Accelerating Learning in Mathematics

RESOURCE 5: HELPING STUDENTS TO PARTICIPATE IN LEARNING CONVERSATIONS

Knowing how to converse is an important skill. Conversation is necessarily two-way communication. To participate in meaningful mathematical conversations, students need to be equipped with ways to express their own ideas. They also need to learn how to listen to and respond to the ideas of their peers.

This resource outlines ways to help students participate in mathematical conversations in pair, small-group, and classroom contexts.

Why is this important?

Active participation in mathematical conversations is important for the development of mathematical understanding. Students cement their understanding by explaining what they have done and benefit from listening to other students describe how they approached a problem.

Students can be excluded from learning conversations for a variety of reasons. Some struggle to put their thoughts into words or lack the confidence to contribute. Others need more time than their peers to formulate a response and so can be overlooked.

Sometimes teachers don't expect all their students to participate. If a student is reluctant to share their thinking, or struggles to put it into words, a well-intentioned teacher may avoid asking the student to contribute. However, by doing so, they position the student as a passive rather than active member of the learning community.

Most importantly, a student's thinking needs to be visible for a teacher to identify misconceptions or to decide how to move the student's thinking forward.

"By expressing their ideas, students provide their teachers with information about what they know and what they need to learn" (*Effective Pedagogy in Mathematics/ Pāngarau BES*, page 72).

Over the past six to seven weeks of focused maths instruction, I have come to realise how important the learning conversations with students are and that the skills of effective communication need to be taught, modelled, and practised to ensure students are confident and comfortable to participate in discussions.

Learning conversations should take place in a supportive environment. The two students who asked the most questions and challenged ideas made the greatest progress, and I will be working to develop more learning conversation skills with my class.

ALiM story (Matamata Intermediate)

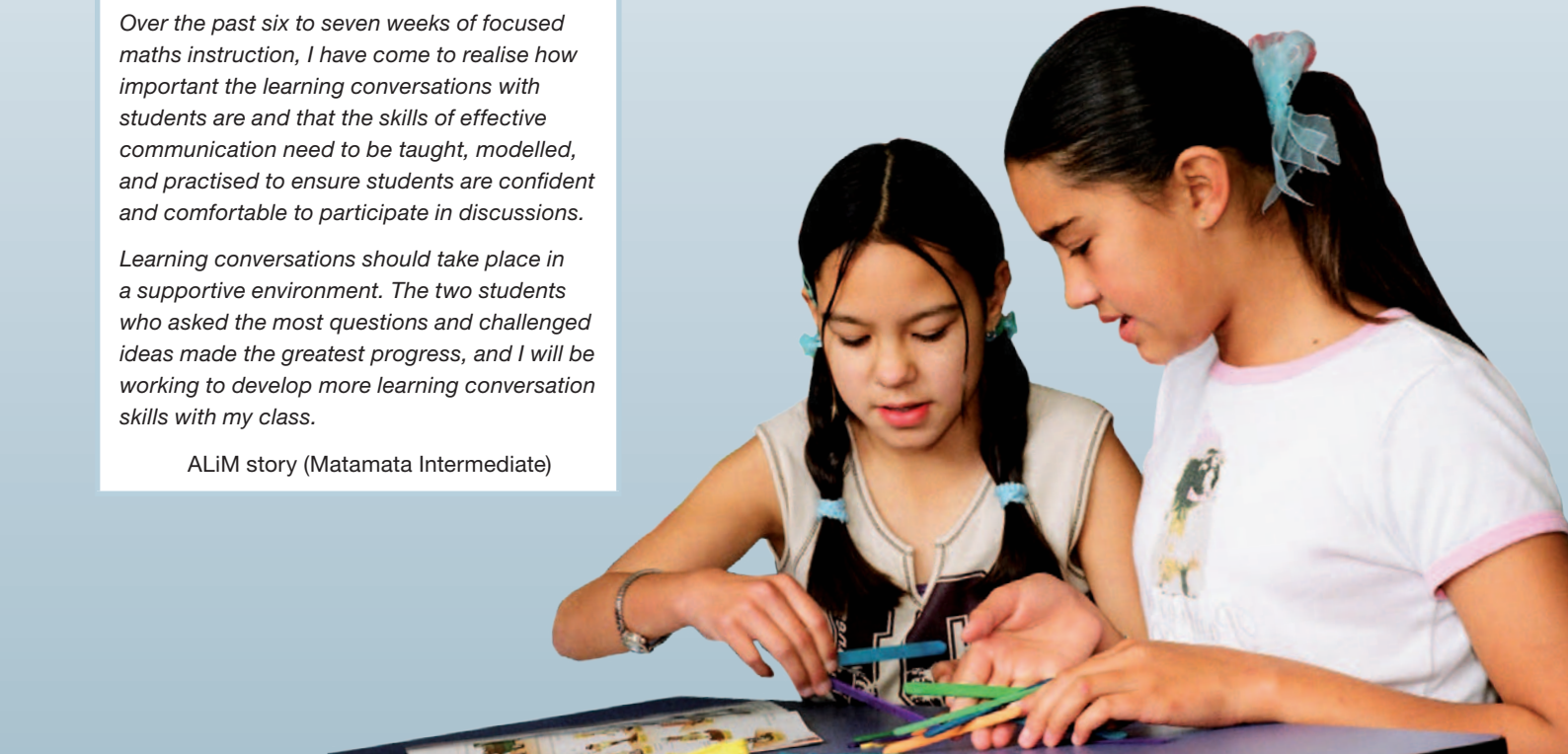
Beliefs underpinning effective teaching of mathematics

- 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



STRATEGIES TO HELP STUDENTS LISTEN AND CONTRIBUTE

The first step is to provide an environment in which students feel comfortable about presenting their ideas, knowing that they will be listened to and that they will receive useful feedback. The small-group structure of ALiM groups is an excellent setting for students to participate in mathematical conversations.

The next step is to lead students along the path towards mathematical discourse – learning how to engage in mathematical argumentation.

Revoice

Quality reasoning and clear communication do not always go hand in hand. Some students struggle to put their thoughts into words, even if their reasoning is sound. Revoicing is a useful way to clarify a student's response.

In simple terms, revoicing involves restating what someone has said in your own words. An effective teacher can use this to model correct mathematical language.

In some instances, a teacher may understand what a student is trying to say but the rest of the group do not. Revoicing can be used to clarify a student's idea so that other students can engage with it. The idea can then be used as the basis for pair, small-group, or class discussion.

After revoicing, it is important to check with the student that their idea has been correctly captured.

For example: A student is exploring fractions. The teacher gives them two same-sized rectangles, one showing three thirds and the other showing four quarters. The teacher asks the student what they notice about the shares.

> *Student: This one is bigger [points to one third] because there are less bits, and this one is smaller [points to one quarter] because there are more bits.*
>
> *Teacher: Let me see if I understand. This shape is shared into three parts – I can see three thirds here. This one is shared into four parts – I can see four quarters. When I compare the shares, one third is bigger than one quarter. That's because if we divide something into lots of parts, the parts get smaller. Is that what you meant?*

Revoicing also creates time for other students to think about an idea and how it relates to their own ideas or to previous activities.

Increase wait time

A simple way to improve the quality of teacher and student discourse is to extend wait time after posing a question. Wait time allows students to think about and formulate their responses. Making time for this indicates that you are genuinely interested in what your students have to say. Interestingly, increasing wait time can also increase the quality of questions that teachers ask.

Lengthening the time provided for thinking helps students to understand that uncertainty is a normal part of problem solving.

Use partner talk

Some students lack the confidence to share their ideas with a group. Talking to a neighbour gives students a chance to practise putting their thoughts into words. Partner talk also gives students an opportunity to quietly ask their classmate a question.

Think, pair, share

Partner talk time can be extended by using think, pair, share.

Note that teachers need to be active listeners when students are sharing their ideas.

> *I like using "think, pair, share" in maths. It gives my students time to think and to either clarify or modify their thinking in a fun way … I pick up the misconceptions and the understandings, and it gives me a good understanding of where to teach next.*
>
> Teacher sharing strategies to support ALiM students

Use question cards

Students who are reluctant to share their own ideas can increase their level of participation by asking questions. Giving students a store of questions to use can enliven class discussions. One of the most important questions in the classroom is "Why do you think that?"

> *I used the fourteen questions from the BSM book to make me ask questions. I copied them out on cards. I chose a couple a day and put them out on the mat in front of me. I used the questions with my instructional groups, for example, "How did you do that?" or "Can you do that another way?" The kids got really interested and asked for the questions. I turned the cards around facing them. We all had a go at using the questions. It took a while to get them to ask the questions of each other; I had to model it for them. I also had to get them to wait for the answer because they wanted an instant response at first. We got so that they chose a question each. We also made up other questions and we added them to our pile of question cards. It helped them to understand the concept of questioning, along with improving their listening skills and their ability to talk about what they had done.*
>
> Facilitator recording a conversation with a year 2 teacher

Create a framework for interaction

Seating arrangements can affect how readily students share their ideas. Encourage students working in pairs to face each other. Small groups often function better when they are sitting in a circle. Choose whether to be part of the circle or to sit or stand within earshot. Sometimes removing yourself to the periphery frees up students to discuss their ideas more openly.

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Clarify the process you want students to follow. For example:

> *I want you to explain to the people in your group how you think you are going to work it out. Then I want you to ask if they understand what you are on about and let them ask you questions. Remember, in the end, you all need to be able to explain how your group did it. Think of questions you might be asked and try them out.*
>
> Mathematics BES, page 73

Co-construct a flowchart showing a process that students can follow as they discuss their ideas. Sentence starters are a useful way to get students thinking:

Explain

Explain your thinking and show your thinking.

"This is my solution/strategy ..."

"I solved the problem by …"

"The steps I followed were …"

If possible, use examples, materials, or drawings to demonstrate your ideas.

Revoice

"I think _____ is saying that ..."

Check whether you have restated the person's ideas accurately. *"Is that how you did it?"*

Agree or disagree

Agree with reason: *"I agree because ..."*

Agree with another student and give a reason or example.

Disagree with reason: *"I disagree because ..."*

Disagree with another student and give a reason or a counter-example.

Build on

Build on the thinking of another student through explanation, example, or demonstration.

"I can show that another way ..."

Go beyond:

Extend the ideas of other students by generalising or linking the idea to another concept.

"This makes me think about ..."

"Another way to think about this is ..."

"_____ is similar to _____ because …"

Wait time

After someone speaks, wait to think about what is being said (try five seconds).

Promote mathematical discourse

When students support their ideas with examples, look for and describe patterns, or make predictions, they are using mathematical thinking. When students share this thinking with others or respond to the thinking of their peers, they are participating in mathematical discourse. ALiM groups provide a safe setting for students to practise this.

You can invite a student to justify their ideas by simply asking "How do you know?" when they offer an answer. By explaining their reasoning, students often cement their understanding of a concept or, in the process, recognise flaws in their own logic.

Explaining, clarifying, and justifying ideas are an essential part of mathematical argumentation, in which ideas are shared, debated, and developed in order to reach a shared understanding. Research shows that young children can learn how to participate in mathematical argumentation. Andriessen (2006) calls this process "arguing to learn".

Students may struggle to challenge another group member's thinking, but a teacher can model how to do this. Counter-examples are an excellent way to challenge student thinking. For example, in the Revoicing example on page 2, the student is given two equally sized rectangles. The student understands that increasing a number of shares decreases the size of each share. The teacher could then present a third, significantly larger rectangle that is divided into four shares, or a third rectangle divided into three uneven shares, to explore the limits of the student's understanding of thirds and quarters.

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