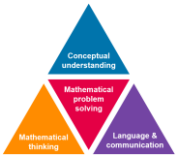
Language & Communication Framework



'*Mathematics education begins and proceeds in language, it advances and stumbles because of language and its outcomes are often assessed in language*.'

David Pimm

1. Learners must actively participate in communication of mathematical ideas.

Language and communication are integral to learning mathematics. By articulating their ideas, learners take control and ownership of those ideas and learn where they can apply them and where not. They become aware of what they know and can then clarify, explore, consolidate and reorganise this knowledge. Non-verbal communication is also important and includes the use of symbols, representations, gestures and other non-verbal signals.

If the teacher uses mathematical language but the learners do not, the words will not become 'their words', but will remain words used by a community of which they do not feel a part. Conversely, the more learners actively use those mathematical words, the more they will feel themselves to be mathematicians.

How would you answer these questions?

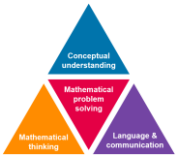
- What will you do to ensure that each learner feels a valued part of the learning community, encouraged to talk about and share their mathematical ideas?
- What opportunities will you plan for all learners to communicate their mathematical ideas?
- How will learners communicate these ideas? (Using language, symbols, diagrams, manipulatives…)
- Who talks in the lesson and when? How will you ensure that learners have ownership over what is discussed?

2. A classroom ethos that encourages and supports meaningful communication is essential.

If learners are to make mathematical language their own, they need to feel their ideas are valued. This is the case in a conjecturing environment, where all learners' contributions are listened to and treated as conjecture, which may be modified, rather than dismissed as 'wrong'. In such an environment, differing points of view are treated with respect and teachers and learners listen attentively to one another, with the expectation that they might change their view as a result of what is said. Participants in this type of dialogue are expected to interpret and evaluate each other's responses and the teacher's role shifts from sanctioning individual learner responses to facilitating extended learner dialogue. Adults make it clear that they are 'listening to' learners' responses, rather than 'listening for' a specific response.

Use of thinking time, paired and group talk activities and ground rules for co-operative work support learners to participate in talk, as do scaffolds such as stem sentences, accurate modelling and frequent use of mathematical vocabulary, and embedding an expectation that all learners talk in complete sentences at all time.

Immediate resolution of discussions is not essential, and learners will understand more if they reach shared conclusions, than if adults tell them what to conclude.



How would you answer these questions?

- How is the room arranged to facilitate talk?
- What are the expectations or 'ground rules' for participating in talk? How are they reinforced?
- What questions / prompts / responses have you prepared to facilitate classroom dialogue?
- What opportunities are there for learners to listen to and build on what their peers say?
- How do your responses to learners' contributions open up or close down subsequent discussion / dialogue? What techniques do you use to encourage others to evaluate, probe and respond?

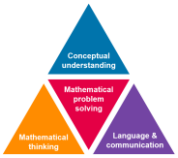
3. Mathematics has a precise formal language, which is distinct from everyday language.

Mathematics has a specific language, the 'mathematics register', which encompasses symbols, specific vocabulary and forms of expression, which follow conventions to express ideas precisely, formally and impersonally. Its use needs to be modelled and explicitly taught. Developing mathematical language requires meaningful sharing of key words, modelling their use in sentences and clarifying distinctions between everyday and mathematical uses of words (e.g. 'volume' or 'mean'); it also requires that learners participate in mathematical conversations.

Exploratory talk (often informal) can play an important role in learners' personal and collaborative sense-making and therefore has value in the mathematics classroom. Learners need to connect their own informal use of language to the mathematics register and this is more powerful when teachers help learners to refine their own definitions, rather than overlaying 'correct' explanations and definitions.

How would you answer these questions?

- Does everyone in the classroom speak in full sentences throughout the lesson?
- What words must be used? Which of these are maths-specific and which are more general words, less common in everyday conversation, whose meaning is essential to accessing the concept?
- Which words, if used, or used without care, could cause confusion? What language could create barriers to comprehension?
- When are informal ways of communicating sufficient and when are they not?
- Are there opportunities to explore different ways of expressing the same or similar ideas?
- How and when will you support learners to refine informal language and move towards formal mathematical language?



4. Language is a form of representation but also supports making connections between representations and between concepts.

Language is a representation in itself; written and spoken forms only take on mathematical meaning when connected to familiar representations that draw upon prior understanding. Labelling a concept gives the learner access to related representations and associated ideas. Learners extend and deepen their understanding when they find that the words they understand in one context also apply in other contexts. The words become the bridge, connecting mathematical ideas.

For example, saying 0.8 out loud as 'eight tenths' helps learners to see that 0.8 can be represented as $\frac{8}{10}$. Being able to move fluently between the vulgar fraction and decimal fraction deepens understanding and may present more efficient solutions to problems.

How would you answer these questions?

- How have you planned to develop meaningful understanding of the key language needed for this learning? What prior learning will you draw upon?
- What language will be necessary to draw attention to connections between the representations you plan to use?
- Can language itself be used to help learners to see connections between (aspects of) concepts?
- What activities will you plan to allow for learners to describe connections between representations and concepts?

5. Language and communication reveal current understanding to inform teaching.

Teachers ask a range of question types, including genuine questions (ones to which they do not know the answer), so that learners can communicate their current understanding. This is underpinned by a classroom ethos where reasoning and dialogue are both supported and expected. The more the teacher can find out about learners' current conceptions, the better position they are in to respond in the moment and to plan for coherent conceptual development that makes sense to learners. This is the essence of formative assessment.

It is important to consider what learner contributions actually reveal; correct answers do not necessarily indicate understanding. For example, a learner could correctly calculate 10% of an amount by dividing by 10, without understanding anything about percentages.

How would you answer these questions?

- How can you find out learners' current mathematical conceptions? What questions or tasks might you use?
- What are the possible learner responses to tasks, both correct and incorrect? How will you respond to these in turn in order to create opportunities for further dialogue? Are you prepared to adapt the planned learning?
- For which of your planned questions can you anticipate learner answers? How will you use these answers to inform your next steps in the lesson? Which genuine questions will you ask and for what purpose?