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CHAPTER 5

What the Students Have to Say

CHAPTER 5

Supporting Student Discourse

We consider the ways in which student discourse supports, encourages, and facilitates instruction. We'll unpack a variety of talk moves that teachers can use during the Main Lesson, in small groups, and with individual students. The goal with this pedagogy is to help students find their own meaning with math concepts and be able to articulate that understanding for themselves and others.

Introduction

Participating in a mathematical community is as much a part of learning mathematics as the conceptual understanding of the mathematics itself (Stein, 2001). Discourse is the primary way students participate in that community.

In this Chapter we examine the role of discourse in the classroom and introduce the All Learners Network (ALN) Discourse Framework. The ALN Discourse Framework provides teachers with a structure for facilitating inclusive, meaningful classroom discussions. The principles of this framework are intended to ensure that classroom discourse supports deep mathematics learning for all students.

What is Student Discourse?

Student discourse refers to the interactions that occur throughout a lesson. According to Van de Walle et al (2016), the goal of discourse is to keep the cognitive demand high while students are learning mathematics. Hattie (2017) explains that classroom discourse is about the exchange of ideas, including ways of representing, thinking, talking, agreeing, and disagreeing. The purposeful exchange of ideas through classroom discussion is at the center of student discourse and allows student thinking to be highlighted.

Why is Discourse Foundational to Student Learning in Mathematics?

Student discourse is an essential element of any mathematics classroom. Discourse is one of the ways students make sense of the mathematics they are learning. Through discourse, students clarify their thinking, share their developing understanding, and get help from their peers. Discourse provides students with opportunities to make sense of the mathematics and to make connections among their ideas and other students' ideas.

The Standards for Mathematical Practice, an important subset of the Common Core Standards for Mathematics (CCSSM), brings the need for discourse into sharp focus. For example, Practice Standard 3: Construct viable arguments and critique the reasoning of others, states:

> Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments…... They justify their conclusions, communicate them to others, and respond to the arguments of others……. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments (CCSSM, 2010, p. 6 – 7).

In order to achieve mathematical proficiency, students need regular opportunities in large and small group settings to communicate their ideas and listen and respond to others.
Providing discourse opportunities allows the teacher instructional moments to help students communicate their ideas precisely and clearly using specific mathematics terminology. Teachers encourage students to use clear definitions in discussion with others and in their own reasoning (CCSSM, 2010, p. 7). Students are learning to attend to precision; Standard for Mathematical Practice 6.

Discourse also plays an important role in Standard of Mathematical Practice 1: Make sense of problems and persevere in solving them. Through discourse students learn to "explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends" (CCSSM, 2010, p. 6.). Thus, it is through discourse with others that students are able to better make sense of problems and become stronger problem solvers. Discourse is a common element in other CCSS Standards for Mathematical Practice as well because it is an essential tool for students to use as they process and expand their mathematical thinking and problem solving.

All Learners Discourse Framework Background

According to Hattie, Fisher and Frey (2017) "…50% of classroom time (averaged over a week) should be devoted to student discourse and student interactions with their peers" (p. 153). The ALN lesson structure functions as a vehicle to support rich and abundant student discourse throughout the math block. In fact, the launch, main lesson, math menu, and closing all offer intentional and systematic moments for meaningful student discourse.

The ALN believes that through the process of making private ideas public and the resulting interactions with others, students' ideas and understanding become more refined. Central to the success of this type of student discourse is the belief that many times during the learning process what students have to say to each other is more important than what the teacher has to say about the math. This requires teachers to step back and allow students' voices to be equal contributors throughout math instruction.

The ALN Discourse Framework guides teachers to include the diverse thinking of all students. When a teacher listens attentively to the ideas that students share with each other, the teacher has the opportunity to synthesize and summarize student thinking. The teacher is better able to leverage students' thinking to deepen the whole class' collective understanding when student thinking remains at the center of developing mathematical understanding.

The ALN Discourse Framework

The **ALN Discourse Framework** focuses on three important guiding principles to develop discourse during math instruction. The ALN believes that the implementation of these principles together with other ALN practices, allows ***all*** students more equitable access to grade level mathematics. These principles for discourse are:

1. Provide opportunities for students to generate and share their ideas with partners, in small groups or with the whole class,
2. Emphasize multiple strategies or points of view, and
3. Encourage students to evaluate or compare their thinking with their peers.

Provide Opportunities to Generate and Share Ideas

As we have described throughout this chapter, student discourse in the classroom is essential to how students make sense of mathematical concepts and skills and build new connections. Consider how much more you understand something after you explain it to someone else. You might discover a new question or idea that invites further exploration. In addition to illuminating new ideas to consider, explaining an idea to someone else can deepen your own understanding or help you understand a concept in a different way.

The foundation for strong student discourse is an inclusive and supportive classroom environment in which all students can feel comfortable sharing ideas, making mistakes, and admitting to moments of disequilibrium.

Below is an example from a third-grade classroom which illustrates how one teacher utilized student discourse to help build student understanding of a new fraction concept. Rich student discourse has been a central part of this classroom's mathematics instruction. In the main lesson described below students explored fractions using real life scenarios and number lines. The students were familiar with the use of number lines for understanding the magnitude of whole numbers and for adding and subtracting whole numbers. This was the first main lesson where students worked with a number line to build understanding of the magnitude of common fractions. Prior to this lesson students had used fraction circles to compare and build common fractions.

To begin the lesson, the teacher drew a number line from 0 to 1 on the board and posed a question to the class: *Where do the numbers one fourth, two fourths, three fourths, and four fourths go on this number line?* The students began working with partners to answer the question. As expected,

some students brought more background knowledge to fraction work than others. The teacher moved around the classroom listening closely as partners reasoned with each other. She noticed that Amelia was in tears and Eleanor, her math partner, was rubbing her back. The box below includes the discussion that ensued.

Teacher: Amelia, what's wrong?
Amelia: I just don't get this.
Teacher: Yeah, that's okay right now. We're learning about a new set of numbers so it might feel a little uncomfortable for a while. Eleanor, how are you feeling?
Eleanor: I think I know where they go on the number line (pointing to her accurate sketch of a number line from 0 to 1 split into four equal parts).
Teacher: Amelia, I want you to listen to what has made sense to Eleanor so far. If you have a question for her, ask it. If it still doesn't make sense, have her explain it again. What is an important thing to remember about a moment when something feels really challenging in class?
Amelia: It's actually when your brain is growing the most.
Teacher: Exactly...so how does that plan sound to you Amelia?
Amelia: *nods*
Eleanor: So the first connection I made was that four fourths means the same as the number one. Remember how when we put all four yellow pieces together we rebuilt the circle?
Amelia: The four pieces made one whole circle. Yeah I remember that.
Eleanor: So that means it has to go on the number line with number one. They mean the same thing. It's one cake. No slices or four slices, you still have one cake.
Amelia: *nods*

The teacher then moved away as Eleanor explained that two fourths was the same as half and was located halfway between 0 and 1. It was obvious to the teacher that the moment benefitted both learners. Amelia felt supported in her moment of disequilibrium and Eleanor cemented her own understanding of this new learning by explaining her reasoning to Amelia. Perhaps Eleanor and Amelia walked into the next day's lesson with a deeper understanding of where fractions are located on a number line because they collaboratively refined their thoughts and deepened their understanding of locating fourths on a number line. Notice the important role discourse played in this collaboration. Some teachers would have made the common mistake of trying to save Amelia from her discomfort and confusion by offering a clear, explicit teacher explanation. Although this is often a common teacher reaction, it may not be the best way to support a student.

> Teachers often step in to help because they think frustration and lack of immediate success are indicators that they have failed their students. We feel strongly that all of us, as mathematics teachers, need to stop doing what is easy (stepping in to rescue) and do what is right (giving students the time or space to become independent, self-reliant problem solvers) (Peterson and Viramontes, 2017, p.75).

What is true for moments of student frustration and disequilibrium during problem solving is also true during student discourse. Teachers who hold high expectations for their students communicate this by allowing the students to refine their thinking through discourse. It is the teacher's responsibility to provide their students with lots of opportunities to generate and share ideas throughout the math instruction.

Emphasize Multiple Strategies or Points of View

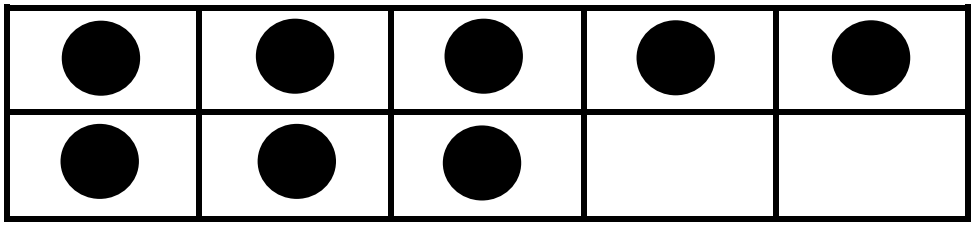
Supporting the learning for all students starts with valuing students' different strategies and points of view. The ALN believes that by emphasizing the multiple strategies students use in problem solving we are showing students that their voices and thinking are valued and mathematically relevant. Emphasizing different points of view shows students that they are in a math classroom where multiple strategies are as important as the accuracy of a solution. Students come to their math classrooms with different levels of experience and strategies for solving math problems. Sharing those strategies is essential to building a robust understanding of mathematical concepts. This includes sharing representations, modeling with manipulatives, or writing equations. The teacher's role is to help students make connections among the different strategies so that students can move with understanding to more efficient strategies.

One goal of student discourse is to help students deepen their conceptual understanding of important grade level math concepts. In order to develop a deep understanding of a concept, students must connect and organize information about the concept in a way that makes sense to them. The teacher can help facilitate connections by paying close attention to how students in the class approach their math thinking differently. When facilitating discussions with the whole class, the teacher purposefully selects and sequences strategies to share. (Stein and Smith, 2011). When selecting and sequencing, teachers intentionally select the student responses to use with the class

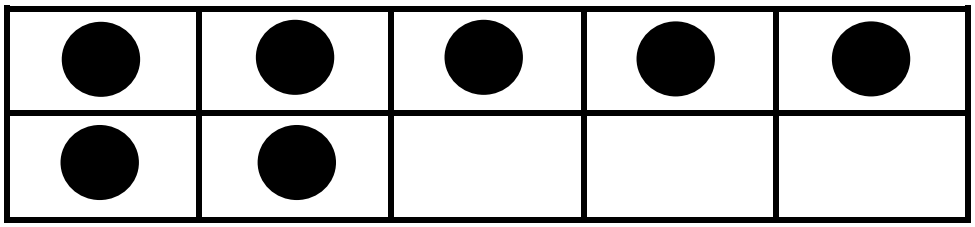
to carefully and logically advance the mathematical understanding of all students. To do this effectively, teachers sequence the solutions in a way that provides a coherent line of reasoning related to the essential concepts in the lesson.

In the Number Talk example below, the teacher uses a select and sequence strategy to help the students advance their understanding of the teen numbers. This class had previously worked on a series of main lessons interpreting teen numbers as the sum of one ten and a number of ones. This Number Talk focused on the strategy of using a "make 10 strategy" in addition. The teacher presented two ten frame dot cards and asked the students to determine the total number of dots on both cards. The two cards students considered looked like this:

Card A



Card B



Students then flashed a "thumbs-up" when ready to discuss their strategies. The teacher recorded answers on the board without indicating in any way if any answer was wrong or right. After the teacher recorded all student answers on the whiteboard, she led a full class discussion beginning with the strategies of Trey and Griffin. This discussion is described in the box below.

Teacher: Let's get some strategies on the board. Trey, start us off.
Trey: There's 15 dots because I counted them.
Teacher: How did you count them?

Trey: *Counts from 1-15 using his finger as an air pointer between himself and the cards repeating exactly what the teacher had watched him do when he solved during private think time*.
Teacher: So Trey counted all the dots to figure out 15 in total. Griffin, let's hear your thinking next. *The teacher had seen Griffin count in a similar way to Trey.*
Griffin: I got 15 too. I figured out 8 (*pointing to card A*). Then 9, 10, 11, 12, 13, 14, 15 (*pointing to each of the dots on card B*).
Teacher: How is the way you counted a little different than the way Trey counted?
Griffin: I just said 8. He counted the 8.
Teacher: How did you know there were 8 dots without counting them?
Griffin: I saw 5 dots and 3 dots which is 8.
Teacher: Both Trey and Griffin used different counting strategies. Other strategies? Miya?
Miya: I got 15 too. I pretended the two dots on the bottom card filled up the empty spots in the top card. So it was a full ten frame. So 10 (*pointing to card A*), 11, 12, 13, 14, 15 (*pointing to the dots in the first row of card B*).
Addy: I did what Miya did too. And I remembered that 10 and 5 more is 15 so I didn't even have to count up.
Teacher: What a great connection! What helped you remember 10 and 5 more is always 15?
Addy: Playing 10 Plus in menu yesterday with Matthew
Teacher: What are other ways you figured out the total? Olivia?
Olivia: I did what Miya did to fill up a ten frame. But then I counted by fives, 5, 10, 15 (*pointing to the first three rows of the two ten frame cards*).

Although it may not be obvious, the teacher made a purposeful selection of the student strategies to include in the discussion and sequenced them in a way that helped the students make connections among the strategies. The *Select and Sequence* strategy intentionally connects strategies that on the surface appear dissimilar. It allows all students opportunities to see how their strategy can become more generalizable and efficient.

> The teacher can help students make judgments about the consequences of different approaches for the range of the problems that can be solved, one's likely accuracy and efficiency in solving them, and the kinds of mathematical patterns that can be most easily discerned. Rather than having mathematical discussions consist of separate presentations of different ways to solve a particular problem, the goal is to have student presentations build on one another to develop powerful mathematical ideas (Smith and Stein, 2018, p. 14).

The teacher also used student discourse to create the environment necessary for all students to experience deeper levels of understanding. She accomplished this by continually asking students to explain their math thinking and clearly communicating that everyone can contribute to class learning. Selecting and sequencing represents one effective strategy for supporting student learning by emphasizing and connecting multiple strategies and points of view.

Encourage Students to Evaluate and Compare their Thinking with Peers

In addition to strengthening opportunities for students to generate ideas and share their different strategies, discourse allows students to evaluate or compare their thinking with their peers. This facilitates peer to peer support in building understanding of important math concepts. Knowledge is built through personal "meaning making" which is supported by connecting ones' thinking to the thinking of others and regularly considering and discussing thinking that is not one's own. Students must have habitual conversations about how different ways of thinking connect within important grade level math concepts.

Consider the "Carrot and Potato" analogy to shed light on the type of discourse we are trying to cultivate in our classrooms. Carrots are harvested one at a time. When one pulls a carrot top from the ground one carrot is exposed. However, when a potato plant is tugged from the ground one exposes a number of potatoes connected by the web of the plant's roots. Essentially, teachers can facilitate student discourse in their math classrooms that either helps "to plant carrots or potatoes in their students' garden of learning." It's easier to retrieve concepts that are interconnected like potatoes rather than concepts that are isolated like carrots. This is why helping students make connections between prior knowledge and new learning is so important (Tapper, 2012). The teacher should orchestrate student discourse so that it builds and deepens connections across student thinking and continually encourages students to focus on the similarities among mathematics concepts, even those that on the surface appear unrelated.

During closure the teacher should make explicit connections among the ideas offered by the students. Student discourse should also occur throughout menu time even though many of those

conversations are independent of the teacher. Students need to develop the skills to independently discuss mathematics with peers.

Consider this excerpt of a third-grade small group lesson. Three students worked on a subtraction problem in which the context suggested removal as a strategy but the numbers made an adding up strategy a more efficient approach.

The teacher provided the students with the problem shown below:

> *At the end of the summer Jose saved 351 dollars from a summer job.*
> *Jose spent 348 dollars to buy an ipad.*
> *How much money did Jose have left after he bought the ipad?*

The teacher asked Charlie, Keith and Sam to share and discuss their solutions. Charlie used a removal strategy that he referred to as "taking away chunks." Keith pictured a number line to go along with his adding-up strategy. Charlie and Keith both used benchmark numbers in their strategies. Sam was confident with several strategies including removal and adding-up. He was beginning to understand how to change and adjust the addends in an addition problem to create an easier problem to solve mentally. He referred to this as "making it into an easier problem." As a result, Sam evaluated the numbers in this problem as he considered which strategy to use. These students had many conversations about their strategies in small groups. They were beginning to examine why you might want to choose one strategy over another based on the numbers in the problem and the problem context.

A description of Charlie, Keith and Sam's discussion is in the box below.

Teacher: Let's start with our answer box. Charlie, what answer will you be defending today?
Charlie: I got 3 for my answer.
Keith and Sam both make the connection hand signal to show that they are agreeing with what Charlie is saying.
Teacher: Looks like Keith and Sam agree with you today Charlie. So let's talk about the strategies you used. Go ahead…

At this point, the teacher expects students to talk to each other about the strategies they've used. Because the group is small and the students have practiced this many times, she does not need to call on raised hands.
Keith: I'll start. I used add up. I started from 348 and imagined jumping 2, then 1 more to get to 351. That's how I got three.
Teacher: Why did you decide to start with a jump of 2?
Keith: I wanted to get to 350 first. The numbers are so close to each other that I could have also just done one jump of 3.
Charlie: I took out chunks. First I took out the 300. That leaves 51. You still have 48 to take out. So then I took out the 40. That leaves 11 and I still have 8 to take out. I split the 8 into a 7 and a 1. Then I took out the 1. That leaves 10 – 7 which I know is 3.
Sam: I started the same way that Charlie did and took out 300. So I had 51 – 48. That's when I realized how close the numbers were to each other. So then I just counted up from 48 to get 3.
Charlie: Oh
Keith: Yeah I didn't really realize how close the numbers were until I did my first jump. Then I was like oh duh.
Teacher: What do you mean?
Keith: I realized I didn't even need to do two jumps. I could have just done it in one.
Charlie: I can't believe I could have just counted up.
Sam: Yeah Keith always uses add up and I noticed how fast he gets the answer when the numbers are close to each other.
Teacher: Hmmm, so Charlie, what would you look for in the numbers to make you change your strategy to adding up?

Notice how the teacher functioned as a facilitator or coach of the conversation and how she steered the conversation towards building connections between their strategies. In addition, the teacher did not tell Charlie directly that adding-up would have been a more efficient approach. Charlie was allowed to discover this on his own during the discussion. The teacher's final question to Charlie was designed to help Charlie be more selective in his choice of strategies. Overall, the teacher was focused on helping students evaluate and compare all the strategies discussed. She provided repeated opportunities for students to explain, argue, connect, analyze, and critique.

Laying the Foundation for the ALN Discourse Framework in the Classroom

A teacher must be purposeful in establishing the practice of providing opportunities for daily student discourse. Two of those practices; establishing norms for discourse and building students' listening skills, are foundational to this work.

Discourse Norms

Creating a classroom where all three aspects of the ALN Discourse Framework are central to learning begins with establishing norms. Norms are "an agreement among members of a classroom or school about how they will treat one another" (Borich, 2012). Norms help an effective classroom run smoothly and maximize student learning. Norms are not rules, as rules are teacher generated and must be obeyed. Rather, norms are agreed upon guidelines for how the classroom community will operate together while learning math. What are possible norms that would allow for student discourse in the classroom?

Below are a few sample norms to consider:

- Questions are important.
- Mistakes are valuable.
- Disagree with people not ideas.
- Take turns.
- Help each other learn.
- Be willing to try new things.

It is worth noting that norms may change over time. You and your students may need to revisit your norms and decide if they are still working or need to be revised. As a teacher, you help clarify and set the expectations, as well as help students process moments when norms need to be revisited. Some students are ready to participate in discussions from the moment they enter the classroom, others will take longer before they are comfortable sharing their thoughts and ideas with the whole class.

Active Listening

It is impossible for discourse to be an effective tool for learning mathematics without the ability to listen to others. Active listening is a skill that takes time and practice to develop. As teachers, we are constantly refining our active listening skills. We continue to learn how to listen for what students are saying, not just for the right answer. Students too will need time and practice to

develop their active listening skills. When you are in a group and you offer an idea, how do you know that others are listening? You may notice that the other people in the group are looking at you. Perhaps they nod. They respond to your idea with questions for clarification or they may extend your idea, building on by adding their own thoughts. These are all ways that people demonstrate that they are listening. Ray (2013) suggests teachers removing themselves from the conversation is one of the most important ways for a teacher to support students in becoming active listeners. As students orient their questions and observations to each other, they take ownership of the learning.

Some strategies that teachers may use to help students develop active listening skills include:

- Asking students to repeat what they are saying so that everyone can hear.
- Remind students to address each other if they are speaking only to you.
- Ask questions that have multiple answers.
- Ask a student to re-voice what another student said.

As students develop active listening skills, they are more likely to enter naturally into a conversation. The classroom culture during discussions will shift as students get better at both speaking with each other and listening to other's thoughts. "When a teacher succeeds in setting up a classroom in which students feel obligated to listen to one another, to make their own contributions clear and comprehensible, and to provide evidence for their claims, that teacher has set in place a powerful context for student learning" (Chapin, O'Connor, and Anderson, 2009, p. 9).

Chapter Summary

Student discourse in the classroom is an essential component in students making sense of the mathematics that they are learning. Discourse allows students to share and consider different solution strategies. It turns students' private thinking into public opportunities for learning and growth. These three principles in the ALN Discourse Framework are designed to allow all students more equitable access to grade level mathematics:

1. Provide opportunities for students to generate and share their ideas with partners, in small groups or with the whole class,
2. Emphasize multiple strategies or points of view, and
3. Encourage students to evaluate or compare their thinking with their peers.

All teachers can grow and improve the skills necessary to effectively facilitate student discourse.

Even if you've already developed an expertise in these skills, there are ways you can deepen your practice. You might consider:

- The ways in which you are providing opportunities for students to generate and share their ideas with partners, in small groups or with the whole class.
- Facilitation moves to promote and emphasize multiple strategies or points of view.
- Instructional techniques you are using that encourage students to evaluate or compare their thinking with their peers.

The benefactors of your purposeful practice will be the students in your classroom. Those students will have increased opportunities to make sense of the mathematics they are learning.

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