The Reflective Assessment Technique

A new way of evaluating in-class student work

By Cathleen Kennedy, Kathy Long, and Arthur Camins

How do you know which students are ready to move on to the next lesson and which students will be left behind if you continue with your lesson plan? Teachers often rely on student questions, their observations of students at work, and their own intuition to monitor how well students are learning. Unfortunately, this method does not always result in reliable information.

We found that teachers learn more about their students when they use a four-step formative assessment technique that draws on guided teacher reflections to inform classroom decision-making. In this method, the assessments occur as part of the curriculum, and teachers need only spend 15 minutes of reflection time at the end of each science activity. This makes it easier—and less time consuming—to conduct the assessment compared with giving a quiz or some other add-on activity.

We developed the technique through our work on two National Science Foundation projects: Formative Assessment in Science Through Technology (FAST), which was a collaborative research project between Hudson Public Schools and FOSS staff at the Lawrence Hall of Science, UC Berkeley; and Assessing Science Knowledge (ASK), which was a FOSS assessment-development project that involved third- through sixth-grade teachers from nine locations around the country. We piloted the method in numerous fourth- and fifth-grade classrooms in Massachusetts and South Carolina as teachers conducted a 10-week study on magnetism and electricity using FOSS curriculum and ASK assessment materials (FOSS 2005; FOSS 2006). The results of our efforts were promising. Students in the classrooms in which the method was used demonstrated dramatic learning gains compared to students in classes in which teachers did not spend regular time reflecting on student learning. In addition to improved student performance, the teachers who used the technique reported that they felt their teaching improved because of it.

With just a short time investment, we found both teachers and students greatly benefited from the use of reflective assessment, and we encourage you to try the method in your classrooms.

How Does It Work?

The Reflective Assessment Technique is comprised of four steps for the teacher: anticipate, review, reflect, and adjust.

Step 1: Anticipate

In the first step of the method, teachers *anticipate* by focusing on one or two key concepts students will be learning in the upcoming classroom activity. They think about past confusion students have had while learning those concepts and they decide which pieces of student work to review after class that will provide needed evidence of learning the focus concepts. (Essentially, any piece of student work that elicits students' understanding of the concept under scrutiny can be used for the purpose of this review.)

We suggest that teachers use reflective assessment only after they have taught a module at least once or twice. Teachers need to be familiar with the content and what students find difficult to master. If teachers are familiar with the curriculum they are teaching, this step should only take 5–10 minutes.

FOSS curricula is designed to enable teachers to focus on one or two key concepts for each activity; activities are designed to elicit specific evidence of knowing and being able to apply these concepts to practical problems. Teachers using curricula that do not clearly identify the key concepts of the hands-on activities and link them to the big ideas of the unit would have to set aside time to do this in advance of teaching the unit.

For example, for an activity requiring students to build simple circuits using bulbs, batteries, and wires, the key concept to focus on is the idea that "there must be a complete pathway for electricity to travel through the circuit; including consideration of contact points and the conductivity of the materials used in the circuit" (FOSS 2006).

Once teachers have identified the key concept for the activity and have decided which student work to examine later, they are ready to conduct the activity with students.

Figure 1.

Assessing student notebook sheets (Foss 2006).

What to look for:

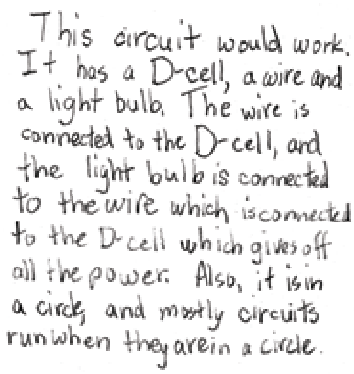
1. Students note that the circuit will not work.
   (a) there is a complete circuit, but it does not include the bulb'
   (b) in order for the bulb to light, both contact points, the base and the metal casing, must be connected to the circuit.
2. Student draws a working circuit, including correct contact points.

Purpose: to clarify student understanding of the need for a complete pathway and correct contact points.

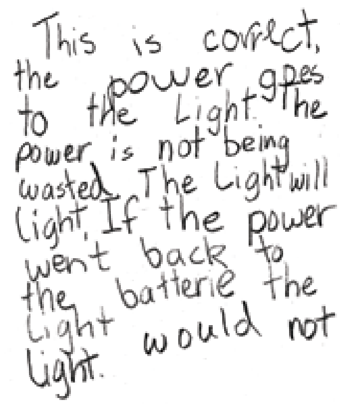
Figure 2.

Student responses and teacher notes.

a.



b.



c. Teacher Reflections:

1. What I noticed as I was evaluating this student work:
   - Student a thinks this will work because there is a complete circuit (didn't notice contact points).
   - Student b thinks this will work because the wire touches the + and the – on the battery.

2. Trends or student confusion I noticed:
   - Most of the students think this circuit will work! They have the idea of a complete circuit, but they are not noticing that the bulb has only one contact point in the circuit.

3. Next steps for this class:
   - We need to focus more on the contact points. As the students build their circuits in the next part, I will go around and ask them to point out the contact points. When we draw schematic diagrams, I'll have them put special points on the drawings to show the contact points.

Figure 3.

FASTmap for FOSS Magnetism and Electricity

File Edit View Reports Help

Row	Name	NBS9 Q1	NBS9 Q2
1	Mary	1	
2	Jenny	1	
3	Thomas	0	
4	Lyle	1	
5	Madison	0	
6	Carrie	1	
7	Lindy	1	

Magnetism and Electricity, Inv 2, Notebook Sheet 9, Q1

Code	Meaning
0	Needs to learn to look for both a complete pathway and contact points when evaluating electric circuits.
1	Student indicates the circuit won't work; considers both complete pathway and contact points.

As students complete the activity, they record the questions they investigate, their observations and discoveries, and their explanations with supporting evidence as notebook entries. (FOSS curriculum materials provide "Notebooks Sheets," worksheets with instructions and/or questions for students to answer as they work through an investigation.)

Step 2: Review

The second step of the technique, *review,* occurs after students have conducted the activity. Students turn in their notebooks open to the page they want the teacher to look at after class. Teachers do not make any marks on the student work but keep a tally of which students got the concepts and which did not.

Figure 1 (p. 51) is an excerpt from the *FOSS Module Teacher Guide, ASK Project Edition* (FOSS 2006) describing what a teacher should look for when he or she evaluates the circuit activity worksheet. The main point of the activity is for students to understand how electricity flows through a circuit (through a complete pathway which requires particular contact points on each component). Thus, the only thing the teacher focuses on when reviewing a student's work is whether it indicates that the student understands this concept. The teacher does not evaluate every aspect of a student's work (e.g., the spelling or grammar used); the point is for the teacher to identify students who do not appear to understand the main concepts covered that day.

Figure 2 (p. 51) shows two students' work and their teacher's reflections about what she learned from reviewing them. In Figure 2a, the student demonstrates that he knows the rule but doesn't recognize the contradiction to the rule in the picture. In Figure 2b, the student describes a circuit but seems to ignore the problem of whether the lightbulb's contact points are in the circuit. After seeing these and the other students' work, the teacher realizes that students understand the concept of a complete pathway but are missing the contact points.

To help teachers tally their results, we provided software (Kennedy, Wilson, and Draney 2006) on which to record their evaluations. Figure 3 is a screenshot showing what the teacher sees as she prepares to evaluate a student's notebook sheet. In this example, the teacher is looking for evidence that students understood the pathway and contact points in the circuit. The pop-up window reminds the teacher of the single concept he or she is evaluating on Question 1 of the activity. The teacher looks for conclusive evidence in the student's work and does not try to read between the lines or use any other evidence or knowledge about the student. If teachers do not have access to a software program such as the one described here, a simple T-table will do the job (Figure 4).

Step 3: Reflect

After the review of student work is completed and the evidence of student understanding recorded, the third step of the assessment is to *reflect* on what the teacher has learned (Figure 2). The teacher spends another five minutes or so thinking about the work he or she has just reviewed and responds to the following prompts:

1. What I noticed as I was evaluating this student work.
2. Trends or student confusion I noticed.

Step 4: Adjust

The fourth step of reflective assessment is to *adjust* by planning "next steps" for helping students clarify their understanding. If just a few students are having difficulties, teachers write sticky notes providing feedback to those students. If half the class is confused, then whole-class "next steps" are in order.

In this example, once the teacher

Figure 4.

Got it	Needs help with...
Sally	Missing contact points
Kevin	Sam
Anna	Jan
	Jeromy

realized that students were confused about the contact points, she made plans to focus on that detail in circuit building in the next activity in the investigation as students continued to build more circuits. A benefit of conducting this assessment at the end of each activity is that teachers often do not need to spend class time revisiting the earlier activity because they caught the problem early on and can draw attention to the concept in the next class session. Had this teacher waited a week to reflect on this learning, the class would have been on to other activities and may not have had opportunities to focus on contact points.

How Did It Work?

The Reflective Assessment Technique was piloted among six teachers teaching seven fourth- and fifth-grade science classes (115 students) in the 2006–2007 school year. Another nine teachers in nine classrooms (with 180 students) constituted the control group. Teachers in both groups taught the same lessons, conducted the same classroom activities, and gave the same assessments. Teachers in the Reflective Assessment group differed by evaluating student work from each of the classroom activities, recording those evaluations, and responding to the reflective prompts about next steps they would take in the classroom.

We compared student performances on the end-of-module assessment and controlled for performance on the pretest. Although students in both groups performed similarly on the pretest, students in the Reflective Assessment group performed better on the posttest. On average, students in these classes achieved posttest scores 30% higher than students in the control group classes.

We considered alternative explanations such as differences in rates of English language learners or special education students in the two groups but found that these factors affected posttest outcomes of students in both groups in the same way, reducing posttest performances regardless of whether the Reflective Assessment Technique was used.

We were not surprised to find that when teachers focus their attention on formative assessment, targeted on learning goals, student learning can be increased. We were happy to find, however, that a relatively modest investment of time brought such a dramatic improvement in student learning. It was not necessary for teachers to introduce new activities or additional tests into their classroom schedules; instead they used what students were already producing as part of the regular instructional activities, making this assessment technique both informative and manageable. ■

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Assessment Standards

Standard A: Assessments must be consistent with the decisions they are designed to inform.

Standard B: Achievement and opportunity to learn science must be assessed.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

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