Accelerating Learning in Mathematics

RESOURCE 3: SUPPORTING ENGLISH LANGUAGE LEARNERS WITH THE LANGUAGE OF MATHEMATICS

Issues for English language learners

English language learners (ELLs) come from diverse backgrounds and have a wide range of proficiency in both their first language and English. Learning a new language is a complex process that requires a significant period of time. Students normally pick up social communication skills first, but their competence with these may mask difficulties with mastering academic language, which generally takes 5–7 years. Every learning area of the New Zealand Curriculum has its own language, and this is particularly true for mathematics.

This resource provides some general strategies for supporting ELLs to build their mathematical language in context.

Why is this important?

ELLs are often assessed as being below or well below expectations in mathematics, and teachers assume that they lack mathematical knowledge. However, because these assessments depend on the students' ability to comprehend the mathematical language in the tasks, the assessments often do not measure ELLs' mathematical knowledge fairly or accurately.

Assessment of ELLs in mathematics is often oral, using GLoSS or IKAN to gain a clear picture of students' mathematical proficiency. Despite this, the structure of the instructions and questions in these assessment tools, and the vocabulary that is used, can prevent ELLs from understanding the task. They are also often unable to show their understanding of mathematical concepts either orally or in writing because of the language demands. Students may still have this mathematical knowledge, so the question teachers need to ask is: *How can I construct this task so that my ELLs can understand what is required and can show their mathematical understanding?* Using equipment or diagrams in your teaching and having students use symbols or drawings to record their responses may elicit the information that you need.

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

HOW DO I KNOW IF AN ELL IS READY FOR A MATHS ASSESSMENT?

Teachers need to make an informed decision as to whether their ELLs are ready for formal assessment tasks that involve reading and/or writing. And if an ELL achieves below expectation on such tasks, the teacher should investigate whether the issue is language rather than mathematics. *The English Language Learning Progressions* are a useful tool for this purpose. As a rule, teachers should not expect the assessments they use for native English speakers to be a reliable indicator of the mathematical understanding of their ELLs. Alternatives, including oral assessment, may need to be used.

TEACHING MATHEMATICAL LANGUAGE

To provide the best possible learning environment for ELLs, teachers need to accelerate their students' acquisition of English at the same time as they build their conceptual knowledge in mathematics. Teachers can do this by identifying the language associated with mathematical concepts and knowledge and teaching it specifically before students are expected to use it in abstract contexts.

Researchers agree that language teaching is more effective when introduced in context. Teaching content and language concurrently accelerates learning in both. The dual focus provides multiple opportunities for recycling concepts, grammar, or vocabulary associated with that learning area (Gibbons, 2002).

> *The critical change occurs when teachers shift from seeing the literacy demands as barriers to students' mathematical learning to seeing the demands as affording opportunities to support the development of students' abilities to communicate mathematically.*
>
> Doerr and Chandler-Olcott, 2005

Most teachers are very skilled at planning for subject learning in terms of content, tasks, and resources and at linking activities with achievement objectives. They also need to consider what language is integral to developing their students' mathematical proficiency. The language used in mathematics is often subject-specific, so teachers need to be aware of these demands as they plan mathematics lessons.

To help build your ELLs' mathematical language, you may need to:

- identify mathematical language structures and vocabulary during the planning process, for example, "doubling", "doubles", "double equals two times"
- alert them to new mathematical vocabulary, before the concepts are taught
- plan for both mathematics and language learning
- provide learning opportunities where the use of mathematical language is necessary and where students are scaffolded and supported through:
  - modelling
  - differentiation of tasks
  - drawing specific attention to the language structures
- link mathematical concepts to appropriate real-life contexts by using props or materials, such as picture cues or prompts, sport or food contexts, books, or mathematics materials
- give students who share the same first language opportunities to discuss ideas together in order to clarify their thinking
- use a modelling book to show students' understanding and working in diagrammatic and/or symbolic forms (Hattie, 2009)
- set up co-operative learning situations, which give ELLs opportunities to articulate their problem-solving strategies and reasoning within a group. This will support improvement with both language and reasoning skills.

STRATEGIES TO PROVIDE SCAFFOLDING WHEN TEACHING MATHEMATICAL CONCEPTS

Effective teachers ensure that all students understand what they are meant to be doing and are actively involved throughout the session. This means that students need to not only recognise the individual words in a problem or an instruction, but also to understand how the words work together to convey a specific, precise mathematical meaning. While some words and phrases have completely different meanings in mathematics from those in everyday English (these can be recognised and taught), other problems are less obvious. The syntax of mathematical discourse, especially in relation to prepositions, word order, and the implications of the context, can be a barrier to ELLs working with word problems.

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The conditional and comparative terms used in contexts involving logic have no equivalent in some languages, and the meaning of terms such as "unlikely", "likely", and "probable" will be unclear to some students. When teaching probability, it is essential that students understand these terms. Explicitly teach the terms in a real-life context and then make links to the mathematical concepts.

Students need to learn ways to explain and justify a concept. Some ways to build this ability include:

- providing multiple opportunities for ELLs to notice and then use the new mathematical language (Ellis, 1991)
- rephrasing and helping students to notice the differences in phrasing
- using guided questioning
- using "wait time" after asking a question so that students have an opportunity to translate the question, if necessary, and to form an answer
- building on what students say, that is, amplifying not simplifying (rather than using only basic language for ELLs, it is essential to model more sophisticated or complex language use)
- beginning with oral tasks and then moving to written responses. The oral task is a "rehearsal" for the written response. Through talk, students are able to formulate ideas, evaluate hypotheses, and reach decisions in a context that is not constrained by the more formal demands of written language (Gibbons, 1991).

ELLs often find symbols more accessible than language by itself. If learners are familiar with these symbols, they provide links to the corresponding English terms. Using symbols alongside mathematical language and abstract concepts can make them more comprehensible to ELLs (Gibbons, 2009). Giving students time to work out mathematical problems using symbols initially and then discussing the reasoning may also be an effective way to scaffold mathematical understanding.

> *When students are treated as capable learners, when they are actively engaged in challenging tasks … and when they are given opportunities to use knowledge in meaningful ways … ELLs not only achieve at higher levels, but also expand their academic and personal identities and their own beliefs about what is possible.*
>
> Gibbons, 2009

Scaffolding can support students to take increased responsibility for their learning. Vygotsky (1978) talks about "the zone of proximal development" – the gap between what a student can do independently and what they can do with help. Teachers need to consider how they can provide high levels of support when necessary while ensuring that students are challenged enough to make progress.

See resource 4 for particular strategies you can use to build ELLs' mathematical language.

REFERENCES AND FURTHER READING

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