Tamara, a preservice teacher, taught a lesson on fractions to a class of fourth-grade students in her field-experience practicum. The instructor of her mathematics methods course observed the lesson. As they met in the hallway to debrief the teaching experience, the instructor began by asking, “How do you think your lesson went?” Tamara replied, “Great. I got through my entire lesson plan.” Tamara’s comment and the subsequent discussion revealed that she was focused on her actions as the teacher but not on the dynamics of instruction (Cohen and Ball 2001).

Similar conversations often have left us pondering our effectiveness as professional support providers, whether in the role of a mathematics teacher educator or a mentor, teacher leader, or staff developer. What questions should we be asking preservice teachers, novice teachers, and more experienced teachers so they think more deeply about these interactions? How can we frame these conversations as a time to think together? How can we support preservice and novice teachers in beginning a lifelong inquiry into their own mathematical teaching practices? How can we support experienced teachers as they shift toward reform-oriented practices in mathematics?

The instructional triangle in figure 1 presents instruction as interactions among teachers, students, and mathematics (adapted from Cohen and Ball 1999 and National Research Council 2001). In our conversations with both preservice teachers and in-service teachers, focusing on how teachers and students attend, listen, and respond to one another while interacting with the mathematics is important. The purpose of this article is to engage professional support providers in thinking about the questions they ask that promote teacher thinking, deeper discourse, and reflection on practice. The authors compare two scenarios based on debriefing teachers after classroom observations and then provide a model for formulating well-structured questions. We hope that you enjoy this first edition of “Supporting Teacher Learning.”—Ed.
Scenario 1: Debriefing a Lesson on Comparing Fractions

Alice, a preservice teacher, was working in a third-grade classroom for her field-experience practicum. One of the authors had an opportunity to observe Alice teaching a lesson on comparing fractions using paper strips. Alice engaged students in small-group work and then closed the lesson with a large-group discussion. The following debriefing conversation with Alice took place after she finished teaching the lesson.

**Professor.** Hi, Alice. It seems like your lesson on comparing fractions went pretty well. How do you think the lesson went?

**Alice.** Pretty good. The kids liked working with the fraction strips. I had never used them before.

**Professor.** The students really got into the class discussion. Morgan was showing everyone how she knew 3/8 was smaller than 3/6. I saw her lining the fraction strips up as she was explaining her thinking to Mark. Do you think Mark understood?

**Alice.** Mark has trouble with fractions. He still doesn’t get it. He couldn’t even fold the strips or mark them correctly.

**Professor.** As you were walking around the class monitoring small groups, were the fraction strips a useful tool for students?

**Alice.** I think so. The students could visualize the fractions more easily.

**Professor.** Do you think the students will need more practice comparing fractions before moving on?

**Alice.** No. I think they’re ready to move on.

The conversation began with a general evaluation of the lesson; then the professor asked Alice...
to comment on the learning of a specific student. Next, the professor asked her to remark on the use of the fraction strips and consider subsequent instructional steps. Although this thinking is good for Alice, she was not pressed to think deeply about her teaching, student learning, or the mathematics. The conversation about the lesson was superficial. The support provider—in this case, the professor—posed only closed questions and therefore received only vague responses. The support provider also did most of the talking and most of the thinking in the conversation.

This conversation occurred a few years ago and is reflective of our past conversations with preservice and in-service teachers. We were asking questions of teachers but the conversations did not seem to go anywhere. We were not focused on helping teachers examine the interactions in their classrooms among the mathematics content, students’ understanding, and the instructional decisions that the teachers made. We now know much more about questioning that will move a teacher to think more deeply. Our work as support providers is to press teachers such as Alice to be clear on their mathematical goals for students and how those goals relate to the task, and then to support teachers as they reflect on their monitoring of student understanding.

Scenario 2: Debriefing a Lesson on Adding Fractions

This next scenario illustrates how thinking shifted from the professor to the teacher. Notice how the line of questioning progresses and how the questions are structured. Laura teaches fourth grade and was a participant in a professional development program for in-service teachers. The following conversation with Laura took place after she finished teaching a lesson on adding fractions.

**Professor.** Hi, Laura. Seems like the lesson went pretty well. Why don’t you begin by summarizing the mathematical ideas your students were learning today?

**Laura.** Well, one of the ideas was helping students see relationships among common fractions and the whole and then use those relationships to add the fractions together. The students were really into sharing their reasoning and explaining how they used fraction relationships by visualizing or using the fraction strips.

**Professor.** The class certainly seemed very willing to share ideas with each other. Let’s talk about Travis. Take a moment and then describe the depth of understanding Travis has about fractions and where he is in regard to your goals for his learning.

**Laura.** Well, Travis can quickly add fractions with unlike denominators. He can picture common fractions in relation to a whole. He also has an understanding of equivalency. Yesterday he was explaining how he knew 1/2 was the same as 2/4 and 3/6. He actually brought out paper and was folding them into fraction strips. I think the students did that activity last year in third grade. He certainly was able to explain how he knew the fractions were the same amount in relation to the same whole.

**Professor.** I am sure there are other students like Travis. Now think a bit about Margaritte. Elaborate on the fraction ideas she is struggling with and describe your interventions.

**Laura.** Hmmm . . . Margaritte is a bit tougher to figure out. She wants to just add the numerators and denominators together. I know that this is a common error as students learn to add fractions. I thought about just working with Margaritte individually, but then decided it would benefit the whole class to engage in a discussion and let them convince each other whether or not it ever works to add fractions this way.

In this scenario, the conversation began with an articulation of the mathematical content goals for students. This mathematical content focus was sustained as the professor prompted Laura to talk about Travis’s understanding of equivalency in relation to the mathematical goals. Laura made a strategic decision as she reflected on Margaritte’s error and used it as a prompt to engage the whole class in a discussion and debate about adding fractions. The professor’s questioning promoted a deeper and richer conversation and the teacher did most of the talking, thinking, and reflecting on the lesson. As support providers, we must ensure that
teachers articulate students’ needs and justify their decisions and actions based on the mathematical goals for student learning.

**Focusing Conversations Using the Instructional Triangle**

A major difference between the two scenarios is in the line of questioning. In the first scenario with Alice, the questioning focused on teacher management of the lesson and lacked specificity of the mathematical content and student understanding of that content. In the second scenario, the line of questioning with Laura focused on the instructional triangle. This enabled Laura to articulate and elaborate on the mathematical goals for the selected tasks and on her decisions and actions throughout the lesson in monitoring and promoting student learning. The following sections of this article examine each component of the instructional triangle in figure 1 and the interactions among the components as a framework for focusing conversations with teachers.

**Mathematics content and tasks**

Teachers must be able to articulate the mathematics content that students will learn and to identify the aspects of the mathematical task that are going to help students learn this content. The support provider’s questioning builds teachers’ capacity to be more intentional and articulate about the mathematical goals for the lesson. This enables teachers to make more effective decisions in the midst of teaching a lesson because they have a clear picture of the mathematics content that students are learning. In the first scenario, the conversation focused on the activity, not on the mathematics. The professor did not ask Alice to verbalize the mathematical goals, so it was unclear whether she could envision the expectations for student learning. In the second scenario, the conversation began with an articulation of the mathematical goals and the connection to the task. This enabled Laura to be attuned to Margaritte’s error and to use it as a teaching opportunity.

**Student engagement and learning**

Monitoring of student learning must focus on how mathematical ideas unfold in reaching the goals of the lesson. Teachers must be able to identify where students are in their understanding and where they are heading mathematically. This includes being more precise about students’ struggles with the mathematical ideas and about which ideas students understand well. Only then can teachers make informed decisions about lesson modifications that provide additional support as well as those that push students along in their learning. Laura was able to specify levels of student learning in relationship to the mathematics content, whereas Alice was vague in expressing the level of students’ understanding. The work of support providers is to press teachers’ thinking to articulate how students are growing in their mathematical knowledge. For example, the professor could have asked Alice to compare the level of understanding between Mark and Morgan.

**Teacher decisions and actions**

Teachers must be able to articulate the mathematical goals for student learning and use them as the basis for making decisions before, during, and following a lesson. For example, Laura’s decision of how to use Margaritte’s error surfaced because of previous conversations about using student errors as opportunities to deepen the mathematical knowledge of all students. This illustrates the support provider’s important role of raising the level of consciousness in the instructional decisions that teachers make.

**Structuring Questions**

Another difference between the two scenarios is in how the support provider structured the questions. A well-structured question is an invaluable tool in our repertoire to promote teacher learning. Costa and Garmston (2002) have extensively studied and delineated the structuring of questions that promote thinking. These questions keep the focus on inquiry into practice and produce more learning than do statements or closed questions (Garmston 2000). By choosing our words carefully and using intentionally designed questions, we can engage and transform another person’s thinking and perspective. Well-structured questions engage individual teachers or groups of teachers in thoughtfully planning, reflecting on instruction, or analyzing situations. Well-structured questions to promote thinking include three essential parts: (1) an invitation to think, (2) a cognitive process, and (3) a specific
topic. The order of the three parts may vary, but all three are necessary to formulate an effective question to promote thinking, such as the following: “As you review the mathematical goals for students’ understanding of fractions, describe the assessment tasks you are considering.” The invitation “as you review” invites the teacher to engage in thinking. The cognitive process is to “describe” assessment tasks and the specific topic is “understanding of fractions.”

### Invitation to think

The invitation invites complex thinking and reflection without making judgments. It is spoken in an approachable voice and uses language that is tentative and explorative to signal inquiry. It also uses plural word forms to signal the expectation of multiple responses, rather than a singular correct answer (Costa and Garmston 2002), as in the following example: “As you reflect on the lesson, what hunches do you have to explain the students’ confusion about how to write a number sentence for the fraction word problem?”

### Cognitive process

Questions elicit different levels of complexity of thinking according to the verbs they use. The verbs elicit a specific level of thinking to prompt analysis and synthesis as well as application and evaluation. Asking questions at knowledge and comprehension levels also is appropriate at times. For example, asking teachers to describe student-generated subtraction strategies is at a lower level of thinking than is asking teachers to compare students’ strategies. Asking teachers to evaluate students’ subtraction strategies for fluency is at an even higher level of complexity.

### Specific topic

The third part of structuring questions is the selection of a specific topic. To promote deep teacher thinking, the topic should focus on the interactions in the instructional triangle among mathematical content and tasks, student engagement and learning, and teacher decisions and actions. NCTM (2000) highlights the complexity of effective mathematics teaching: It involves engaging and observing students in mathematical tasks, having clear mathematical goals for student learning, listening carefully to student ideas and explanations, and using the information to make instructional decisions. To achieve high levels of instructional effectiveness, teachers must develop a reflective disposition to carefully and intensely examine their practice (Schon 1987).

### Closing Comments

Whether you are a mathematics teacher educator at a university or college, a district staff developer, or a classroom teacher with support responsibilities, thinking very carefully about the questions you pose to other teachers is important. We avoid questions that can be answered with a one-word response because they do not prompt deeper
thinking and may even prevent the discussion from occurring. For example, we no longer ask, “How did your lesson go?” or “How are you doing with the new curriculum materials?” because the common response of “Fine” does not engage teachers in deeper thinking and reflection. We are more likely to say, “As you think about your mathematical goals for today’s lesson, describe how you structured your lesson to impact student understanding” or “Given what you know about students’ difficulties with fractions, summarize ways the new materials are supporting their learning.” These latter instructions prompt teachers to talk further, elaborate, make connections, and even ask questions of themselves. As NCTM (2000) notes in the Teaching Principle, “Engaging in reflective practice and continuous self-improvement are actions good teachers take every day” (p. 18). One of our greatest tools as professional support providers is the formulation of well-structured questions to engage teacher reflection and conversation on instructional decisions made in the classroom. Our responsibility is to promote teacher thinking about the relationships among what teachers do, what students are learning, and the mathematics content.

References

Call for Manuscripts: Supporting Teacher Learning

Teaching Children Mathematics is launching a new department, “Supporting Teacher Learning.” This department will serve as a forum for the exchange of ideas and a source of activities and pedagogical strategies for pre-K–6 mathematics teacher educators. We broadly define “teacher educators” as individuals who plan, facilitate, and support teacher learning. They include college and university mathematics and mathematics education instructors, professional development providers, mathematics specialists, teacher leaders, and anyone involved in the professional education of other teachers. If you have worked with a preservice intern or a student teacher, mentored a new teacher, or facilitated a professional development session for teachers at your school, you are a teacher educator.

The Editorial Panel is seeking manuscripts that address a variety of issues, such as the following:

Innovative ways of using technology, such as videotaped cases, in teacher education courses and professional development sessions
Examples of effective activities used during pre-student-teaching field placement
Creative approaches to enhance student-teacher supervision or mentoring of new teachers
Productive ways to promote deep understanding of elementary school mathematics by teachers
Effective use of student work to enhance teacher knowledge

Send three copies of a completed manuscript for review to “Supporting Teacher Learning,” Teaching Children Mathematics, 1906 Association Dr., Reston, VA 20191-1502. The manuscript should not exceed ten double-spaced pages. Include figures and photographs at the end.