3

Using Questions to Check for Understanding

The art of questioning is central to the practice of teaching. Spending a few minutes watching a small child play school gives evidence: the stuffed animals are arranged in rows as the teacher faces them, firing questions all the while. "What's 2+2?" she asks a teddy bear. "Right!" she exclaims to the answer that only she can hear. Even at an early age, children are socialized to a framework of school that demands that the teacher ask questions and the students answer them.

As such, well-crafted questions are a great way for teachers to determine what their students know, need to know, and misunderstand. In this chapter, we explore using questioning to check for understanding. We consider effective questioning techniques as well as instructional practices that promote effective questioning. We also discuss ways to reply to incorrect responses to questions and how teachers use the responses they receive from students to determine the next steps to take in their instruction.

Misuses of Questioning in the Classroom

Durkin's (1978) research on classroom practices confirmed that teachers rely primarily on questioning to check for comprehension. As noted in the previous chapter, the difficulty in this approach is that the questioning rarely advances beyond

the Initiate-Respond-Evaluate cycle (Cazden, 1988; see Chapter 2). In the hands of less-able teachers, questioning can devolve into interrogation, as students struggle to guess what's in the teacher's head. Fullan, Hill, and Crévola (2006) assert that teachers from 50 years ago could step into the classrooms of today without much difficulty because so little has changed in the design and delivery of lessons. Undouhtedly, the practice of teacher-generated questions to elicit student responses would be among the most familiar of all.

Traditional teacher-generated questioning is problématic for students. As noted in Chapter 1, gender differences in response rates have a negative impact on girls (Sadker, Sadker, & Klein, 1991). In addition, there is evidence that a vocal minority of students dominate classroom conversations and questioning, while less-assertive students rarely participate (Brophy & Evertson, 1974). This not only results in behavioral difficulties and marginalized students, but it affects the ability of the teacher to check for understanding. After all, knowing that six or seven students understand is not the same as knowing that 32 do. Therefore, it is essential to use effective questioning techniques to elicit richer evidence of understanding. These questioning techniques should be coupled with instructional approaches that maximize participation in classroom discourse.

Effective Questioning Techniques

Constructing Effective Questions

Checking for understanding through questioning should not he thought of as a simple two-step process (question and answer) but rather as a complex progression as the teacher formulates and then listens to the response of the learner. In their book *Quality Questioning*, Walsh and Sattes (2005) describe five distinct steps of the questioning process that they use in their professional development activities called Questioning and Understanding to Improve Learning and Thinking (QUILT). The process is described in Figure 3.1.

The first step is to formulate the question. In particular, the teacher must determine the purpose of the question itself. Is it a recognition question to orient students? For example, the 4th grade geography teacher who points to Pennsylvania on a map of the United States and asks, "What's the name of this state?" is asking a recognition question. This allows the teacher to follow up with questions about

Figure 3.1 QUILT Framework

Stage 1: Prepare the Question
- Identify instructional purpose
- Determine content focus
- Select cognitive level
- Consider wording and syntax

Stage 2: Present the Question
- Indicate response format
- Ask the question
- Select respondent

Stage 3: Prompt Student Responses
- Pause after asking question
- Assist nonrespondent
- Pause following student response

Stage 4: Process Student Responses
- Provide appropriate feedback
- Expand and use correct responses
- Elicit student reactions and questions

Stage 5: Reflect on Questioning Practice
- Analyze questions
- Map respondent selection
- Evaluate student response patterns
- Examine teacher and student reactions

From *Quality questioning: Research-based practice to engage every learner* (p. vi), by J. A. Walsh and B. D. Sattes, 2005, Thousand Oaks, CA: Corwin Press.

geographical features of the area, such as its rivers and mountains. A question can also serve the purpose of recalling information, such as when the same geography teacher asks, "What are the two largest cities in Pennsylvania?" In this case, students must recall what they know about the state, about urban centers, and about cities in Pennsylvania. Both questions are examples of factual knowledge but are

not likely to promote enduring understanding. It is necessary, however, for students to possess this information. A third type of question asks students to apply information in a novel way. For example, the geography teacher might ask, "What are the advantages and disadvantages of locating the state capital in Harrisburg?" In any case, the teacher needs to be clear on the type of knowledge the question assesses and not fall into the trap of confusing recognition or recall for application.

After formulating the question, the teacher must determine the format of the desired response and who will provide it. Will it be a choral answer, where all students respond together? Is it a partner discussion question? If so, the teacher should preface the question itself with information about the response format so that students know what they will do with the question before it is asked. If it is to be answered by an individual student, teachers should announce the student's name before asking the question. This alerts the learner to the expected response and avoids using the question as a means for classroom management.

Once the question has been asked, students need time to process the answer. Commonly referred to as "wait time," this questioning technique of pausing for three to five seconds allows learners time to digest the question, retrieve information, and formulate a response (Rowe, 1986). This is particularly useful for English language learners who may still be code switching (i.e., mentally translating the question from English to their primary language, then translating their answer to English).

If a student is unable to respond, consider how the question might be scaffolded so that the student can arrive at the correct answer. It is possible that the student does not understand the question itself or that he or she is unable to retrieve the information needed to reply. In designing online learning situations, Dodge (1998) categorizes scaffolds as tools that prompt different types of responses, but we find them to be equally useful in thinking about questioning. Reception scaffolds direct a student to information necessary to formulate an answer. For example, the teacher might prompt the student, "Look at the graph on page 252 of your textbook." Transformation scaffolds provide a way of structuring the information to help students develop an answer. This type of prompt might ask students, "How does the largest bar on the graph on page 252 of your textbook help you to find your answer?" Finally, production scaffolds provide a student with a way of producing an answer. In this case, the teacher might direct the student,

"Use the largest and the smallest bars from the graph on page 252 of your textbook to compare the amounts used."

Once the student has answered, the teacher must use the response to make decisions about what will occur next. Feedback, which includes praise, should be offered to the student; it may include affirmation of a correct response or elaboration on an incomplete answer. It is useful to think about reception, transformation, and production scaffolds as follow-up probes when responding to incomplete or incorrect answers. These follow-up probes serve as a means for teaching students how to use information to formulate answers. Ultimately, the art and science of teaching require the ability to use scaffolds effectively to cultivate student learning. The challenge is to use the right scaffold to assist the learner in doing the cognitive work (Wood, Bruner, & Ross, 1976).

Walsh and Sattes (2005) advise that the final step to effective questioning involves analyzing the techniques used as well as the content of the students' answers. One tool to determine equitable distribution of questions is charting who answers and how often. We have done this using a seating chart inside a clear binder sleeve. As students answer, we place a check on the chart using an overhead marker. This is also useful for identifying students who are not participating. Using this technique may identify patterns such as favoring one section of the room over another or calling on boys more frequently than girls. The content of the questions is important, too, and an audiotape of a lesson can assist in determining whether the range of questions a teacher asks reflects the types of knowledge taught.

Perhaps the most important practice is analyzing students' responses. Again, an audiotape can be useful for engaging in this reflective practice. It is easy to be lured into thinking of students' answers as dichotomous—either correct or incorrect. However, it is essential to keep in mind that a student's answer reflects everything he or she knows and does not know at that particular moment. In other words, an incorrect answer is completely logical to the learner, even if it seems irrational to the teacher. The challenge is to analyze the incorrect answer to hypothesize what the student understands and does not understand, because then the teacher can determine what needs to occur next.

As you listen to a tape of one of your lessons, note the answers your students supplied and how you handled incorrect responses. How often did you scaffold their answers? Were there times when you rephrased a question to clarify understanding?

Were there times when a clue would have been more useful? Sometimes a student is not able to answer even when supports have been offered. In this case, it may be wise to ask another student the question and then return to the first student to ensure understanding. These strategies for responding to incorrect answers are described in Figure 3.2.

Figure 3.2 Helping Students Who Respond Incorrectly

Cue: Use symbols, words, or phrases to help student recall.

Clue: Use overt reminders such as "Starts with . . ."

Probe: Look for reasoning behind an incorrect response or ask for clarity when the response is incomplete.

Rephrase: Pose the same question in different words.

Redirect: Pose the same question to a different student.

Hold accountable later: Later in the lesson, check back with the student who responded incorrectly to make sure that he or she has the correct answer.

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Providing Nonverbal Support

In addition to the dialogic support teachers offer in helping their students construct answers, nonverbal cues can promote or discourage learner response. You have probably been asked a question by someone and started to respond, only to find that he or she does not appear to be listening to your reply. The person may be looking over your shoulder or may turn away from you to complete a task. It's likely that you immediately thought, "Now, why did he even bother to ask?" It is also likely that you were not inclined to continue the conversation. This type of interaction occurs in classrooms each day. Busy teachers attempt to multitask, posing a question while distributing papers. Or another student catches the teacher's eye, and she turns her back on the student who is attempting to offer a reply. This is usually inadvertent, and yet the effect is the same: "Why did she bother to ask?" Of even more concern, the student may think, "I won't bother to answer again."

Nonverbal cues convey a tone of respect for the respondent and encourage the target student and others to continue to participate. Kindsvatter, Wilen, and Ishler (1996) identify seven components of listening that teachers can and should use

to communicate with students that their ideas and participation are valued. They suggest that these seven components indicate to students that the adult is interested and that the student is worthy of attention:

- *Eye contact.* Look directly at the speaker and maintain eye contact.
- *Facial expressions.* Use a variety of appropriate facial expressions, such as smiling or demonstrating surprise or excitement.
- *Body posture.* Use gestures such as hand signals; maintain body posture that signifies openness to students' ideas.
- *Physical distance.* Adjust your position in the classroom according to your condition of instruction; for example, move closer to a student who is speaking (or to a student who is less engaged).
- *Silence.* Be quiet while a student is speaking; don't interrupt; honor wait times after a student stops speaking.
- *Verbal acknowledgments.* Use brief, appropriate verbal acknowledgments such as "Go ahead," "Yes," or "I understand."
- *Subsummaries.* Restate or paraphrase the main ideas presented by students during lengthy discussions.

These simple techniques convey respect for the speaker and provide the questioner with the opportunity to analyze the response and make decisions about scaffolds and feedback. By attending to the respondent and the response, the answer can be used as a means to check for understanding. A distracted teacher is incapable of engaging in anything beyond a superficial awareness of whether the answer was correct or incorrect.

Developing Authentic Questions

As we have noted, teachers are going to ask questions of students. Questions are a great way of checking for understanding. The important thing is to ensure that the questions engage students in deeper thinking and not merely prompt them to recall information that they have read or been told.

One way to make certain that the questions we ask engage students' creative and critical thinking is to plan them in advance using an organizational structure such as Bloom's (1956) taxonomy. Figure 3.3 provides a review of Bloom's taxonomy and descriptive words and prompts related to each level. It is important to

keep in mind that a taxonomy is not a hierarchy, and that Bloom never discussed so-called "lower order" and "higher order" questions. Rather, a taxonomy is a way of classifying information, in this case, types of knowledge. Therefore, knowledge and comprehension questions are directed at gathering a specific type of input. This information is necessary to apply, analyze, synthesize, and evaluate. The criticism of knowledge and comprehension questions concerns the extent to which they are used at the expense of others. As we discussed earlier, recognition and recall are requisite skills, but they do not encompass the limits of understanding. Bloom's taxonomy is an excellent tool for developing questions that represent the range of knowledge that should be taught in the classroom.

Sixth grade teacher Alexandria Ollendorff uses Bloom's taxonomy with her students to encourage them to ask and answer their own questions. She introduces prompts like the ones listed in Figure 3.3 to guide her students. They play a daily game in which groups of students create questions based on the information they are studying that day. The questions they create are used for a Jeopardy-type game, with the number of points determined by the level of the question according to the taxonomy (knowledge is 1 point; evaluation is 6 points). During a unit of study about ancient Egypt and their gods, some of the questions one group created included the following:

- Who was Ra? (knowledge)
- Why do some gods and goddesses have animal heads? (comprehension)
- How do you feel about mummification? (evaluation)
- Compare and contrast Isis, Ptah, and Horus in terms of their importance to the Egyptian people. (analysis)
- What role should gods play in setting rules for people? (evaluation)

This process allows the teacher to check for understanding twice—as students create their questions and when they play the game.

Second grade teacher Heather Jennison also uses Bloom's taxonomy in her planning. For example, during her interactive read-aloud of *Nana Upstairs and Nana Downstairs* (dePaola, 1973), Ms. Jennison prepared the following questions:

- *Knowledge:* What were the names Tommy used for his grandmother and great-grandmother?
- *Comprehension:* How did Tommy feel when he went to visit them each Sunday?

Figure 3.3 Bloom's Taxonomy

Level	Key Words	Prompts
Knowledge: Recall data or information.	define, describe, identify, know, label, list, match, name, outline, recall, recognize, reproduce, select, state	Where is . . . What did . . . Who was . . . When did . . . How many . . . Locate it in the story . . . Point to the . . .
Comprehension: Understand the meaning, translation, interpolation, and interpretation of instructions and problems.	comprehend, convert, defend, distinguish, estimate, explain, extend, generalize, give examples, infer, interpret, paraphrase, predict, rewrite, summarize, translate	Tell me in your own words . . . What does it mean . . . Give me an example of . . . Describe what . . . Illustrate the part of the story that . . . Make a map of . . . What is the main idea of . . .
Application: Use a concept in a new situation or unprompted use of an abstraction.	apply, change, compute, construct, demonstrate, discover, manipulate, modify, operate, predict, prepare, produce, relate, show, solve, use	What would happen to you if . . . Would you have done the same as . . . If you were there, would you . . . How would you solve the problem . . . In the library, find information about . . .
Analysis: Separate material or concepts into component parts so that its organizational structure may be understood.	analyze, break down, compare, contrast, diagram, deconstruct, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, relate, select, separate	What things would you have used . . . What other ways could . . . What things are similar/different? What part of this story was the most exciting? What things couldn't have happened in real life? What kind of person is . . . What caused _____ to act the way he/she did?

- *Application:* What would you have said to Tommy's older brother when he called Nana Upstairs "a witch"?
- *Analysis:* How were Nana Upstairs and Nana Downstairs alike and different?
- *Synthesis:* Add a new last page to the book. What might the two grandmothers say to the adult Tommy when he looks at the stars to remember them?
- *Evaluation:* Did you like this story? Why or why not?

Figure 3.3 Bloom's Taxonomy *(continued)*

Level	Key Words	Prompts
Synthesis: Build a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	categorize, combine, compile, compose, create, devise, design, explain, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize, tell, write	What would it be like if . . . What would it be like to live . . . Design a . . . Pretend you are a . . . What would have happened if . . . Why/why not? Use your imagination to draw a picture of . . . Add a new item on your own . . . Tell/write a different ending . . .
Evaluation: Make judgments about the value of ideas or materials.	appraise, compare, conclude, contrast, criticize, critique, defend, describe, discriminate, evaluate, explain, interpret, justify, relate, summarize, support	Would you recommend this book? Why or why not? Select the best . . . Why is it the best? What do you think will happen to . . . Why do you think that? Could this story really have happened? Which character would you most like to meet? Was _____ good or bad? Why? Did you like the story? Why?

While Bloom's taxonomy provides us with a way of organizing questions, teachers can structure interesting questions in other ways. The goal is for questions to provide students with an opportunity to think and the teacher with an opportunity to check for understanding. Figure 3.4 provides a list of question stems that teachers can use in planning open-ended questions.

Instructional Practices That Promote Participation

In addition to monitoring nonverbal behavior and creating quality questions, there are a number of instructional practices that teachers can use to increase participation and engagement in the classroom. The following strategies are especially useful in the area of questioning and may also apply to other methods of checking for understanding.

Figure 3.4 **Sample Question Stems**

- How is _____ similar to/different from _____?
- What are the characteristics/parts of _____?
- In what other way might we show/illustrate_____?
- What is the big idea/key concept in _____?
- How does _____ relate to _____?
- What ideas/details can you add to _____?
- Give an example of _____.
- What is wrong with _____?
- What might you infer from _____?
- What conclusions might be drawn from _____?
- What questions are we trying to answer? What problem are we trying to solve?
- What are you assuming about _____?
- What might happen if _____?
- What criteria might you use to judge/evaluate _____?
- What evidence supports _____?
- How might we prove/confirm _____?
- How might this be viewed from the perspective of _____?
- What alternatives should be considered?
- What approach/strategy could you use to _____?
- How else might you say _____?

Adapted from *Understanding by design* (p. 167), by G. Wiggins and J. McTighe, 1998, Alexandria, VA: Association for Supervision and Curriculum Development.

Response Cards

Response cards are index cards, signs, dry-erase boards, magnetic boards, or other items that are simultaneously held up by all students in class to indicate their response to a question or problem presented by the teacher. Using response cards, the teacher can easily note the responses of individual students while teaching the whole group. Additionally, response cards allow for participation by the whole class and not just a few students who raise their hands to respond (Heward et al., 1996).

While there are a number of examples of response cards, there are basically two types: preprinted and write-on cards. Preprinted cards already have responses on

them; write-on cards allow students to indicate their responses in real time. There are specific reasons to use each.

When Dana Nielsen wanted her 1st grade students to learn to use response cards, she first provided each student with two preprinted index cards that read "yes" and "no." Then, she introduced the picture book *George and Martha* (Marshall, 1974). Looking at the cover, she asked her students, "Are these dogs?" Several hands shot up; Alicia shouted out, "NO!" Ms. Nielsen paused and looked at the class. She reminded them that they should use their response cards and asked the question again. This time, all of the students held up their "no" cards. Ms. Nielsen then asked, "Is this story a real story? Do you think it could really happen?" Most of the class held up their "no" cards, but four held up "yes" cards. Ms. Nielsen said, "Hmm, I wonder if these animals really are friends and would wear clothes like this." She then pointed to the name of the author, read it aloud, and asked, "Is this the name of the author?" All of the "yes" cards were displayed. Ms. Nielsen was quite pleased to see this as she had been focusing her instruction on identifying title and author information. As she read the book, she paused periodically to ask questions. At one point she asked, "Do you think Martha likes split pea soup?" About half of the "yes" cards went up. She asked Jeremy why he held up his "yes" card, and he answered, "Because she likes to make it. See right there? She likes to cook that." Ms. Nielsen then asked Brianna why she held up her "no" card. Brianna replied, "Yuck, peas! She can't like that." The use of these preprinted response cards ensured that all of the students remained focused on the contents of the book and allowed Ms. Nielsen to check her students' understanding of the information on a regular basis.

Mr. Hernandez uses response cards with his 3rd grade students during their word study lessons. He purchased tile board (used in shower stalls) from his local hardware store and had it cut into 12-inch squares. These work great with dry-erase pens as low-cost personal write-on, wipe-off boards.

Mr. Hernandez displayed a bunch of scrambled letters (d, s, i, a, n, u, o, r) on the overhead projector. Students were asked to write three-letter words using these letters and hold up their boards. The range of student responses included *nor, our, sin, sun, son, and, run, ran,* and *dor.* (Mr. Hernandez noted that Tony had incorrectly spelled *door* as *dor.*) Then Mr. Hernandez asked students to create four-letter words using these letters. The range of words now included *rain, dino, sour, sins, said, raid,*

and so on. These write-on response cards allowed Mr. Hernandez to check his students' understanding of word study while his students identified longer and longer words from the letters that eventually formed the word *dinosaur.*

Physics teacher Tom Jensen uses preprinted response cards that read "potential energy" and "kinetic energy" as part of his instruction in matter and motion. Using an LCD projector to display images on the screen, Mr. Jensen asked his students to identify if the energy being displayed was potential or kinetic. In response to a slide showing a stretched rubber band, all of the students held up their "potential energy" cards. To a slide of a pitcher throwing a baseball, all but two students held up their "kinetic energy" cards. Additional slides focused on roller coasters, a professional runner, a glass of water at the edge of a dinner table, and so on. Several slides later, the image of a massive waterfall was displayed. The majority of the students held up their "kinetic energy" cards. Mr. Jensen asked Antony why he held up his "potential energy" card. Antony responded, "I see more potential energy. Look at all that water ready to go over the edge. The majority of the information in this picture suggests potential; only a small amount of the water is really kinetic at any one time." Mr. Jensen's use of response cards allowed him to check his students' understanding of the key ideas they were learning. These cards also allowed him to note areas of weakness or misconceptions that he could address in his subsequent instruction.

Hand Signals

Hand signals are often used as a classroom management tool. For example, Wong and Wong (2005) suggest a classroom procedure called "Give Me Five" in which students are taught specific behavioral expectations for each of the numbers 5, 4, 3, 2, and 1 as the teacher counts down on his or her fingers. Hand signals have also been successfully used to ensure that students with ADD/ADHD or behavioral disabilities get immediate and private feedback from their teachers (and possibly trusted peers) regarding their performance.

Students can also use hand signals to indicate their understanding of content information. Similar to response cards, hand signals require engagement from the whole group and allow the teacher to check for understanding in large groups of students.

In her kindergarten classroom, Donna Kim uses "thumbs up" to check her students' understanding of instructions and information. Her students know how to display the following signals:

- *Thumbs up:* "I understand _____ and can explain it."
- *Thumbs sideways:* "I'm not completely sure about _____."
- *Thumbs down:* "I do not yet understand _____."

At one point, Ms. Kim used the "thumbs up" procedure to determine which of her students needed additional assistance in their journal writing. The task involved writing at least two follow-up sentences and drawing an illustration of kangaroos based on a shared reading and interactive writing lesson the class had just completed. Ms. Kim reminded her students that the sentences needed to be informational and not fiction. She then said, "Thumbs up?" Several students immediately put their thumbs up and were dismissed to their tables. A few students had their thumbs sideways, and three had their thumbs down. Ms. Kim started with Creshena, who had her thumb sideways. Creshena asked, "You mean it could really happen, right?" Ms. Kim replied, "Yes, informational—not fiction or pretend." When all of the students who had their thumbs sideways had their questions answered and were sitting at their desks writing and illustrating, Ms. Kim focused on the students with their thumbs down. She reviewed the shared reading text, thinking aloud about the range of possible sentences that her students might want to write.

Using this procedure, Ms. Kim was able to allocate instructional time to students who really needed additional support to be successful. In addition, her ability to check for understanding ensured that her students were successful in completing the task at hand.

Seventh grade pre-algebra teacher Tara Jacobsen also uses hand signals to check her students' understanding. As she models the solutions to word problems, she asks her students to hold up fingers based on how well they understand each step along the way. Five fingers means that you have a deep understanding and can explain this step or idea to others in the class; one finger means that you have no idea what just happened. Two to four fingers indicate varying levels of understanding.

As Ms. Jacobsen worked out a problem on the overhead, she shared her thinking and checked for understanding regularly. The problem read as follows:

An 800-seat multiplex is divided into three theaters. There are 270 seats in Theater 1, and there are 150 more seats in Theater 2 than in Theater 3. How many seats are in Theater 2?

Ms. Jacobsen: Okay, so my total has to equal 800; that's all the seats we have in the whole thing. Fingers?

All hands are showing five fingers.

Ms. Jacobsen: I know that there are 270 seats exactly in Theater 1. Fingers?

All hands show five fingers.

Ms. Jacobsen: Well, that's not a lot of help yet. We need to know how many are in Theater 2. There are 150 more seats in Theater 2 than in Theater 3. Thoughts?

Almost all hands show five fingers; three students show three or four.

Ms. Jacobsen: Let me think about this again. [She underlines "150 more seats."] There are 150 more seats in Theater 2 than in Theater 3. So I know that Theater 2 has to be bigger than Theater 3 by 150 seats. Responses?

All hands again show five fingers.

Ms. Jacobsen: So, if Theater 3 is represented as x, then Theater 2 can be represented as $x + 150$, because there are 150 more seats in Theater 2 than 3. Fingers?

All hands show five fingers.

Ms. Jacobsen: I know that all three theaters have to add up to 800. T1 + T2 + T3 = 800. Reactions?

All hands show five fingers.

Ms. Jacobsen: I know that T1 is 270. Fingers?

All hands show five fingers.

Ms. Jacobsen: I know that T2 is $x + 150$. Thoughts?

All hands show five fingers.

Ms. Jacobsen: I know that T3 is x. Fingers?

All hands show five fingers.

Ms. Jacobsen: So, my formula is $270 + (x + 150) + x = 800$. Do you agree?

All hands show five fingers.

Ms. Jacobsen: So I can add like terms: $420 + 2x = 800$. Fingers?

Many hands show four fingers; several students show one or two.

Ms. Jacobsen: Oh, so here's the problem. We need to think about adding like terms. Talk with your partner and explain how like terms are added. [Students start talking with one another.]

Ms. Jacobsen: Here's how I did this. I added the numbers together: 270 + 150 = 420. There isn't a multiplication sign to confuse us; we can just add. Fingers?

All hands show five fingers.

Ms. Jacobsen: Then I added x and x together. Is this what you talked about with your partners? Mikel, what did your partner tell you?

Mikel: She said that the two unknowns could be added because they were both the same kind—x.

Ms. Jacobsen: Right. Are you all thinking that? Do you agree?

All hands show five fingers.

Ms. Jacobsen: Now, I just need to solve for the x. That's the simple part, right? So my answer is 190. Thoughts?

All hands show five fingers.

Ms. Jacobsen: But let's check our variables. We let x = Theater 3. Remember that we were asked to find out how many seats were in Theater 2. So we have to return to our variables and remember that Theater 2 is $x + 150$. So Theater 2, my answer, is 340. Fingers?

All hands show five fingers.

Ms. Jacobsen: Let's check to see if this works. We know that Theater 1 has 270 seats. We learned that Theater 3 has 190. We know that Theater 2, from our addition, has 340 seats. So let's add those together. Do we get 800? Fingers?

All hands show five fingers.

The use of hand signals allowed Ms. Jacobsen to identify the places where her students did not understand the math content so that she could reteach this information on the spot. Checking for understanding as she modeled the solution to the word problem increased the likelihood that her students could use this information to solve similar problems in small groups and eventually on their own.

Audience Response Systems

New technologies have provided teachers with unique opportunities for checking for understanding. For example, Audience Response Systems (ARS)—handheld devices (e.g., remote controls) that allow each learner to respond to questions individually—enable teachers to gather students' responses to interactive questions in real time. Most systems of this type are integrated into software programs such as PowerPoint so that the responses are aggregated and displayed immediately. Imagine being a learner in a classroom where you used a remote control to answer questions, knowing that your response would matter each and every time.

Tom Hayden uses an ARS from TurningPoint (www.turningtechnologies.com) to engage his middle school science students during their unit of study on cells. At one point, he asked the following question:

Which of these things do both plant and animal cells have?
A. Cytoplasm
B. Chloroplasts
C. Cell wall
D. Vacuole

Students quickly entered their responses on their handheld devices. Over 90 percent of the students had this answer correct. Mr. Hayden congratulated his students and quickly summarized the answer: "Yep, cytoplasm. Both animal and plant cells have cytoplasm. You'll recall that cytoplasm is jellylike material that fills cells."

Pleased that his students knew this, he continued to ask questions, provide answers, and integrate brief lecture points into this experience with his students. They remained engaged, waiting for opportunities to demonstrate their knowledge of science. This changed when he asked the following question:

What is the function of the cell membrane?
A. To control which substances move in and out of the cell
B. To help the cell maintain a firm shape
C. To make food for the cell
D. All of the above

More than half of the students selected D; the other half were spread across answers A, B, and C. Mr. Hayden was clearly surprised. "Wow!" he responded: "That membrane really caught us! Why does the cell have a membrane? Let's look at this illustration again. [He turned on the overhead projector and displayed a diagram of a cell.] Tell your partner how the cell maintains its shape. [He paused while students talked.] Ah yes, I'm hearing the answer all around. The cell *wall* helps the cell maintain its shape. So B can't be correct. Try again, everyone. [Students reentered their responses on the handheld devices.] Oh, I'm glad to see no one selected B and only a few people selected C, but lots of you selected D. How could that be if we just determined that B can't be correct? If B isn't correct, then D can't be your answer. Let's review some test-taking skills . . ."

Using technology, questions, and systems for checking for understanding, Mr. Hayden was able to challenge his students' knowledge and misconceptions and provide them with a strong foundation in understanding the physical and biological world.

ReQuest

ReQuest, or reciprocal questioning (Manzo, 1969), was designed to teach students to ask and answer questions as they read. We know that good readers engage in questioning as they read, and the theory is that teaching all students to do this will improve their comprehension (Harvey & Goudvis, 2000). In fact, simply thinking about questions while reading improves comprehension, whether the questions are "question-the-author" questions, "question–answer relationship" questions, or dense questions (Beck, McKeown, Hamilton, & Kucan, 1997; Christenbury, 2006; Raphael, Highfield, & Au, 2006).

The original version of ReQuest requires that the teacher lead the whole class in silently reading a segment of text. Students then ask questions of the teacher about the content of the section of text they read. Next, students and teacher change roles. They all read the next section of the text silently. When they finish the second segment of text, the teacher questions the students. They take turns back and forth alternating between questioning and responding. As the ReQuest process continues, students learn to imitate the teacher's questioning behavior.

Physics teacher Vince Andrews uses ReQuest in his classroom on a weekly basis. He starts each term modeling ReQuest with his students as outlined above. Over

time, he transfers the responsibility totally to his students. They work in pairs, taking turns responding and questioning as they read complex pieces of text. In one instance, students focused on an online text about amusement park physics (www.learner.org/exhibits/parkphysics/index.html). After reading, pairs of students asked and answered questions about roller coasters, how they work, how mass has an impact on the ride, and so on. After reading the section "Wooden or Steel Coaster: Does It Make a Difference?" one student, Violet, asked the following questions:

- What role does the construction material play in the ride?
- What are the advantages and disadvantages of each type of coaster?
- Which would you rather ride and why?
- Which do you think is safer and why?

Socratic Seminar

The Greek philosopher and teacher Socrates (ca. 470–399 BCE) was convinced that the way to gain reliable knowledge was through the practice of disciplined conversation. He called this method *dialectic*, which means the art or practice of examining opinions or ideas logically, often by the method of question and answer, so as to determine their validity.

Educators have developed the Socratic seminar as a way of engaging a group of learners in a conversation and series of questions. There are a number of considerations to address when conducting Socratic seminars, including the text, the question, the leader, and the participants.

The text. Socratic seminar texts should be selected for their ability to engage students in discussion. The text should be rich enough to ensure that readers will ask and answer questions for themselves. Both narrative and informational texts can be used in Socratic seminars. The most important thing is that the text can capture the imagination of the group.

The question. A Socratic seminar begins with a question posed by the leader. As students develop their expertise in Socratic seminars, they will begin asking questions themselves. The question should have no right answer. Instead, the question should reflect authentic wonder and interest. A good opening question requires that students return to the text to think, search, evaluate, wonder, or infer. Responses to the opening question should generate new questions, leading to new responses and still more questions. In a Socratic seminar, inquiry is natural and continuous.

The leader. In a Socratic seminar, the leader serves as both participant in and facilitator of the discussion. The seminar leader demonstrates "habits of mind" (see Costa & Kallick, 2000) that lead to a reflective and thoughtful exploration of the ideas presented in the text and referenced in the discussion. In addition to this facilitator role, the leader is also a seminar participant. As such, the leader actively takes part in the group's examination of the text. Naturally, the leader must know the text well enough to anticipate misconceptions and misunderstandings, various interpretations, reader responses, and issues that may invoke strong emotions. At the same time, the leader must trust the process and allow the group to come to its own understanding of the text and the ideas represented in the text.

The participants. In a Socratic seminar, participants are responsible for the quality of the seminar and discussion. Good seminars result when participants study the text in advance; listen actively; share their ideas, opinions, and questions; and search for evidence in the text to support their ideas. Over time, participants realize that the leader is not expecting "right answers" to the questions that are asked but instead is hoping to get students to think out loud as they discover the excitement of exploring important issues through shared inquiry. Guidelines for Socratic seminar participants can be found in Figure 3.5.

Figure 3.5 **Guidelines for Participants in a Socratic Seminar**

1. Refer to the text when needed during the discussion. A seminar is not a test of memory. You are not "learning a subject"; your goal is to understand the ideas, issues, and values reflected in the text.
2. It's okay to "pass" when asked to contribute.
3. Do not participate if you are not prepared. A seminar should not be a bull session.
4. Do not stay confused; ask for clarification.
5. Stick to the point currently under discussion; make notes about ideas you want to come back to.
6. Don't raise hands; take turns speaking.
7. Listen carefully.
8. Speak up so that all can hear you.
9. Talk to each other, not just to the leader or teacher.
10. Discuss ideas rather than each other's opinions.
11. You are responsible for the seminar, even if you don't know it or admit it.

From Guidelines for participants in a Socratic seminar, by C. Adams, 2004, Vestavia Hills High School, Birmingham, Alabama.

Conclusion

Questioning is a powerful tool that teachers can use to engage students in authentic learning. Questioning is also an excellent way for teachers to check for understanding. There are a number of effective approaches to questioning, both at the individual level and at the classroom level. However, questions can be ineffective when they are not thoughtfully planned or when a teacher's nonverbal behavior indicates lack of interest in the responses or the individual responding.