gether to develop authentic, reliable, and valid measures to assess these more holistic aspects of mathematical learning and problem solving.

Having students involved in problem-based learning that develops their persistence and communication skills will also enhance their future workplace success (Boaler). American students who experience non-standard problem solving in classrooms aligned to the 5 C's and CaCCSSM, especially problem solving which employs collaboration and communication in tasks that require evidence of reasoning, will be better prepared for the demands of PISA, similar types of assessments, college, the work place, and social participation.

Reference

National Academies Press. *Assessing 21st Century Skills; Summary of a Workshop*: **http://www.nap.edu/cataglo.php?record_id=13215d**

As this article goes to press, California, as one of the "Governing States," will have already voted upon Smarter Balanced Assessment Consortium (SBAC)'s (**www.k12.wa.us/smarter**) claims for what its summative, CaCCSSM-aligned tools will assess, and item writing will commence. It is our hope that California will assert its vision for student learning outcomes that prepare our children for the 21st century. **http://www.k12.wa.us/SMARTER/ContentSpecs/MathContentSpecifications.pdf**

Practicing Questioning Skills as a Tool to Assess Student Understanding

by Robert Kaplinsky, Downey USD, rkaplinsky@dusd.net; and Melissa Canham, Downey USD, mcanham@dusd.net

Educators struggle to meaningfully assess students in a timely manner. Multiple choice and written-answer tests take time to process and often lack evidence of student reasoning. Asking students "Does everyone understand?" or "Does anyone have any questions?" gives some information, but often students either say they understand or say nothing at all. One potential solution to this problem is as simple as teachers modifying their questions. Teachers can quickly assess students' knowledge and immediately adjust the lesson by asking questions that facilitate classroom discussions and encourage elaborate responses.

Teachers are aware that some questions require students to think more meaningfully, yet research shows that these questions are rarely asked. According to Gall (1970), "About 60% of teachers' questions require students to recall facts; about 20% require students to think; and the remaining 20% are procedural." These percentages are not surprising since it takes practice and patience for teachers to develop questioning skills.

It is critical that teachers refine their questioning skills since they are an effective tool in implementing the Common Core's Standards for Mathematical Practice that call for teachers to develop students' reasoning ability. Standard 3—Construct viable arguments and critique the reasoning of others—requires "[students to] justify their conclusions, communicate them to others, and respond to the arguments of others." Also Standard 1—Make sense of problems and persevere in solving them—states: "[students] can understand the approaches of others to solving complex problems and identify correspondences between different approaches." Teachers need opportunities to focus on their questioning skills to prepare to implement these standards.

As the mathematics teacher specialists for our school district, we developed an activity

called Questioning Scenarios to help teachers practice questioning skills. The activity begins with teachers in groups of three taking the roles of teacher, student, or observer. The individuals playing the role of teacher and student each receive a slip of paper that describes their corresponding scenario. Here is an example of a teacher and a student scenario:

> You are an elementary teacher. You want to find out what answer your student got to the question, "What is the area of a square with a side length of 4?" Determine what conceptual understanding the student has by asking questions, especially questions that encourage elaborated responses.

> You are an elementary student who is working on finding the area of a square with a side of length 4. You are confusing finding the area of a square with finding the perimeter of a square. As such, to get your answer you count all the sides of the square and get an answer of 16. You are proficient in addition, subtraction, multiplication, and division.

The individuals playing the role of teacher and student get time to read their cards and learn their roles. Meanwhile, the individual playing the role of observer is waiting to record all of the teacher's questions to the student. Once the activity begins, the teacher will talk to the student in the context of the scenario described on the slips of paper. Here is a possible interaction for this scenario:

Teacher (T): Please tell me what the area is for a square with a side length of 4.

Student (S): 16.

T: Great. Does that make sense?

S: Yes it does.

This interaction may seem common for most mathematics classrooms. The teacher asked a question to which the student responded with a correct answer. The teacher checks to see if the question makes sense to the student and the student replies that it does. However, consider this slightly different interaction:

T: Please tell me what the area is for a square with a side length of 4.

S: 16.

T: Great. How did you get that answer?

S: The square's sides are all 4 long so I added them together and got 16.

When the teacher changed the question from "Does that make sense?" to "How did you get that answer?", the student's response of "Yes it does" was no longer a sufficient answer. The student was now forced to explain his or her thinking. In this case, asking a question that encouraged an elaborate response allowed the teacher to uncover a misunderstanding that may have otherwise gone unnoticed. Having students explain their thinking is one of the simplest and most natural forms of assessment in the mathematics classroom.

During the Questioning Scenarios activity, we emphasize that the teacher's goal is to uncover the student's misunderstandings by asking questions that will encourage the student to respond elaborately. The initial goal is not to help the student solve the problem, although the teacher can go in that direction if the misunderstanding is uncovered quickly.

The interaction between the teacher and student continues until the facilitator who is running the activity stops the groups. Most groups seem to uncover the misunderstandings within three minutes but more time may be allocated as necessary. Once stopped, the observer begins the debriefing process by reading each of the questions the teacher asked. Collectively, the group identifies those questions that led the student to respond with an elaborate mathematical explanation that consequently made it easier for the teacher to understand the student's reasoning. In general this debriefing process also takes three minutes and again the time limit can be extended if groups are having constructive conversations.

After the questioning and debriefing have been completed, the facilitator then brings all the groups back together and discusses with them which types of questions allowed the teacher to better assess the student's knowledge. The facilitator might also ask a group to share a question they found particularly effective. Most often the group responds that the "How" and "Why" questions produced the most elaborate responses. Sometimes they also

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add that questions that ask students to model or draw out their thoughts are effective.

The process of acting out and debriefing the scenario takes place a total of three times, with a new scenario presented each time and the roles of the individuals changing. This gives each person the opportunity to experience questioning from three different perspectives and reflect on their own questioning skills. Completing three rounds of scenarios generally takes between thirty and forty-five minutes.

It is important to understand that the transition from asking questions that elicit uninformative responses to questions that encourage elaborate answers does not happen quickly or easily. It is difficult to come up with questions that will challenge students to make connections without simply telling them what to do. Since classroom minutes are limited, the Questioning Scenarios activity provides practice in asking questions that require meaningful responses. Finding the right balance is a process that will take many years to master, but the benefits of knowing what students are thinking and how they reason makes it all worthwhile.

In the past, many students have been trained to believe that teachers only care about the answer to the problem, not how they thought about it. It will take time for students to adjust to discussing the problems and explaining themselves. Some possible activities for increasing student participation include using a Think-Pair-Share strategy, giving students sentence stems to structure their responses, and modeling the teacher's thought process using think-alouds.

Based on our experience, here are some suggestions for those new to Questioning Scenarios;

- ✔ When introducing Questioning Scenarios to a group of teachers for the first time, it is helpful to do an example similar to the scenario shown in this article, involving the square with a side length of 4. Modeling both ineffective and effective questions will help them understand what to focus on.
- ✔ Pick a mathematics topic that the teachers are certain to feel comfortable with even if it means picking a topic below the grade level they teach. We found that when teachers feel out of their mathematics content comfort zone, their anxiety is so high that they cannot focus on their questioning.
- ✔ Include as much information as possible about what the student knows or does not know so the individual playing the role of the student can portray it accurately.
- ✔ When including a picture, chart, or table, make sure to add it to both the teacher and student scenarios so they have the same thing to reference.
- ✔ Consider providing a list of questions for teachers to use when they struggle to find one to ask. An excellent set of questions is listed in the Introduction section of the *Professional Standards for Teaching Mathematics* from the National Council of Teachers of Mathematics.

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