Accelerating **Learning in Mathematics**

RESOURCE 2: HELPING STUDENTS DEVELOP THE SPECIALISED LANGUAGE OF MATHEMATICS

Understanding the specialised language of mathematics and being able to confidently use this language are essential to the growth of mathematical understanding. Many mathematical tasks and activities require students to read and interpret both written words and symbols.

This resource provides strategies that teachers have used to help their students develop and strengthen their understanding of mathematical terminology.

Why is this important?

Several aspects of mathematical language present students with additional challenges. Making these challenges explicit helps students to realise that mathematical language is something that needs to be learned and practised.

Developing confidence with mathematical language is a complex process. Teachers need to be deliberate about the way they introduce, use, and reinforce mathematical terms. Vocabulary building should be incorporated into the teacher's planning as a key focus in the day-to-day teaching of mathematics. For strategies to support the particular needs of English language learners, see resources 3 and 4, which outline these.

Beliefs underpinning effective teaching of mathematics

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

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.

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

TAKING ON THE CHALLENGE

Some of the challenges of mathematical language include:

- terms used in everyday language that have different or more precise meanings when used in mathematics, for example: average, similar, difference, negative, product, power, prime, line, fraction
  - For example, a parent might say at the deli section of the supermarket, "Could I have a fraction more?" What the parent means by fraction is "a tiny amount". However, in mathematics a fraction could be close to 1 (e.g., $^{19}/_{20}$), equal to 1 whole (e.g., $^4/_4$), or more than 1 (e.g., $^3/_2$).
- words that are found only in mathematics, for example, denominator
  - These words can make mathematics seem like a foreign language. Students might understandably feel that the "person" who "made them up" was deliberately trying to make mathematics seem hard to understand.
- words that have more than one mathematical meaning, for example, round, square, and cube
- words that are homonyms (sound alike), for example, some and sum
- words that are easily mixed up, for example, factor and multiple
- task words: find, solve, investigate, problem, record, compare, explain, work out, prove.

Pre-teach mathematical vocabulary

When planning a lesson, identify the vocabulary students will need in order to understand or explain ideas. Introduce these terms at the start of the lesson so that students for whom they are unfamiliar won't be confronted by new words and procedures simultaneously later in the lesson. The meaning of the vocabulary can then be reinforced when students put it to use. The "vocab session" can also be used to systematically review terms introduced in previous lessons.

Include mathematical vocabulary in spelling lists. Provide opportunities for students to practise and use this new vocabulary throughout the lesson.

Make links between language and meaning

Exploring the etymology of a word can help students make connections to its meaning. Here are some examples:

- Triangle literally means "three angles". What other words can the students think of that use "tri"?
- Equal comes from the word "level" and relates to balanced scales.
- Denominator comes from a word that means "to name". The denominator "names" the unit you are working with, for example, fifths.
- Fraction comes from a word that means "to break".
- The word "multiply" comes from a word that means "many folds".

To illustrate this, you could give students a piece of paper and ask them to fold it into three parts, then in two. Have them open it up and count how many sections there are (6). 3 x 2 makes 6 sections. Extend the model by showing that folding in two and then three gives the same result (2 x 3 = 3 x 2). Challenge students to see whether this multiplication method works for other pairs of numbers.

Modelling books

Modelling books are a useful tool for learning new terms. They allow learning conversations to be recorded, clarified, and revisited.

> *During maths, my students have their maths books beside them while working with me. They record any new maths vocabulary in the back of their maths books. I make sure they have a definition that they understand before they leave the group. We refer back to this a lot.*
>
> Christine – Sacred Heart School

Word walls

Create a "word wall" on the classroom wall. Students can post definitions, drawings, and examples next to the terms. The students can refer to the word wall throughout the lesson.

Consider having students make fun visual representations of words, using the word as a visual cue to its meaning. See www.broward.k12.fl.us/studentsupport/ese/PDF/MathWordWall.pdf for examples.

Maths Pictionary

Give students a set of vocabulary cards and give them some time to familiarise themselves with the words. The students can use the words to play Pictionary, taking turns to draw the words. Alternatively, give the students materials that they can use to help "make" the word, e.g., place value blocks, counters, play dough.

Use movement and interaction

Movement can be a powerful way to connect words and meanings.

> *D took her new entrants class outside. She asked them to get into groups of numbers from 1–10. She gave each group a long skipping rope, and they linked it around themselves, then she tied each rope in a bow. She was talking and questioning all the time. I heard "groups", "groups of", "How many in ...?", "How many groups?", "Any left over?", "How many left?", "How many altogether?", "How many more?", and "What if ...?". The children were very excited – they were answering D's questions and echoing her language with each other. They then went back into the classroom, and the children made groups from equipment that was waiting for them on the tables. D roved around the room, interacting with groups and individuals. The lesson finished with D recording the children's words in a modelling book, where she introduced the mathematical symbols and made diagrams to illustrate the concept. D told me she found the questions on page 5 in the Numeracy book Enriching the Number Framework with Beginning School Mathematics very helpful.*
>
> Maths facilitator observing teacher

Frayer Model

The Frayer Model is a useful way to define what a concept is and is not. Begin by asking students to identify examples of a term. Then ask them to identify "non-examples". Next, ask the students what facts or characteristics they can identify. Finally, have students work together to create a definition. For example:

Definition	Facts/characteristics
Factors are the numbers that you multiply to get another number.	1 is a factor of every number.
	Numbers that have only two factors are called primes.
	All even numbers have a factor of 2.
	If you divide a number by one of its factors, you will get another whole number.
	If you can share a number into equal groups, then the number in each group is a factor and the number of groups is another factor.

FACTOR

Examples	Non-examples
2 x 6 = 12, so 2 and 6 are both factors of 12.	5 is not a factor of 12 because if you divide 12 into 5 groups you will have some left over.
The factors of 8 are 1, 2, 4, and 8.	

Identify key vocabulary

The following resources provide information on the vocabulary students should be acquiring:

- Numeracy Development Project *Book One: The Number Framework*, pages 15–22, gives progressions and specialised mathematical language within each stage.

- Numeracy Development Project *Book One,* pages 3–13, describes strategies that demonstrate the use and meaning of specialised mathematical language.

- Numeracy Development Project book *Home–School Partnership: Numeracy* (available only online), pages 20–26, gives content knowledge and includes challenges for children and ideas for ways to develop their understanding.

- *Mathematics Standards for Years 1–8*, pages 51–53, provides a mathematics language glossary for all strands.

- A glossary covering terms used in the Numeracy Projects can be found on the NZ Maths website at http://www.nzmaths.co.nz/glossary

- Equipment Animations demonstrate the use of mathematics equipment and the specialised language associated with it at http://www.nzmaths.co.nz/equipment-animations?parent_node

- Specific content and vocabulary support for all strands is available on the NZ Maths website at http://nzmaths.co.nz/nzc-and-standards

Making links between home and school

The NZ Maths Families site (http://nzmaths.co.nz/families) suggests activities and games that parents can use to help their children develop mathematical language. Each game has a vocabulary list (English and Māori) showing the related mathematical language.

REFERENCES AND FURTHER READING

Hunter, R. (2005). "Reforming Communication in the Classroom: One Teacher's Journey of Change". MERGA research paper, available at www.merga.net.au/documents/RP492005.pdf

For more strategies to use with students, see:

- Concept circles: http://literacy.kent.edu/eureka/strategies/concept_circles.pdf

- Think boards: http://www.peelweb.org/admin/data/articles_online/i10p042a1.htm