

How to Get Students Talking!

Generating Math Talk That Supports Math Learning

By Lisa Ann de Garcia

Due to the attention in the last few years on discourse and its importance to student learning, educators nationwide are finding that they can help children become confident problem solvers by focusing on getting them to talk and communicate in partnerships, small groups, whole groups, and in writing. In addition, English Language Learners are flourishing as they experience focused opportunities for talking and trying on new mathematical vocabulary.

So what exactly is discourse? What are the teaching practices associated with successfully establishing an environment to support it, and as a result, to improve mathematical proficiency? How does one begin to elicit meaningful talk during math lessons? As a profession, we share a vision about the role student discourse has in the development of students' mathematical understanding, but are often slow to bring the students along. Children do not naturally engage in this level of talk.

This article addresses the above questions and concerns—and more. It opens with a look at discourse through NCTM's definition and its involvement with the Common Core State Standards. It then focuses on literature available on discourse, specifically the book *Classroom Discussions*, and addresses five teaching practices focused on the *how to* of getting students talking about mathematics. The article concludes with journaling insights on discourse from a kindergarten and second-grade classroom. This article is by no means an exhaustive list of discourse "to dos;" hopefully it will however get us all started in thinking about and implementing best talk practices.

What is Discourse in the Mathematics Classroom?

NCTM's Definition

The National Council of Teachers of Mathematics (NCTM) in their 1991 professional standards describes discourse as ways of representing, thinking, talking, agreeing, and disagreeing; the way ideas are exchanged and what the ideas entail; and as being shaped by the tasks in which students engage as well as by the nature of the learning environment.

A View Through The Common Core Lens

As much of the country begins to implement the new Common Core State Standards, it is important to reflect on the role of discourse in these new standards. The Common Core was created based on five process standards: communication, reasoning and proof (another form of communication), problem solving, representation, and connections. Evidence of the importance of communication in learning mathematics is found in the Common Core introduction in statements such as, "One hallmark of mathematical understanding is the ability to justify . . . a student who can explain the rule understands the mathematics and may have a better chance to succeed at a less familiar task . . ." (p. 4). In the grade-specific standards, the importance of communication in learning mathematics is reflected in statements such as, "Students also use the meaning of fractions, of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for multiplying and dividing fractions make sense" (p. 33). These Common Core statements make it clear that conceptual understanding must be connected to the procedures, and that one way to deepen conceptual understanding is through the communication students have around concepts, strategies, and representations.

Learning from Literature on Discourse

One of the leading resources for discourse is *Classroom Discussions: Using Math Talk to Help Students Learn* (Chapin, O'Connor, and Anderson 2009). This resource and others highlight five teaching practices associated with improving the quality of discourse in the classroom.

Five Teaching Practices for Improving the Quality of Discourse in Mathematics Classrooms

- 1) Talk moves that engage students in discourse,
- 2) The art of questioning,
- 3) Using student thinking to propel discussions,
- 4) Setting up a supportive environment, and
- 5) Orchestrating the discourse.

Practice 1: Talk Moves That Engage Students in Discourse

For the first practice, the authors of *Classroom Discussions* propose five productive talk moves that can get talk going in an otherwise silent classroom. The first is *revoicing*. An example would be, “So you are saying that . . .” This *revoicing* allows the teacher to check in with a student about whether what the student said was correctly heard and interpreted by the teacher or another student. A way to encourage students to listen to their peers is through asking them to *restate someone else’s reasoning*, such as, “Can you repeat what he just said in your own words?” Another way is to ask students to *apply their own reasoning to someone else’s* using questions such as “What do you think about that?” and “Do you agree or disagree? Why?” This helps prevent students from just thinking about what they want to share and focuses their attention on what their classmates are saying. It also helps to strengthen the connections between ideas.

Simple questions such as, “Would someone like to add on?” are ways teachers can *prompt for further participation*. This helps elicit more discussion when not many students are talking, especially when they are not accustomed to explaining their thinking. Again it helps students to tune in to what others are saying so that they are able to expand on someone else’s idea.

Perhaps the most valuable talk move suggested by Chapin, O’Connor, and Anderson is the use of *wait time*. Often teachers are too quick to answer their own questions when no one chimes in. Children quickly become accustomed to this. Waiting provides think time and sets the expectation that someone will indeed respond and that the teacher will wait until someone does. Another important use for wait time is to provide English Language Learners or anyone who needs extra time with an opportunity to process the question and formulate an answer. One teacher reported that in his initial uses of wait time, one of his English Language Learners was able to participate in class discussion for the first time.

Practice 2: The Art of Questioning

Questioning is another critical component in supporting students to engage in meaningful discussions. The NCTM Standards outline roles questions have in the math classroom. The first role, *helping students to work together to make sense of mathematics*, is addressed by the five talk moves discussed above. The second role, *helping students to rely more on themselves to determine whether something is mathematically correct*, can be supported by questions such as, “How did you reach that conclusion? Does that make sense? Can you make a model and show that?” Questions such as, “Does that always work? Is that true for all cases? Can you think of a counterexample? How could you prove that?” are designed to *help students to learn to reason mathematically*. To *help students to learn to conjecture, invent, and solve problems*, the teacher might ask, “What would happen if? Do you see a pattern? Can you predict the next one? What about the last one?” Finally, teachers use questions to *help students connect mathematics, its ideas and applications* by asking, “How does this relate to . . .? What ideas that we have learned were useful in solving this problem?”

Practice 3: Using Student Thinking to Propel Discussions

Because discussions help students to summarize and synthesize the mathematics they are learning, the use of student thinking is a critical element of mathematical discourse. When teachers help students build on their thinking through talk, misconceptions are made clearer to both teacher and student, and at the same time, conceptual and procedural knowledge deepens. When doing so, the teacher must be an active listener so she can make decisions that will facilitate that talk. She also needs to respond neutrally to errors, so that the students can figure out misconceptions themselves. For example, the teacher can ask the whole class, “What do you think about that?” when a student offers an incorrect strategy or can ask the rest of the class to prove whether or not the strategy works. Through the conversation, the misconception becomes apparent to the class. This practice results in an authentic discussion focused on the mathematics and not on the individual student. The teacher also needs to be strategic about who shares during the discussion, since it is not a show-and-tell session, and choose ideas, strategies, and representations in a purposeful way that enhances the quality of the discussion.

Practice 4: Setting Up a Supportive Environment

When setting up a discourse-rich environment and one that enhances student engagement, both the physical and emotional environment must be considered. Teachers who have studied engagement find that it is very

effective if students face each other, either sitting in a circle or semi-circle on the floor or sitting in chairs arranged in a circle. Teachers can sit with students as part of the circle to encourage peer-to-peer discussion. If teachers are still having difficulty getting children to talk, they can remove themselves from the group and stand outside the circle. As a result, students are left looking only at each other, which encourages them to direct their comments to one another.

Careful consideration of the placement of visual aids and mathematically related vocabulary is important in supporting the level of talk. If charts are not visually accessible when they need to be, they will likely not be resourced by the students during whole group conversations. To increase the extent to which English Language Learners participate in group discussions, having related vocabulary and sentence frames where they can be easily accessed is critical.

For rich discussions, the emotional environment of the classroom must be safe and must be one where students want to learn and think deeply about the mathematics. When these elements are not present, the discussion stays at the surface level. Imagine a third grade classroom where the teacher introduces division for the first time and is met with cheers. It can happen! It happens when the value is on learning, challenging each other, and working together to solve problems as opposed to just getting the right answer. For more on setting up a supportive classroom environment for discourse, see Chapter 8 of *Classroom Discussions*.

Practice 5: Orchestrating the Discourse

The teacher becomes not unlike a conductor as he supports students to deepen their understanding of mathematics through a carefully orchestrated environment. In *Orchestrating Discussions*, Smith, Hughes, Engle, and Stein outline the *Five Practices Model*, which gives teachers influence over what is likely to happen in a discussion.

The Five Practices Model

The teacher's role is to:

- 1) anticipate student responses to challenging mathematical tasks;
- 2) monitor students' work on and engagement with the tasks;
- 3) select particular students to present their mathematical work;
- 4) sequence the student responses that will be displayed in specific order; and
- 5) connect different students' responses and connect the responses to key mathematical ideas.

Even if the teacher is focused, he still needs to hold students accountable. Otherwise the discussion will be unproductive. A lot of explicit teaching must go into how to engage in each level of discussion: whole group, small group, and partnerships. In the younger grades, one will find teachers showing students exactly what they should look like and sound like when discussing their thinking. Teachers may say things like, "Today in math, we are going to practice turning and talking with our partner. When I say go, you are going to turn like this and look at your partner. When I say stop, you are going to turn around and face me. Let's practice that right now." Even older students need to be explicitly taught what to do and say. A teacher might teach how a partnership functions by saying, "It sounds like you have an idea and you have an idea, but what seems to be lacking is for you two to put your ideas together to come up with a solution. So, what is your plan?"

One very effective method of holding students accountable is to let them know exactly what they should be saying when they are talking in their partnerships or small groups. For example, "Today, when you are talking to your partners and describing your solid shapes, I expect to hear you using the words faces, edges, and vertices." It is also supportive to let students know what they should be focusing on when someone is sharing a strategy, so they have a lens for listening, which heightens the level of engagement. A teacher might say, "When he is sharing his thinking, I want you to be thinking of how his way is similar or different to your way."

Students need to be aware of themselves as learners, and a great way to heighten this awareness is through self-evaluation and goal setting. Sometimes the child is the last one to know that he is distracting or not listening. Part of developing a safe culture is supporting students in being open with each other regarding their strengths and weaknesses so they can improve their communication skills and behaviors. It is wonderful to hear one child compliment another when she has participated for the first time or give gentle correction when another has been dominating the conversation. This level of self-awareness happens through consistent venues such as class meetings and tracking the progress of personal goals related to participation in mathematical discussions. The more students open up about themselves as learners, the deeper the relationships and, as a result, the deeper the trust.

Kindergarten						
Teaching Points	Sept	Oct	Nov	Dec	Jan	Feb
Partnerships						
Partner Talk Expectations	X					
Problem solving possible partner problems, such as: "What do you do if you both want to go first?" "How do you talk to your partner if they are not sharing?" Modeling language such as, "You can go first, or I can go first"		X				
"Turn and Talk", "hip to hip", "knee to knee"	X	X	much less prompting			
Demonstrating with a partner Modeling with another student how to share	X		X			
Showing Eye Contact	X	X	prompting	prompting		refine
What Listening Looks Like	X	X				
Teaching students to ask and answer a question on cue Ex: "Turn and talk. First partner ask... second partner answer..."		X				
Using partnerships to move towards whole group share of what they did together			X	X		
Comparing their work with a partner Ex: Asking partner, "How did you sort?" Partner answers, "I sorted by..."			X			
Have partners share in front of the whole group				X		
Introducing story problem procedures by saying the story a few times while students listen, then having them repeat it with the teacher a few times, then turn and tell their partner the story, then solve.				X		
Holding class meetings to help a partnership problem solve something related to working as partners						X
Formulating own question to ask their partner						X
Whole Group Discussion						
Comparing their work as a whole group "Is what so and so did the same or different as what s/he did?"	Very Guided					
Eye contact towards speaker		X				
Can you tell me what so and so said? (revoicing) "What do you notice about..." (this promoted a lot of talk)		X				
Learning to compare their work with others Prompting, "Who is talking?" "What should you do?"		X			X	
Turning and looking with just the heads and not entire bodies					X	
Whole group physical behaviors						X
Supporting Language and Vocabulary						
Use Sentence Stems "When you turn and talk to your partner, I want you to use the words..."	X	X	X	X	X	
Model Language: "I say it, you say it."	X	mimic with a partner	X			
Responding, "I did it like so and so"		X				
Language when comparing work: "same/different, because"		X	X	prompting		
Use of co-created charts / prompting students to reference them			X			
Vocabulary: agree/disagree			X			
Teaching how to ask a question back & generate own spontaneous questions					X	
Vocabulary: accurate / efficient						X exposure

Table 1: Teaching points of a kindergarten teacher during the year

2 nd Grade						
Teaching Points	Sept	Oct	Nov	Dec	Jan	Feb
Partnerships						
Whisper to your partner (during whole group)	X					
"Did you and your partner agree or disagree?" (beginning listening and repeating Tell me what your partner said	X					
"You two don't agree? Who is right?" Don't just let it be, but push-back on each other		X Students are voicing disagreement on own respectfully	X	X		
"How can you figure that out?" "Can your partner help you with that?" Students are pushing on each other and keeping each other accountable		X				
Coaching on how to wait for your partner to finish her turn. "Watch your partner." "Do you agree with how she took her turn?"			X	Partner coaching really paying off!!		
Model how to help telling with out telling answer. "You could say...you have a lot of coins, do you think you could trade?"			X			
Disagreeing and justifying "Is the way he/she did it the same as how you did it?"			X	X		
Providing list of questions students were to ask as partnership during games (race to a stack with beans and cups)				X		
Talk to your partner about _____'s way				X		
Modeling how to ask partner to repeat and how to explain Using sentence starters				X		
Providing limited tools to promote discussion in small groups						X
Provide team activities where members have to decide how to solve and which strategy to share						X

Table 2: Teaching points of a second grade teacher during the year for Partnerships

2 nd Grade						
Teaching Points	Sept	Oct	Nov	Dec	Jan	Feb
Whole Group Discussion						
Teach "quiet thumb"	X					
Respect: No laughing, mistakes are learning opportunities	X					
Good listening behaviors: No touching manipulatives, eye contact.	X	X			Reminders	
Physically adjusting eyes, heads, body	X				Reminders	
Begin number talks; collecting all answers without judgments	X					
Choosing kids to explain	X					
Ask questions to draw out solutions, such as, "How did you figure that out?" "How did you count?" "Where did you start?" "Did you count like this or a different way?" Modeling if they still cannot explain	X					
Strengthening listening by asking another child to repeat/explain strategy of another student	X	X				
Ask questions to hold students accountable for listening and deepening understanding such as "Does that make sense?" "What do you think of what ____ said?" "Do you agree/disagree?" "Any questions for ____?" "Who can explain ____'s strategy?" "What should you say if you didn't understand, couldn't hear, etc.?"	X	X	X		Reminders	
Chart and name strategies students use, such as: "Oh, you counted all, counted on, made a 10, used doubles." Chart as the students talk to make steps visible.	X	X	X			
Referring to other kids' ways as a way to celebrate students taking risks by trying a new way	X	X	Kids starting to notice, "Oh, that is how __ did it"			
"Is your strategy the same or different than ____'s strategy?" "Which strategy did ____ use?" (referring to the chart)	X				X	
Teacher scripting children's strategies on their papers and on the chart.	X					
Highlighting students who try on another student's strategies		X				
Trying to get students to see that their peers are their teachers to foster reason for listening more carefully			X			
Getting students to try on another someone else's strategy and acknowledging it with students, such as "Oh, Marquis did it like Yosef did yesterday."			X			
Helping students learn how to articulate their thinking (e.g., "What did you do? Tools you used? Where did you start?") to be easier understood by others				X		
Helping students to record their thinking. Model how to record each step so the listeners can see what you did				X		
Highlighting different ways of recording and different tools used in solving a problem ("Let me show you another way to record" "When you put the blocks together, how can you show that on paper?")				X		
Slowing down the person sharing between each step and ask class "Does that make sense?" "Do you understand" "Who can explain that step" "Why do you think she did that?"				X	X	
"Which ways are the same or kind of the same?" "Who's might you try on?"				X		
Having preselected student writing strategies to share				X		
Discussing incorrect answers to see if kids will listen and respectfully agree and disagree				X		
Allow time for the other person to react to partner during share out				X		
Moving position from front of the room to promote explaining				X		
Share partner's strategy rather than your own					X	X
What do you think ____ did next (heighten engagement)					X	
Using document camera more for share out since students have become more proficient with recording					X	X

Table 3: Teaching points of a second grade teacher during the year for Whole Group Discussion

First Discourse Experience 3 rd - 6 th Grade	
Teaching Points	
Whole Group Discussion	
Explain that we are having a conversation about what we built (model for problem given)	
What do we do when someone is explaining his/her thinking?	
*Listen (not just hearing, but thinking about what they said)	
*Listening to compare to see if we thought the same thing the speaker did	
*What does paying attention look like?	
Don't merely think what you are going to say next, rather respond back to the speaker - adding on or comparing	
How do we talk like adults? - taking turns, not raising hands	
Who would like to share? - opening it up to anyone (sometimes - other times choosing someone specific - this depends on if the focus is on the act of sharing or a specific strategy.	
When one person shares, ask some to restate	
Teach students how to ask someone to speak up or to repeat themselves if they weren't listening or if they couldn't hear	
"Could you please say that again, I wasn't listening."	
Lots of turn and talk to partner with something specific to talk about	
I have to listen so I can highlight a partnership and ask students to think about their thinking	
Asking students to try on someone else's way and explain what they did.	
Asking lots of questions such as "Does their way make sense?"	
**It is necessary to remind students often where their eyes need to be and to listen to what the speaker is saying.	
Partner Talk	
Generally on the first day I go around and listen and make sure that the partnerships are working together rather than side-by-side play and coach accordingly	
I will ask questions such as, "Do you know what he did?" "Can you explain it?"	
Direct when necessary (if students are having trouble working together) by saying, "When we share out, I want you to explain what your partner did."	
Note:	
At the end of one lesson, the discourse is not beautiful, but if the teacher is explicit with expectations and how to engage in discourse. children will talk, mostly to partner, as they are a little shy about the group at first. Students definitely engage in what the other students are thinking and make sense of other strategies. I would expect to be emphasizing the above points repeatedly for the next couple of months.	

Table 4: Teaching points that can be made on the first day in an upper grade classroom around discourse

Managing a classroom that makes students are responsible for their own learning means that the teacher has to become accustomed to not doing all of the work for them. One of the hardest things for teachers is to stop jumping in too soon and answering their own questions. Once a teacher I was working with told me that if she wasn't always doing the talking, she felt that she was not doing her job. Just because the students are the ones who should be doing the thinking and talking doesn't mean that the teacher does not play a significant role. One of the biggest jobs of the teacher is that of decision maker. The NCTM Standards state that teachers must decide what to pursue in depth, when and how to attach mathematical notation and language to students' ideas, when to provide information, when to clarify an issue, when to model, when to lead, and when to let a student struggle with difficulty, and how to encourage each student to participate. These decisions, so well-articulated by NCTM, are central to effective math teaching and remain crucial as we move into the implementation of the Common Core State Standards for Mathematics.

A Look into Classrooms: Journaling About Discourse

Recently, a kindergarten and a second-grade teacher were invited to spend most of one school year journaling exactly what they do to explicitly teach meaningful mathematical discourse. I also reflected on what I do when I go into a 3rd – 6th grade classroom for the first time for a demonstration lesson and how I start to get students to talk when they are not accustomed to it. This analysis was further broken down into partnerships and whole group discussion. In the case of the kindergarten teacher, the explicit teaching she did to support language and vocabulary was also noted. The following tables outline the teaching points and what time of year each was a primary focus. For example, in kindergarten, the teacher worked on the children turning and talking in September and October. In November, much less prompting was needed, and after that it became a norm in the classroom culture.

Each group of students is unique and has different needs. The above insights are not meant to be a checklist or recipe of how to facilitate deep mathematical discourse in your individual classroom, but they can serve as a resource of the types of behaviors teachers need to explicitly teach and pay attention to when trying to deepen the quality of talk. They can also serve as a reminder that it is best to teach behaviors in small segments, especially with younger children. When teaching older children, unless they exhibit significant social difficulties, it may be possible to focus on several different aspects of talk at once, but these behaviors need to be reinforced on an ongoing basis. Once these behaviors become part of the classroom culture, it is important to refine and deepen the talk by addressing specific needs of the individual group of students.

Carrying Discourse into the Individual Classroom

Mathematics educators nationwide agree that student engagement in meaningful mathematical discourse has a positive effect on their mathematical understanding as they increase the connections between ideas and representations. As we begin to implement the new Common Core State Standards, we need to not only have a vision for what meaningful talk might look like, but also be equipped on how to get the talk going. Teachers need to explicitly teach the social behaviors necessary in engaging in discourse on a whole group, small group, and partnership level. Although there are common behaviors most teachers can initially address, most behaviors are unique to the dynamics of an individual classroom.

Works Cited

- Chapin, S. H., C. O'Connor, and N.C. Anderson. *Classroom Discussions: Using Math Talk to Help Students Learn, Grades K-6, Second Edition* (Math Solutions, 2009)
Professional Standards for Teaching Mathematics (National Council of Teachers of Mathematics, 1991)
Smith, M. S., E. K. Hughes, R. A. Engle & M. K. Stein. *Orchestrating Discussions, (Mathematics Teaching in the Middle School, 14 (9). 548-556, 2009)*

Recommended Reading List

- Classroom Discussions: Using Math Talk to Help Students Learn, Grades K-6, Second Edition, S. H. Chapin, C. O'Connor, and N.C. Anderson.
Classroom Discussions: Seeing Math Discourse in Action, Grades K-6, N.C. Anderson, S.H. Chapin, C. O'Connor, (Copyright © 2011 by Scholastic, Inc.)
Good Questions for Math Teaching: Why Ask Them and What to Ask, K-6, Peter Sullivan and Pat Lilburn (Copyright © 2002 Math Solutions)
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