Teaching K-2 Students to Participate in Mathematics Discourse: Techniques that Work

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How can elementary teachers effectively promote and support student engagement in meaningful mathematics discourse?

**Importance of Math Discourse for Learning**

- Facilitate meaningful mathematics discourse
- Pose purposeful questions
Overview of Webinar

1. Describe Project AIM
2. Engage with two discourse techniques
3. Questions & answers
Description
Project AIM
Guiding Principles

1. Practical techniques help teachers build a toolkit for high-quality math discourse.

2. These techniques help students learn about math talk.

3. All students can learn to participate productively in high-quality math discourse.
Project AIM (All Included in Mathematics)

- Support engagement in productive discourse
- Purposeful use of discourse techniques
- Adapt from literacy instruction
- Elementary grades
Project AIM (All Included in Mathematics)

- Several implementations in three districts
- Over 300 teachers
- Positive impacts on teachers’ knowledge, beliefs, and practice
- Moving to a hybrid PD (in-person & asynchronous online)
Project AIM Goals

- Discourse
- Content
- Instruction
Project AIM Modes

- Experience as Learners
- See in Action
- Rehearse as Teachers
When you think about discourse in the math classroom, what features do you consider most important?
**Different Types for Different Purposes**

- **Correcting** - assessing factual knowledge
- **Eliciting** - supporting students to join
- **Probing & Responsive** - developing conceptual understanding & building procedural fluency
- **Responsive** - supporting students in taking responsibility
## Math Discourse Matrix

<table>
<thead>
<tr>
<th>Dimensions &amp; Types</th>
<th>Discourse Types</th>
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</thead>
<tbody>
<tr>
<td><strong>Correcting Discourse</strong></td>
<td><strong>Exciting Discourse</strong></td>
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<tr>
<td>1. T asks open-ended questions that encourage many Ss to share their answers and how they found them, expanding the breadth of who participates</td>
<td>1. T asks probing questions that require Ss to justify their answer, how they found it and why they used their approach</td>
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<tr>
<td>2. T asks follow up questions when needed to lead to correct answers</td>
<td>2. T asks follow up questions to support the sharing and collection of several solutions</td>
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<tr>
<td>3. So ask T questions to establish correctness of answers</td>
<td>3. So ask “What” and “If...then” questions to clarify solution methods</td>
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### Discourse Dimensions

#### Explaining
1. T demonstrates procedures used to solve a problem
2. So present their answers when T asks
3. T presents correct answers and corrects S's incorrect answers

#### Correcting
1. T listens for correct answers to problems and proper vocabulary
2. Science for T's verification of their answers

#### Listening
1. T listens for S's answers and how they found them, with attention to S's vocabulary
2. T listens for S's explanations of their answer and rationale, with attention to S's vocabulary

#### Modes of Communication
1. T and S communicate in T-S-T patterns
2. T forces use of verbal or pictorial modes when Ss share procedures and answers
3. T provides Ss with representations they need to use to solve a problem
4. T forces S's use of academic language as "correct;" first or everyday language, if permitted, lacks math connections

#### Questioning
1. T asks open-ended questions that encourage many Ss to share their answers and how they found them, expanding the breadth of who participates
2. T asks follow up questions when needed to lead to correct answers
3. So ask T questions to establish correctness of answers

### Difference in Breadth
1. T and S communicate in T-S-T S-S-S patterns
2. T forces use of verbal or pictorial modes when Ss share procedures and answers
3. T provides Ss with representations they need to use to solve a problem
4. T forces S's use of academic language as "correct;" first or everyday language, if permitted, lacks math connections

### Difference in Depth
1. T and S communicate in T-S-T S-T-T-S patterns
2. T encourages use of multiple modes as Ss share an answer, how they get it, and why they used their approach
3. T encourages S's use of various representations to convey math thinking
4. T encourages S's use of academic, first, and everyday languages when appropriate to convey math meaning

### Difference in Responsibility
1. T makes guiding questions that promote Ss sharing their answers, how, and why, and connections between math ideas and representations
2. T asks follow up questions to check that all Ss understood all of the concepts of math ideas

(Sztajn, Heck, & Malzahn, 2020)
Responsive Listening

1. T listens for partial and complete understanding in Ss’ explanations and connections, with attention to Ss’ vocabulary

2. Ss listen to others’ explanations to make connections across math ideas
Poll Question

What is the biggest challenge you have in engaging students in responsive discourse in your math classroom?

a. Students justifying their thinking and making connections
b. Students actively listening to each other’s ideas
c. Students taking responsibility for the discussions
d. Including all students in the discussions
e. All of the above
Features of Math Talk Techniques

- Designed to teach students how to engage in high-quality math discourse
- Readily useable
- Used at different points in the lesson
- Tied to a purpose
- Foster teacher reflection on nature of discourse
Math Teaching Guide

ENACT

Launch
- Establish purpose
- Motivate interest
- Foster understanding
- Elicit prior knowledge
- Attend to language
- Model expectations
- Scaffold work

Discuss
- Scaffold discourse
- Foster understanding
- Promote students’ authority
- Release responsibility
- Push for connections
- Select extensions
- Formalize ideas
- Assess understanding

Explore
- Monitor understanding
- Promote connections
- Scaffold discourse
- Select and sequence responses
- Encourage rehearsing

Reflect
- Assess engagement and progress
- Examine classroom discourse
- Evaluate progress
- Consider further scaffolding

PLAN
- Identify goals
- Select task(s) and techniques
- Understand the mathematics
- Consider challenges
- Anticipate student work and discourse
- Determine teacher actions
- Organize lesson structure
- Decide grouping

(Sztajn, Heck, & Malzahn, 2020)
Engaging with techniques
Launch Phase

Discourse Techniques:
- Math Bet Lines
- Story Problem Retelling
- Task Think-Aloud

ENACT

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Bet Lines in Literacy

- Overall purpose is to build students’ reading comprehension skills.
- Can use the sentence starter “I bet ...”
- Students make predictions of what will happen next in a story after reading or hearing part of it.
**Math Bet Lines**

- Overall purpose is to build students’ problem comprehension skills.
- Can use the sentence starter “I bet….”
- Students make predictions of what information and question a math problem will include as the teacher reveals the problem one sentence at a time.
Specific Purposes:

- Use reading skills to comprehend problems
- Engage prior knowledge and connections to other problems
- Consider what each part of a problem says about known and unknown parts and relationships
- Anticipate information or question a problem may include
There are 38 pieces of fruit in the basket.

16 are apples.

12 are oranges.

And the rest are bananas.

How many bananas are in the basket?
Let’s See One in Action

Watch and listen for students’ “bets” and consider:

○ Does the prediction make sense?
○ What new math information does it offer?
Teacher: How many of you agree that they want us to know how many bananas there are in the problem.
Explore Phase

ENACT

Launch

Discuss

Explore

- Monitor understanding
- Promote connections
- Scaffold discourse
- Select and sequence responses
- Encourage rehearsing

Discourse Techniques:
- Solution Draft & Final Copy
- Math Four Square
- Talk Triangle
- Think-Pair-Rehearse-Share
Explore Phase

Discourse Techniques:
- Solution Draft & Final Copy
- Math Four Square
- Talk Triangle
- Think-Pair-Rehearse-Share
Solution Draft & Final Copy

Process in which students record their initial mathematical ideas, strengthen, clarify, and correct their thinking, and create a more complete and organized representation of that thinking for sharing.
Solution Draft and Final Copy

Purposes:

- Normalize mistakes and dead ends
- Model with math and construct arguments
- Encourage peer work and making connections
- Clearly represent and articulate mathematical reasoning

Let’s Return to the 2nd Grade Lesson...
Angie: We were trying to find out how many bananas there are.

Claudia: There’s not 28 bananas because you said that we would add 16 plus 12 to get how many bananas there are and I disagree because that would, that’s the total of apples and oranges. That’s not getting the total of how many bananas.
Claudia: We added in this equation and subtracted in this equation. Why did we subtract? We need to do a little statement about this (pointing to the 38-28).
How can elementary teachers effectively promote and support student engagement in meaningful mathematics discourse?
Discourse Techniques:
- Math Bet Lines
- Story Problem Retelling
- Task Think-Aloud

Discourse Techniques:
- Solution Draft & Final Copy
- Math Four Square
- Talk Triangle
- Think-Pair-Rehearse-Share

Discourse Techniques:
- Math Talk Chain
- All Talk Math
- Probing & Pressing
- Math Questions
- Math Learning Summary

Math Teaching Guide
Supporting Sense Making with BET LINES

This discourse strategy helps students understand story problems by revealing the task in stages and having learners adjust their predictions.

Launching a Discourse-Rich Mathematics Lesson

Adapted from literacy instruction for use in mathematics, the think-aloud strategy models mathematical thinking.

By Aaron Trocki, Christine Taylor, Tina Starling, Paola Stajn, and Daniel Heck
Activating Math Talk
11 Purposeful Techniques for Your Elementary Students
Paola Sztajn, Daniel Heck, Kristen Malzahn

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Questions & Answers

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