below). They are intended to help teachers plan intensive instruction for targeted groups and identify barriers or misconceptions that students may

Achievement focus area → Learning to: use decimals to solve problems

Target group → Target group: students in years 6–8

Beliefs and principles that inform the ALiM support programme → Beliefs underpinning effective teaching of mathematics:

- Every student's identity, language, and culture is respected and valued.
- Every student has the right to access effective mathematics education.
- Every student can become a successful learner of mathematics.

Achievement profile developed from observational assessments → Ten principles of effective teaching of mathematics:

1. An ethic of care
2. Arranging for learning
3. Building on students' thinking
4. Worthwhile mathematical tasks
5. Making connections
6. Assessment for learning
7. Mathematical communication
8. Mathematical language
9. Tools and representations
10. Teacher knowledge

Barriers that may have contributed to the profile → POSSIBLE BARRIERS TO THE STUDENT'S PROGRESS

POSSIBLE BARRIERS TO THE STUDENT'S PROGRESS	
1	Difficulty placing decimals on a number line
2	Weak understanding of decimal place value
3	Difficulty multiplying decimals

Achievement expectations alignment diagram → EXPECTATIONS FOR NUMBER

AFTER 1 YEAR AT SCHOOL		AFTER 2 YEARS AT SCHOOL		AFTER 3 YEARS AT SCHOOL		BY THE END OF YEAR 4		BY THE END OF YEAR 5		BY THE END OF YEAR 6		BY THE END OF YEAR 7		BY THE END OF YEAR 8	
COUNTING FROM ONE	ADVANCED COUNTING	EARLY PART-WHOLE THINKING	EARLY ADDITIVE	EARLY ADVANCED ADDITIVE	ADVANCED ADDITIVE – EARLY MULTIPLICATIVE	EARLY ADVANCED MULTIPLICATIVE	ADVANCED MULTIPLICATIVE – EARLY PROPORTIONAL								
NZC EARLY LEVEL 1	NUMERACY STAGE 2 OR 3	NZC LEVEL 1	NUMERACY STAGE 4	NZC EARLY LEVEL 2	NUMERACY STAGE 5	NZC LEVEL 2	NUMERACY STAGE 6	NZC EARLY LEVEL 3	NUMERACY STAGE 7	NZC LEVEL 3	NUMERACY STAGE 8	NZC EARLY LEVEL 4	NUMERACY STAGE 9	NZC LEVEL 4	NUMERACY STAGE 10

See Effective Pedagogy in Mathematics by G. Anthony and M. Walshaw, Educational Practices Series 19, International Bureau of Education, available at: www.ibe.unesco.org

Aligned to The New Zealand Curriculum and Mathematics Standards for years 1–8

have. They provide a starting point for instruction, make links to other support materials, and suggest next steps and ways of making connections with the home.

School stories

This section of the NZ Maths website contains stories from 39 schools about their 2010–2011 ALiM pilot programmes. Principals and teachers describe the structure and content of their programmes, reflect on what worked and what didn't, and explain what they plan to do

next. Photographs, video clips, and quotations from teachers, students, and whānau support the stories and illustrate the impact of accelerating learning in mathematics.

Themes for success

This section uses the 10 effective pedagogical practices that are discussed in *Effective Pedagogy in Mathematics* (2009) and that inform all ALiM work as a way of grouping examples taken from the school stories.

“Lightbulb” moments

ALiM teachers have been asked to go back through their journals and their planning and assessment notes to identify “lightbulb” moments: moments when a specific action or way of demonstrating or describing a concept helped a student or group bridge a particular barrier to their understanding. This section includes short video clips and links to other materials and school stories.

DRAFT

Accelerating Learning in Mathematics

BARRIER BEING ADDRESSED	2 WEAK UNDERSTANDING OF DECIMAL PLACE VALUE	
DIAGNOSTIC QUESTIONS	WHAT TO NOTICE IN THE STUDENT'S RESPONSE	
1. a. Draw a square on a piece of grid paper and write 0.5 inside it. Tell the student that the square is 0.5 of a larger rectangle. Ask the student to draw the larger rectangle. If the student is struggling, tell them that the square is half the size of the larger rectangle and see whether this helps. 2. a. Show the student a second square with 0.1 written on it. Tell the student that the square is 0.1 of a larger rectangle. Ask the student to draw the larger rectangle. If the student is struggling, tell them that the square is one-tenth of the size of the larger rectangle and see whether this helps. b. Draw four identical squares with 0.1 written on them and ask the student what decimal they represent. c. Ask the student what fraction of a larger rectangle the four squares represent. 3. a. If the student demonstrates an understanding of 0.5 and 0.1, draw a square with 0.25 written on it and ask them to show you the size of the larger rectangle. If necessary, tell the student that the paper is one-quarter of the original rectangle.	Does the student know that 0.5 is equivalent to $\frac{1}{2}$? Do they know that two halves make a whole? Does the student know that 0.1 is equivalent to $\frac{1}{10}$? Can the student identify that 4×0.1 is 0.4? Does the student know that 0.25 is equivalent to $\frac{1}{4}$?	Barrier that may have contributed to the achievement profile Sample diagnostic questions that can be used to reveal the student's current understanding of the concept Prompts for teachers to support decisions about whether this is an area requiring targeted instruction
4.953 0.003 0.05 0.9 4.		Suggested learning experiences that can be used to help the student develop the concept
DELIBERATE ACTS OF TEACHING	MATERIALS/LINKS	
Use whole numbers to review the rules for place value. For example, 10 of one unit creates a new grouping or room in a place value house; a place has 10 times the value of the place that comes after it and $\frac{1}{10}$ of the value of the place that precedes it. Use these rules to identify the value of the first decimal place. Decimats Use one colour for the mat on which the decimals will be modelled and different colours to represent tenths, hundredths, and thousandths. Cut out tenths and use them to model different decimals (1 d.p.). Model a decimal such as 0.3 and ask the student how many tenths are needed to make a whole. Make connections to making-tens skills. Use the decimat to make visual links between $\frac{1}{2}$ and 0.5, $\frac{1}{4}$ and 0.25, $\frac{1}{5}$ and 0.2, and $\frac{1}{10}$ and 0.1. Explore place value to 3 decimal places. Introduce problems involving whole numbers, for example, $2.3 + \square = 4$. Relate the decimat model to the way decimal values are written or to arrow cards. Use Digital Learning Object: Decimaster to model numbers and to locate them on number lines.	Decimats (Material master 7-3) Place value house or place value flip chart for decimals Decimal Arrow Cards (Material master 7-2) Digital Learning Object: Decimaster (Number, level 3) $\frac{1}{10}$ $\frac{1}{10}$ $\frac{1}{10}$ $\frac{1}{10}$ $\frac{1}{10}$ $\frac{1}{10}$	Resources and links
WHAT TO DO NEXT IF THE STUDENT IS STUCK	INITIATING HOME-BASED ACTIVITIES	NEXT TEACHING STEPS BACK IN THE CLASSROOM
Check whether the student understands whole number place value and unit fractions. Do not move on to the second and third decimal places until the concept of tenths is secure. Use other objects that can be divided into ten pieces.	The student can make a copy of decimats or use Digital Learning Object: Decimaster to practise at home. Encourage the student to record decimal numbers that they find in their home environment. Send home a copy of Decimal Place Loopy.	Give the student problem-solving activities involving decimals, with equipment available if required. Measurement and statistics work are useful contexts within which to explore decimals.
		Possible next steps if the learning experience does not seem to be supporting the student Suggested homework or shared activities to provide practice Suggested connections between the ALiM work and the classroom work that will support student understanding

Accessed from <http://nzmaths.co.nz/accelerating-learning>
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MATHEMATICS H 3

Meeting diverse learning needs in mathematics

In *Effective Pedagogy in Mathematics/Pāngarau* (2007), Anthony and Walshaw state that:

Effective teaching for diverse students demands teacher knowledge. Studies exploring the impact of content and pedagogical knowledge have shown that what teachers do in classrooms is very much dependent on what they know and believe about mathematics and on what they understand about the teaching and learning of mathematics. Successful teaching of mathematics requires a teacher to have both the intention and the effect to assist pupils to make sense of mathematical topics.

page 203

They also point out (2007, page 69) that competency requires students to understand the specialised language of mathematics and that the language students use derives from the language used by their teacher.

I have often found that children struggling with mathematics do not understand the language demands of the task and therefore are unable to access the maths in order to succeed in the subject. With this knowledge in mind I ensured that children were given exposure to appropriate language, which I modelled consistently ...

I ensured that I consciously planned for and taught language objectives and mathematical objectives concurrently ...

Teacher, Sylvia Park School

<http://nzmaths.co.nz/sylvia-park-school-alim-report>

Guiding questions He pātai

- How well equipped are your teachers in terms of their mathematical content and pedagogical content knowledge?
- Do your teachers explicitly and deliberately model the language of mathematics?
- In what ways is an ethic of care evident in the mathematics teaching in your school?

> References and other useful resources

- > Anthony, G. and Walshaw, M. (2009). *Effective Pedagogy in Mathematics*. Educational Practices Series No.19. Brussels, Belgium: International Bureau of Education. Available as a pdf at: <http://www.educationcounts.govt.nz/publications/series/2515>
Drawing on a wide range of research, this booklet describes 10 pedagogical practices that have been shown to “engage learners and lead to desirable outcomes”. The booklet is a summary of the findings from *Effective Pedagogy in Mathematics/Pāngarau: Best Evidence Synthesis Iteration [BES]* (Ministry of Education, 2007), by the same authors.
- > Education Review Office (2008). *Schools’ Provision for Students at Risk of Not Achieving*. Wellington, New Zealand: Education Review Office. Available as a pdf at: <http://www.ero.govt.nz/National-Reports/Schools-Provision-for-Students-at-Risk-of-Not-Achieving-August-2008>
- > Ministry of Education (2008). *Getting Started*. Numeracy Professional Development Project Book 3. Wellington, New Zealand: Ministry of Education. Available as a pdf at: <http://www2.nzmaths.co.nz/Numeracy/2008numPDFs/NumBk3.pdf>
- > Neill, A., Fisher, J. and Dingle, R. (2010). *Exploring Mathematics Interventions: Exploratory Evaluation of the Accelerating Learning in Mathematics Pilot Study*. Wellington, New Zealand: NZCER Press. Available as a pdf at: <http://nzmaths.co.nz/sites/default/files/Numeracy/References/ALiMreport.pdf>
This report was commissioned by the Ministry of Education to evaluate the ALiM projects undertaken by schools in 2010.

> The NZ Maths website

(<http://nzmaths.co.nz>) has a number of sections that will support a school to develop and implement an effective targeted support programme. These sections include:

Accelerating Learning

This page has links to support materials (such as the school stories) that are related to ALiM work currently going on around New Zealand (see pages 6–7 of this Update).

Figure It Out

This extensive series of student books and teacher resources is available in schools. A number of the books are also available through the NZ Maths website, enabling teachers to use the activities, investigations, and games on data projectors.

Numeracy Projects

All the resources related to the Numeracy Development Project are housed here and provide teachers with teaching and assessment support.

Assessment Tools

This page describes and provides links to various tools that support teachers and schools with decisions about data collection.

National Standards Illustrations

This page links to tasks and annotated student responses that illustrate achievement at particular standards.

The New Zealand Curriculum

Update