

Chapter 1

Fostering Small-Group, Student-to-Student Discourse (S³D)

As I was working with one group of students, I looked across the room at another group. About five minutes prior, one of the students in that group had raised her hand, stating that her group needed my help. I assured her that I would come to her group next. Now, the four students in the group were sitting in silence, not engaging with the task, and waiting for my arrival. I felt conflicted. I wanted to give attention to the group in front of me. Yet I did not want the other group to be doing nothing for an extended period of time. How could I help my students progress to the point at which they could effectively communicate about a task without my constant support?

We have students work in small groups because reasoning, problem solving, communicating clearly, and making sense of others' ideas all support students in learning mathematics with deep understanding. However, in order for students to get the most out of small-group work, each and every group member must participate in productive mathematical discussions. Unfortunately, this usually does not come naturally for students. Similar to my experience, they need your support, yet the very nature of small-group work means that you cannot assist every group at the same time. You need strategies and tools that will foster productive, independent student-to-student conversations. The primary purpose of this book is to help you learn, and in time improve upon, such strategies and tools.

Despite the challenge of promoting productive discussion when we cannot actually be present with all groups, we can anticipate some common difficulties and dynamics and specific moves to use in response. This chapter introduces a two-phase approach for fostering small-group, student-to-student discourse (S³D approach). It starts with evaluating current discourse (Phase 1), and then engaging in a cycle of planning, using, and evaluating teacher moves aligned with specific goals (Phase 2). By learning some of these common dynamics and moves, we as teachers will be able to collaborate more effectively in addressing a common problem of practice.

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SMALL-GROUP TALK IN MS. YOUNG’S GEOMETRY CLASS

Before being introduced to the various aspects of the approach, let’s look in on a small group of three students (Derek, Emily, and Claire) in Ms. Young’s high school geometry class. Dialogue 1.1 occurred early in the year, and dialogue 1.2 happened one month later.

OPPORTUNITY FOR ENGAGEMENT

- Before reading each dialogue, do each task. Anticipate strategies students may use and challenges they may encounter while solving the problems.
- Read dialogue 1.1 and describe the strengths and weaknesses of the student communication.
- Read dialogue 1.2 and describe the strengths and weaknesses of the student communication.
- Compare the nature of the student-to-student discourse between dialogue 1.1 and dialogue 1.2.

Fig. 1.1

Greg works in construction. His boss asks him to check if two triangles (ABC and XYZ) in a truss are congruent. Greg knows that if the two triangles have three pairs of congruent sides and three congruent corresponding angles, then the triangles are congruent. However, he thinks he does not have to measure all the sides and all the angles.

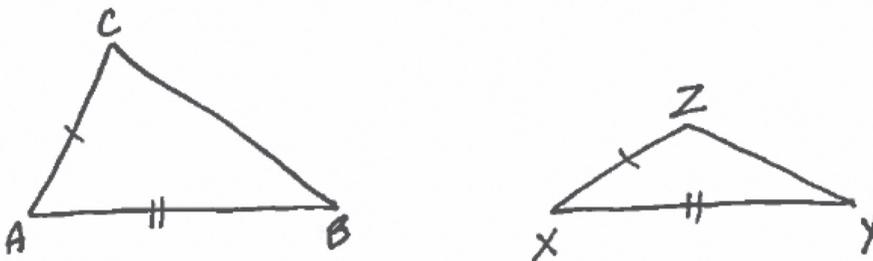
Greg measures two pairs of corresponding sides of the two triangles. He finds that \overline{XY} is the same length as \overline{AB} and \overline{XZ} is the same length as \overline{AC} . He thinks that because \overline{XY} is congruent to \overline{AB} and \overline{XZ} is congruent to \overline{AC} , then the two triangles must be congruent. Is it possible that \overline{XY} and \overline{AB} are congruent, \overline{XZ} and \overline{AC} are congruent, but that the triangles are NOT congruent? Draw triangles to support your answer.

The Triangle Congruence Shortcuts task that students in Ms. Young’s class are discussing in dialogue 1.1 (Adapted from *SpringBoard Geometry*, © 2015. The College Board. www.collegeboard.org. Used with permission. SpringBoard® is a trademark registered by the College Board, which is not affiliated with, and does not endorse, this product.)

Dialogue 1.1		Teacher: Ms. Young	Commentary
Task: Triangle Congruence Shortcuts (Y1, p. 200)			
1	<p><i>Emily/Claire:</i> I don’t get it.</p> <p><i>Derek:</i> Basically, you have to change the angle.</p> <p><i>Emily:</i> What?</p>		<i>Emily and Claire relied on Derek to address their questions, clarify their confusion, and evaluate their ideas.</i>

Dialogue 1.1 <i>continued</i>		Commentary
5	<p><i>Derek:</i> You just have to make sure that you have two lines inside the triangle that are equal to AB and AC.</p> <p><i>Emily:</i> Oh, the measurement has to be the same, but the degrees?</p>	<p><i>Emily continued to ask a sequence of clarifying and confirming questions. Notably, Claire was not participating in this segment of the dialogue.</i></p>
10	<p><i>Derek:</i> Different, they have to be different.</p> <p><i>Emily:</i> So, you want us to get drawing. For CB, does that one have to be the same length too?</p> <p><i>Derek:</i> Yes.</p>	
15	<p><i>Emily:</i> Oh, but the angle changes the length. Okay, it worked for me. [figure 1.2]</p> <p><i>Claire:</i> I still don't get it.</p> <p><i>Emily:</i> Is that clock wrong, or is that really the time. It was the same time the last time I looked at the clock.</p>	<p><i>Although off-topic conversation is bound to occur between students, in this case, the off-topic talk happened at the expense of the understanding of one of the group members.</i></p>
20	<p><i>Derek:</i> That's not right.</p> <p><i>Emily:</i> Okay, because the last time I looked at the clock it was the same time.</p> <p><i>Claire:</i> It's not working anymore.</p>	

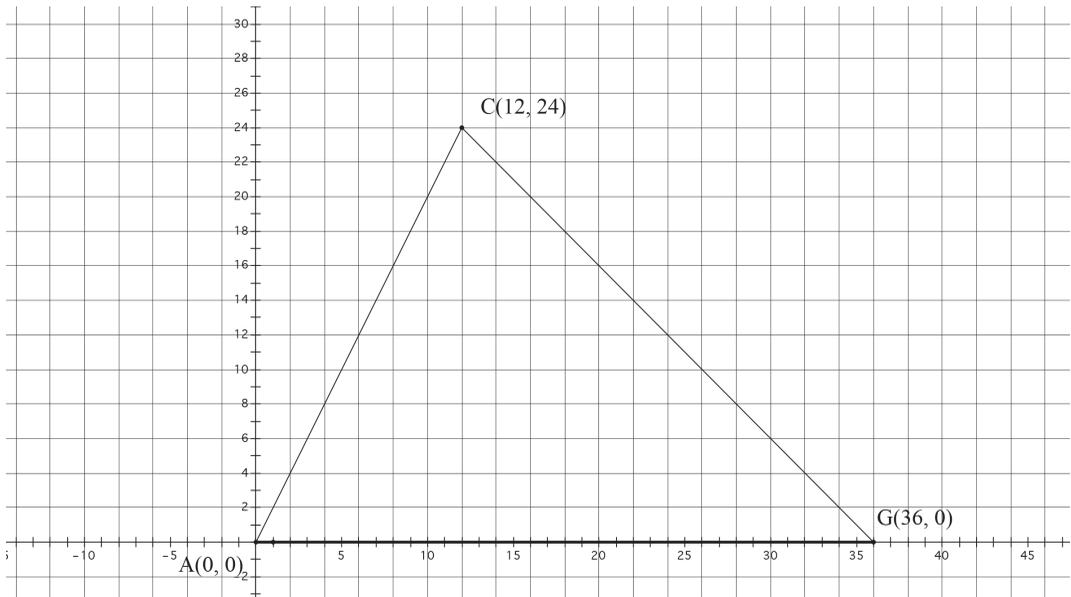
Fig. 1.2



The perpendicular bisectors of the sides of a triangle are concurrent. This point of concurrency is called the **circumcenter**.

Emily's work on the Triangle Congruence Shortcuts task in dialogue 1.1

Fig. 1.3



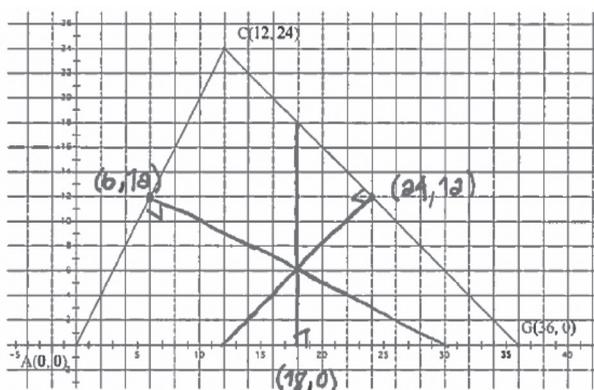
Al found the circumcenter of the triangle above using an algebraic approach. His answer was (18, 6). Geoff decided to carefully sketch the perpendicular bisector of each side of the triangle. Use Geoff's method to decide if Al is correct. Is (18, 6) the circumcenter?

The Circumcenter task that is the focus of Claire, Emily, and Derek's discussion in dialogue 1.2. (Adapted from *SpringBoard Geometry*, © 2015. The College Board. www.collegeboard.org. Used with permission. SpringBoard® is a trademark registered by the College Board, which is not affiliated with, and does not endorse, this product.)

Dialogue 1.2		Teacher: Ms. Young	Commentary
Task: Circumcenter (Y2, p. 200)			
1	<p><i>Claire:</i> I have no idea.</p> <p><i>Emily:</i> Just draw it like this one. From the midpoint.</p> <p><i>Derek:</i> It has to go from the midpoint and make a 90-degree angle.</p>		<p><i>This conversation began in a similar manner with Claire acknowledging confusion and asking a question about the task.</i></p>
5	<p><i>Claire:</i> But how does that work?</p> <p><i>Emily:</i> We just draw a straight line from here straight up.</p>		
	<p><i>Derek:</i> What about the other midpoints [from the sides that are not horizontal]?</p>		<p><i>Derek also asked a question to which both Emily and Claire contributed ideas.</i></p>
10	<p><i>Emily:</i> Do the same thing.</p>		

Dialogue 1.2 <i>continued</i>		Commentary
	<i>Derek:</i> You can do straight up but you want to know, is it crooked or is it perfectly straight?	
	<i>Emily:</i> Well, the line is right here on paper.	
15	<i>Claire:</i> Wait, I have an idea. [<i>Demonstrates her approach with a protractor</i>] Look. Does that make a 90-degree angle?	<i>Claire took an active role in the conversation, suggesting and defending her approach.</i>
	<i>Derek:</i> Yes.	
	<i>Claire:</i> Exactly.	
20	<i>Derek:</i> But if you were to do it from here and do it the same way that you just did it, it wouldn't make a 90-degree . . .	
	<i>Claire:</i> Well, this is the midpoint and I just used it at 90 degrees . . .	
25	<i>Emily:</i> Hey! Is this the midpoint of this? Because it does not look exact.	<i>Emily made an inquiry, and Derek deferred the conversation to Claire and Emily.</i>
	<i>Derek:</i> Discuss it.	
	<i>Emily:</i> Discuss?	
	<i>Claire:</i> It's right here. It's (6, 12).	
	<i>Emily:</i> Is that the point here, (6, 12)?	
30	<i>Claire:</i> Think so.	
	<i>Emily:</i> Two, four, six. Okay. And then what's the other one, for the other side?	
	<i>Claire:</i> (24, 12).	
	<i>Emily:</i> How is it (24, 12)?	
35	<i>Derek:</i> It is. It's right.	<i>Emily conceded to Claire and Derek's answer.</i>
	<i>Emily:</i> Oh, okay.	

Fig. 1.4



Claire's work on the Circumcenter task in dialogue 1.2

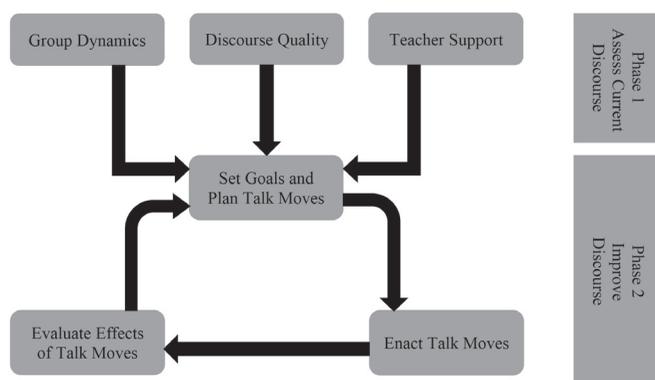
Dialogue 1.2 demonstrates a marked improvement in the quality of discourse between Derek, Emily, and Claire. In dialogue 1.1, Derek is the authority and Emily and Claire turn to him for explanations and confirmation of their ideas. Further, they engage in off-task talk without ensuring that Claire understands. In dialogue 1.2, all three students share authority and reason about the task. They stay focused and do not engage in any off-task talk. How did this change come about? The next section introduces the S³D approach designed to support improvement in small-group, student-to-student discourse like that seen in Ms. Young's class. In particular, using dialogues 1.1 and 1.2 as examples, you will learn about the framework that is the foundation of the S³D approach and involves strategies for evaluating various aspects of small-group discourse as well as ways to help students in improving their ability to communicate with one another.

S³D APPROACH

One of the most important ideas to remember about small-group discourse is that students will not necessarily be very good at participating in meaningful mathematical discussions at first. They may engage in off-task talk or not interact at all. However, this does not mean our students are not able to communicate well. They simply may not yet know how. For instance, in dialogue 1.1, the students struggled to communicate effectively. The discussion did not involve Claire and quickly devolved into an off-task conversation. However, Ms. Young did not give up on small-group work. Instead, she saw this as a baseline and worked to move toward productive student-to-student discourse. With guidance and support, the same students who struggled with equitable participation developed into more capable communicators.

Ms. Young engaged in the S³D approach, involving two interrelated phases, to improve the small-group, student-to-student discourse (figure 1.5). In the first phase, she assessed three aspects of the small-group discourse. In the second phase, she engaged in a cycle of planning, enacting, and evaluating. She made specific goals (based on her work in Phase 1) and planned to use talk moves aligned with those goals. She then enacted the moves and evaluated their effectiveness. Finally, she set goals and revised her plan to use talk moves based on her new assessment. The following sections elaborate on each phase.

Fig. 1.5



The two phases of the S³D approach

Phase 1: Assess Current Discourse

Before we can help students get better at small-group talk, we must know what their current conversations are like. This is not easy work; we need to learn how to notice and attend to important aspects of small-group discourse. Phase 1 of the S³D approach is a structured way to do this using three different lenses: group dynamics, discourse quality, and teacher support.

Lens 1: Group Dynamics

Different groups demonstrate different dynamics. In other words, each unique combination of students leads to distinctive modes of communicating. Various factors, including student personalities and the nature of a task, contribute to how a particular group of students interacts with one another. When evaluating group dynamics, we look at three elements:

- **Participation**—Are the students talking to each other? Who is talking? Who is not participating?
- **Momentum**—How is the conversation progressing? Are the students communicating effectively? Does each and every student have the opportunity for equitable participation?
- **Definition of Success**—When do the students decide they are done? What is their criteria for success?

As you observe small groups, you will consider these guiding questions to help you identify group dynamics.

In dialogue 1.1, two dynamics are evident. First, Derek dominates the conversation by explaining to Emily and Claire what they have to do to solve the task and answering a series of questions posed by Emily. The positive aspects of the interchange are that Derek and Emily are talking about the task and Emily feels comfortable asking questions of her fellow group member. However, Derek holds all of the mathematical authority. Second, Claire is considered a nonparticipatory student and does not engage in any meaningful way in the mathematical discussion.

In order to improve student-to-student conversations, we need to ascertain the dynamics that manifest in a group. This will enable us to establish goals for our work with that particular group. Chapter 3 describes various dynamics in detail and illustrates how to recognize them.

Lens 2: Discourse Quality

In small groups, students may be participating equitably and asking and answering questions. However, the cognitive level of the discussion may be low if, for example, it lacks clear explanations or evidence of sense making. When we observe discourse quality, we seek to assess the content and sophistication of student-to-student discourse:

- Are students asking questions about directions and logistics?
- Are students inquiring about answers and procedures?
- Are students evaluating one another's thinking? Justifying their ideas? Explaining connections?

Our overarching goal in working with small groups is to improve the quality of independent discussion between students.

The two dialogues demonstrate such growth. In dialogue 1.1, Emily asks Derek to explain his strategy (lines 1 and 4). At first, Derek provides a detailed response followed by briefer answers to a sequence of questions from Emily as she works through understanding his reasoning (lines

5–14). Claire’s statement that she does not understand is never addressed by Derek or Emily (line 17). Dialogue 1.2 includes a greater array of types of questions and corresponding responses. Claire asks how to construct one of the perpendicular bisectors, and Emily and Derek explain (lines 1–6). Similarly, Derek asks how to find the perpendicular bisectors for the other two sides of the triangle, and Emily responds (lines 7–9). Twice, Derek poses the challenge of ensuring that the bisectors are perpendicular, and Emily and Claire justify their approach (lines 10–22). In dialogue 1.2, the students moved toward attending to one another’s ideas, assessing the thinking of others, and justifying their own reasoning.

As you observe small groups at work, you want to hear students sharing and justifying their thinking, listening to and evaluating the ideas of others, attempting to use and explaining the approaches of others, and comparing strategies. The types of questions that students ask each other are indicative of the discourse quality. Chapter 4 presents classroom examples of a set of questions and corresponding responses that can be used for the evaluation of student-to-student discourse.

Lens 3: Teacher Support

One of the greatest challenges in teaching is that we cannot wait to gather all the data we need before we are forced to act. Supporting effective discourse in small groups is no exception. While we are observing groups, we are also responding to students who need our help. As difficult as this may be, our interactions provide an additional opportunity to assess our own role in small-group discourse. When we examine teacher support, we consider how our interactions affect small-group discourse:

- Are we addressing the whole group or just one student?
- Are we doing too much of the mathematical work?
- Are we focusing students on the ideas of their peers?

We want our exchanges with small groups to foster meaningful mathematical student-to-student discussion.

Although Ms. Young did not interact with the students at the time of dialogue 1.1, imagine two different scenarios in which she interacts with the group (figure 1.6). In both situations, after Derek and Emily do not respond to Claire’s confusion, she turns to Ms. Young for help. In the first scenario, Ms. Young is only interacting with Claire, counter to the goal of fostering student-to-student discourse. Further, Ms. Young is reinforcing the false norm that she is the expert who is able to answer Claire’s questions and evaluate her work. Claire leaves the conversation without learning that her group members can be a source of help, and Derek and Emily do not have the opportunity to gain an understanding about their responsibilities with respect to assisting their

fellow group member. In the second scenario, all of Ms. Young’s interactions serve to support Claire in engaging with her peers and to remind Derek and Emily of their role in making sense of the mathematics both for themselves and with Claire.

Fig. 1.6

Scenario 1	Scenario 2
<i>Claire:</i> What?	<i>Claire:</i> What?
<i>Ms. Young:</i> So, how long is AB ?	<i>Ms. Young:</i> Emily, do you know what Claire’s question is?
<i>Claire:</i> Four centimeters.	<i>Emily:</i> What question?
<i>Ms. Young:</i> So, if AB is four centimeters, how long is XY ? What does it say in the problem?	<i>Ms. Young:</i> Claire, could you ask Emily a question about this problem?
<i>Claire:</i> They are equal? Four centimeters?	<i>Claire:</i> What did Derek just say?
<i>Ms. Young:</i> Right. So, draw a side that is four centimeters on your paper. Now, how long is AC ?	<i>Emily:</i> He said that you just need to make two sides that are the same size as AB and BC .
<i>Claire:</i> Three centimeters.	<i>Claire:</i> Oh.
<i>Ms. Young:</i> Right, so if AC is three centimeters, how long is XZ ?	<i>Ms. Young:</i> Do you understand what Emily said?
<i>Claire:</i> Three centimeters also.	<i>Claire:</i> Not really.
<i>Ms. Young:</i> So, now what do you do with that? Where does XZ go? How do you draw XZ ?	<i>Ms. Young:</i> So, can you ask another question about that?
<i>Claire:</i> Here? [<i>pointing to point X</i>]	<i>Claire:</i> So, are we making a new triangle? What size are the sides of the new triangle?
<i>Ms. Young:</i> Right. So, draw it there.	

Two possible scenarios for how Ms. Young could interact with the group

Dekker and Elshout-Mohr (2004) differentiate between two types of teacher interactions: *product help* and *process help*. In scenario 1, Ms. Young provides product help with her questions focused on the mathematics content, and her goal is to guide Claire through answering the question correctly. Ms. Young is doing much of the mathematical thinking. In contrast, Ms. Young uses process-help interactions in scenario 2; her questions focus on encouraging productive student-to-student

exchanges. Chapter 5 elaborates on the distinction between product and process help and provides examples in small-group settings.

Phase 2: Improve Discourse

In Phase 1, we assess the small-group, student-to-student discourse in our classes in terms of group dynamics, discourse quality, and teacher support. During Phase 2, we use this information to set goals, plan process-help talk moves specifically designed to help students reach those goals, enact these moves, and then evaluate their effect before repeating the process (figure 1.5).

For instance, after assessing the current level of discourse in Phase 1, Ms. Young might notice that Claire is not participating and make it one of her goals to support Claire's inclusion in the group talk. She then makes a plan. She anticipates that when she observes the group, Claire may ask a vague question to which the others do not respond. When that happens, she plans the very moves we see acted out in scenario 2 (figure 1.6):

- Ask a group member if she heard Claire's question
- Ask Claire to repeat her question
- Check for understanding with Claire
- Prompt Claire to ask a more specific question if she does not understand

After enacting these moves several times, Ms. Young looks to see if Claire is more involved in her group's discussion. If not, Ms. Young may need to plan alternative moves. If so, Ms. Young can create another goal and continue the practice of implementing talk moves.

Phase 2 is an ongoing, cyclical process. As you try the talk moves, you continue to observe the group dynamics and student discourse quality as well as challenges you encounter using the talk moves (e.g., the tendency to use product help or employ only one talk move regardless of the group dynamics). Over time, you will notice that small-group, student-to-student discourse will improve, leading you to re-evaluate, create new goals, and engage in new talk moves in support of these goals. Chapters 6, 7, and 8 outline the process-help talk moves associated with each dynamic presented in chapter 3 and share examples of each in practice.

CONCLUSION

The overall goal of the two phases of the S³D approach is to foster and improve small-group, student-to-student discourse. The first phase is critical to engaging in the second. We need to identify group dynamics, evaluate discourse quality, and distinguish types of teacher support. This assessment

enables us to make goals for improvement in discourse during Phase 2 and then plan specific talk moves to support students (and ourselves) in becoming more and more adept at participating in productive and rigorous mathematical discussions.

The next chapter presents a case study of my work with one group of students. In particular, the case demonstrates how I progressed through the two phases to improve the small-group, student-to-student discourse over time. Following the case study, one chapter each is dedicated to the three lenses of Phase 1, and three chapters are dedicated to Phase 2. Every chapter includes detailed descriptions accompanied by classroom examples, supporting your engagement in the S³D approach as you advance through the book