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## DIFFERENT TYPES OF MATH DISCOURSE

Because there can be several different patterned ways of using questioning, explaining, listening, and modes of communication in the classroom, we contend that teachers can use different types of math discourse in the classroom. These types can be used at different times and for different purposes. Figure 1-2 describes four types of discourse that are commonly seen in math classrooms.

Each cell of the Math Discourse Matrix contains indicators of what teachers (T) and students (S) are doing during a particular type of classroom discourse.

When engaging their students in these different types, teachers have different goals. For example:

- Correcting discourse can be appropriate for practicing facts.
- Eliciting discourse can support many students in joining the conversation.
- Probing and responsive discourse can develop conceptual understanding and build procedural fluency from this understanding.
- Responsive discourse can support students in taking responsibility for their learning.

### THINK ABOUT IT

Before moving forward, spend some time examining the Math Discourse Matrix (Figure 1-2).

What are students and teachers doing in each type of discourse in terms of their questioning, explaining, listening, and modes of communication?

We will take a more careful look at each of these discourse types.

### Correcting Discourse

This type of classroom discourse is organized around the teacher initiate–student respond–teacher evaluate (IRE) pattern of discourse in which the teacher asks questions, a student responds (*what* they did or found), and the teacher listens to verify whether the answer is right or wrong. The teacher then moves to accept the answer as correct, or corrects the student and provides the answer, or asks a new question or a different student for the correct answer. For teachers who may have learned math through engagement with this type of discourse, it can become a default pattern to which they turn. This

**Correcting Discourse:** a type of discourse that follows the pattern of teacher asks, students respond (*what*), and teacher verifies the correctness of the answer. It can support speed and accuracy with facts and procedures.

Figure I-2 • Math Discourse Matrix

Discourse Dimensions

	Discourse Types			
	Correcting Discourse	Eliciting Discourse	Probing Discourse	Responsive Discourse
Questioning	<ol style="list-style-type: none"> <li>1. T asks frequent, short-response questions that attend to Ss' accuracy and speed</li> <li>2. T asks follow-up questions when needed to lead to correct answers</li> <li>3. Ss ask T questions to establish correctness of answers</li> </ol>	<ol style="list-style-type: none"> <li>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</li> <li>2. T asks follow-up questions to support the sharing and collection of several solutions</li> <li>3. Ss ask T "what" and "how" questions to clarify solution methods</li> </ol>	<ol style="list-style-type: none"> <li>1. T asks probing questions that require Ss to justify their answer, how they found it, and why they used their approach</li> <li>2. T asks follow-up questions to press for mathematical depth</li> <li>3. Ss ask T "how" and "why" questions to clarify their own math thinking</li> </ol>	<ol style="list-style-type: none"> <li>1. T includes pressing questions that promote Ss sharing their answers, how, and why, and connections between math ideas and representations</li> <li>2. T asks follow-up questions to check that all students are making sense of and connecting math ideas</li> <li>3. Ss ask one another "how" and "why" questions, taking responsibility for understanding others' math thinking</li> </ol>
Explaining	<ol style="list-style-type: none"> <li>1. T demonstrates procedures used to solve a problem</li> <li>2. Ss present their answers when T asks</li> <li>3. T praises correct answers and corrects Ss' incorrect answers</li> </ol>	<ol style="list-style-type: none"> <li>1. T adds to Ss' presentations of their solution methods for solving a problem</li> <li>2. Ss present their answers and how they found them when T asks</li> <li>3. T accepts incorrect and less sophisticated answers as indication of Ss' current understanding</li> </ol>	<ol style="list-style-type: none"> <li>1. T revoices and extends Ss' presentations of various solution methods for solving a problem</li> <li>2. Ss present their answers, how they found them, and why they approached a problem as they did when T or other Ss probe</li> <li>3. T probes Ss' thinking about incorrect answers to deepen discussion about why they are incorrect</li> </ol>	<ol style="list-style-type: none"> <li>1. Ss restate, extend, and make connections across various solution methods presented</li> <li>2. Ss volunteer their answers, how they found them, why they approached a problem as they did, and connections to other ideas</li> <li>3. T and Ss examine incorrect answers so that all Ss can learn from mistakes and connect them to correct solutions</li> </ol>
Listening	<ol style="list-style-type: none"> <li>1. T listens for correct answers to problems and proper vocabulary</li> <li>2. Ss listen for T's verification of their answers</li> </ol>	<ol style="list-style-type: none"> <li>1. T listens for Ss' answers and how they found them, with attention to Ss' vocabulary</li> <li>2. Ss listen for T's reactions to ensure they have an acceptable procedure</li> </ol>	<ol style="list-style-type: none"> <li>1. T listens for Ss' explanation of their answer and rationale, with attention to Ss' vocabulary</li> <li>2. Ss listen to others' explanations to consider if their ideas are similar</li> </ol>	<ol style="list-style-type: none"> <li>1. T and Ss communicate with significant S-S patterns</li> <li>2. T requires use of multiple modes of communication as Ss share the answer, how they got it, why, and math connections</li> <li>3. T expects comparisons across representations to develop math understanding</li> <li>4. T expects use of academic, first, and everyday languages to develop math understanding</li> </ol>
Modes of Communication	<ol style="list-style-type: none"> <li>1. T and Ss communicate in T-S-T patterns</li> <li>2. T favors the use of verbal or pictorial modes when T/Ss share procedures and answers</li> <li>3. T provides Ss with representations they need to use to solve a problem</li> <li>4. T favors Ss' use of academic language as "correct"; first or everyday language, if permitted, lacks math connections</li> </ol>	<ol style="list-style-type: none"> <li>1. T and Ss communicate in T-S-T-S patterns</li> <li>2. T makes verbal, pictorial, or written modes available as Ss communicate the answer and how they got it</li> <li>3. T accepts all representations as equally effective</li> <li>4. T allows Ss' use of academic, first, and everyday languages equally as modes to share answers and methods</li> </ol>	<ol style="list-style-type: none"> <li>1. T and Ss communicate in T-S-T-S or T-S1-S2-S3 patterns</li> <li>2. T encourages use of multiple modes as Ss share answer, how they got it, and why they used their approach</li> <li>3. T encourages Ss' use of various representations to convey math thinking</li> <li>4. T encourages Ss' use of academic, first, and everyday languages when appropriate to convey math meaning</li> </ol>	<ol style="list-style-type: none"> <li>1. T and Ss communicate with significant S-S patterns</li> <li>2. T requires use of multiple modes of communication as Ss share the answer, how they got it, why, and math connections</li> <li>3. T expects comparisons across representations to develop math understanding</li> <li>4. T expects use of academic, first, and everyday languages to develop math understanding</li> </ol>



Difference in Breadth



Difference in Depth



Difference in Responsibility

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type of discourse can be effective to *access and assess students' accuracy and speed* regarding factual math knowledge and supports recall of facts and procedures. Correcting discourse lacks attention to students' own strategies and does not explicitly promote student engagement with strategic competency, math concepts, or higher-order thinking.

## Eliciting Discourse

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The transition between correcting and eliciting classroom discourse involves a *difference in breadth* of what is discussed and by whom. This type of discourse can include a change in turn-taking patterns and wait time so that more students participate in the classroom discourse community, expanding the breadth of who is included in the conversation and what is discussed. The teacher collects several answers to a problem, and students present their mathematical solutions together with explanations of their procedures (*what* and *how*). In this type of discourse, the teacher asks open-ended questions and creates a safe space for students' mathematical thinking. Students feel comfortable knowing that all answers are welcomed and mistakes become nonshameful events. Equally valuing all students' solutions can sometimes mean that less sophisticated mathematical answers, and sometimes even incorrect answers, remain unchallenged and more sophisticated and conceptually rich answers remain unexplored.

**Eliciting Discourse:** a type of discourse in which the teacher elicits and welcomes participation from a broad group of students who share their solutions (*what* and *how*). It can support engagement in math discourse.

## Probing Discourse

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The transition between eliciting and probing classroom discourse involves a *difference in depth* of the mathematical conversation. Here the teacher transitions from eliciting a collection of student answers to probing students' mathematical thinking and showing appreciation for their mathematical justifications and strategic competence (*what*, *how*, and *why*). While staying positive and supporting a high level of student participation, the teacher uses questioning to probe for student explanations about their ideas or solutions, including why they were thinking or working in particular ways and what their ideas or solutions mean. The teacher requires students to construct and present their mathematical arguments, with justification. The teacher also encourages students to critique their peers' reasoning while positioning incorrect or partially correct ideas as learning opportunities on which to build. There is a change in what is accepted as mathematical justification and what it means to be engaged in doing math.

**Probing Discourse:** a type of discourse in which the teacher uses questions to probe students' answers and press for depth in students' explanations of their mathematical thinking (*what*, *how*, and *why*). It can support understanding and fluency with mathematical ideas.

## Responsive Discourse

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**Responsive Discourse:** a type of discourse in which students take responsibility for asking each other questions that probe their answers and press for explanations, establishing connections among different mathematical representations (*what, how, why, and connections*). It supports reasoning and strategic thinking.

The transition between probing and responsive classroom discourse involves a *difference in responsibility* within the classroom organization. The teacher moves from being the sole authority for the quality of the content and the nature of the discourse to helping students take responsibility for them. The teacher purposefully works on releasing responsibility for the discourse to students. In turn, students understand that, together with the teacher, they are in charge of helping each other understand math. Maintaining both the eliciting and the probing nature of the two previous types of discourse, the teacher who engages with responsive discourse poses challenging tasks to students and asks them to not only present their thinking and justifications, but also establish mathematical connections among different solutions (*what, how, why, and connections*). The teacher expects *all* students to take initiative and to feel responsible for asking each other probing math questions that make thinking and justification available for discussion. Students become accustomed to comparing and contrasting their mathematical approaches to solving problems, examining similarities and differences across their solutions, and looking for connections. Through these collective, content-rich, and goal-focused math conversations, responsive discourse supports students' development of rigorous math knowledge, including conceptual understanding, procedural fluency, and strategic competence.

## HIGH-QUALITY MATH DISCOURSE

From the definitions of the different types of discourse, we can see that high-quality discourse supports the development of all strands of math proficiency: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (National Research Council, 2001). High-quality discourse is purposeful and engages students in taking responsibility for their own learning and for the learning of their peers. Although high-quality discourse can include a combination of all types of discourse for appropriate purposes, to support the development of conceptual understanding, probing and responsive discourse need to become the most common and evident patterns in the classroom.

This book focuses on how to move in this direction. With appropriate classroom structures and techniques, teachers can teach all young learners how to engage in responsive discourse—we have seen it emerge and persist in the classrooms of teachers who have collaborated with us.



## DISCUSS WITH COLLEAGUES

- 1 How does your definition of math discourse compare to the definition provided in this chapter? Which of the four parts of the definition (patterned; using questioning, explaining, listening, and different modes of communication; conceptual understanding; for all learners) are easier for you to support in your classroom? Which are more challenging? Why?
- 2 Think about a math lesson you recently taught. Share what happened in this lesson with your colleagues using the discourse features from the Math Discourse Matrix (Figure I-2). What evidence from your classroom indicates the types of discourse you and your students engaged with during the lesson?



## CONNECT TO YOUR PRACTICE

Pick one discourse dimension (questioning, explaining, listening, or modes of communication) under probing or responsive discourse. Plan and implement a math lesson focused on helping students engage in features of that particular dimension. Think about supports your students will need to engage in those ways. After your lesson, consider:

- ❑ How well did students engage in those features of the dimension? What was successful and what was challenging for students?
- ❑ What might you do differently in the future to improve student engagement in that dimension?