

Mathematics Strategy

Mathematical Discussion



What is mathematical discussion?

Mathematical discussion occurs when students are engaged in talking about their mathematical thinking and reasoning. Through rich discussions, students exchange ideas, agree, disagree, conjecture and justify their thinking as they make sense of the mathematics together.

Why is mathematical discussion important?

Research tells us that students learn when they are encouraged to become the authors of their own ideas and when they are held accountable for reasoning about and understanding key ideas (Engle and Conant 2002). Students make and defend mathematical conclusions using logical reasoning and evidence. By stating their ideas clearly to others they often come to understand their ideas more fully. By understanding other students' ideas they can see and evaluate alternative ways of thinking and build connections or modify misunderstandings.

How do teachers facilitate rich mathematical discussions?

Rich mathematical discussion facilitated through purposeful questioning and intentional prompts and cues that begin with the teacher. The goal of mathematical discourse is to build student understanding and confidence. The teachers' role is to honor the ideas students bring to the math classroom while introducing and reinforcing more standard or formal ideas and vocabulary. Facilitating the discussion is the art and science of teaching that requires the teacher to **anticipate** the responses, **monitor** engagement, **make decisions** about who shares their mathematical work, the **sequence** that the work is shared and **draw connections** between the student responses and the key mathematical ideas (Smith and Stein, 2011).

“Talk Moves” are practices that teachers use during class discussions. These moves include *revoicing* a student's reasoning to check for understanding and correct interpretation, asking students to *restate* another classmates reasoning or *apply their own reasoning* to another classmates by asking if they agree or disagree, *prompt students* to participate by asking if anyone would like to add on and finally *wait time*, which is potentially the most valuable talk move. Wait time provides much needed think time for students. (Chapin, O'Connor, and Anderson 2009)

(See Appendix A for more examples of talk moves.)

Posing Purposeful Questions encourages students to explain and reflect on their thinking and reasoning. Encouraging students to be active participants in reasoning and sense-making, teachers ask questions that reveal students' current understanding of a concept and make learning visible and accessible to all students (Hattie, Fisher & Frey, 2017). Teachers might ask questions such as “Does that make sense?” “Does your solution always work?” or “How could you prove that?”



There are different types of questions that are used for different reasons and at different times:

- *Questions that check, build and deepen student understanding* are questions that reveal misconceptions, overgeneralizations or partial understanding.
- *Funnelling vs Focusing Questions* is an important distinction to make as funnelling questions limit student thinking by hinting at an answer while focusing questions support students thinking by helping push their thinking forward.

(See appendix A for more examples of powerful question prompts.)

Fostering Mathematical Thinking is essential for the success of mathematical discussion. The teacher must be an active listener using “interpretive listening” in which teachers deliberately listen for student understanding instead of “evaluative listening” in which teachers listen for particular responses (Davis, 1997). Active listening allows the teacher to make decisions including which students share their thinking by intentionally choosing specific ideas, strategies and representations that will help build connections for the students. Students are prompted to compare and contrast different approaches to the same problem as well as justify their own thinking.

Mathematical discussion plays a critical role in the development of mathematical vocabulary. Teachers need to consistently and explicitly model the use of mathematical language as well as use specific vocabulary acquisition techniques such as word walls and concept mapping. Meaningful classroom discussions provide students opportunities to use the new vocabulary to make sense of their thinking.

Creating a Positive and Supportive Culture requires teachers to consider both the physical and emotional environment. Physical environment factors to consider include how and with whom students are sitting and working. Conversation is encouraged when people are situated to be able to look at one another. The use of random groups and non-permanent vertical spaces make it less likely for students to withdraw when the discussion requires more thinking and mobility of knowledge between students is increased ([Liljedahl, 2016](#)). In a supportive emotional environment a mindset of perseverance is cultivated and mistakes are valued and seen as opportunities to clarify their thinking.



(See Appendix B for a Classroom Discussion Self Reflection Tool for considering practices and goals for incorporating mathematical discussion in your classroom.)



Appendix A

Question Prompts to Support Mathematical Discourse

Talk Moves:

- Revoicing – So you are saying that . . .
- Restate someone else's reasoning –
 - Can you repeat what she just said in your own words?
- Apply their own reasoning to someone else's –
 - What do you think about that? Do you agree or disagree? Why?
- Prompt for further participation –
 - Would someone like to add on?
- Respond neutrally to errors –
 - What do you think about that? (to whole class)

Posing Purposeful Questions:

- Help students rely more on themselves to determine whether something is mathematically correct –
 - How did you reach that conclusion?
 - Does that make sense?
 - Can you make a model and show that?
- Help students learn to reason mathematically –
 - Why does . . . work?
 - Does that always work?
 - Is that true for all cases?
 - Can you think of a counterexample?
 - How could you prove that?
- Help students to learn to conjecture, invent, and solve problems –
 - What would happen if?
 - Do you see a pattern?
 - Can you predict the next one? What about the last one?
 - When does . . . work?
 - When will . . . be (larger, smaller, equal to, exactly twice, etc.) compared to . . .?
- Describe how to find . . .?
 - What do I do if I want . . . to happen?
- Help students connect mathematics, its ideas and applications –
 - How does this relate to . . .?
 - What ideas that we have learned were useful in solving this problem?
 - What advantages does this strategy have?

Adapted from Visible Learning for Mathematics (Hattie, Fisher & Frey, 2017) and Classroom discussions using math talk to help students learn, grades K-6 (Chapin, O'Connor, and Anderson 2009)



Appendix B

Adapted from:

Fig. 11. Levels of classroom discourse. From Hufford-Ackles, Fuson, and Sherin (2014), table 1.

Facilitating Mathematical Discussion Self Reflection				
				
Teacher Role	Teacher is the primary participant in math talk and thinking.	Teacher encourages the sharing of mathematical thinking and directs students to talk to the class, not the teacher only.	Teacher facilitates sharing of mathematical thinking between students, and encourages students to ask questions of one another.	Teacher creates space for students to carry the conversation themselves, share mathematical thinking, and build knowledge together.
Questioning	Teacher is only questioner. Questions serve to keep students listening to teacher. Students give short answers and respond to teacher only.	Only teacher asks questions. Teacher questions begin to focus on student thinking and less on answers.	Students ask questions of one another with prompting from teacher. Teacher asks probing questions and facilitates some student-to-student talk.	Students ask questions and listen to responses. Many questions ask "why" and call for justification. Teacher questions may still guide discourse.
Fostering Mathematical Thinking	Teacher questions focus on correctness. Students provide short answer-focused responses. Teacher may give answers. Teacher defines the thinking for the students.	Teacher probes student thinking somewhat. Teacher may fill in an explanation. Students provide brief descriptions of their thinking in response to teacher probing.	Teacher probes more deeply to learn about student thinking. Students respond to teacher probing and volunteer their thinking. Students begin to defend their answers.	Teacher follows student explanations closely. Students compare and contrast strategies. Students defend and justify their answers.
Positive Mathematics Culture	Culture supports students keeping ideas to themselves or just providing answers when asked.	Students believe that their ideas are accepted by the classroom community. They listen to one another supportively and restate in their own words what another student has said.	Students believe that their ideas are important and they value the ideas of others. They listen actively and contribute to the ideas of others.	Students believe that they are math leaders and can help shape the thinking of others. They contribute to others' ideas regularly and accept the same support from their peers.



References

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