

CHAPTER 8

Online Assessments and Hearing Students Think About Science

Taryn L. S. Hess and Sherry A. Southerland

Ellen, a student new to Parkview Middle School, was late to her first period science class. As she approached the door of the science classroom, she found the following note: “You can find Ms. Hannah’s class at the computer lab,” with an arrow indicating the direction of the lab. Ellen groaned to herself, knowing that she really didn’t enjoy the computer assignments in her former school. As she had explained to a teacher, “At first they’re pretty cool, but after you get used to doing your work on the computer, what’s the difference between that and a worksheet?”

As she approached the computer lab, she was surprised to hear a number of students arguing. Upon entering the lab, Ellen saw about 30 students in the classroom, in groups of two or three, sitting in front of a computer screen. Why, she wasn’t sure, as there were more computers available, sitting unused. Some groups of students were quietly reading the screen and whispering ideas to one another. Other students raised their voices, and gestured to one another over the tops of monitors.

“What did you get for that one?” a boy called out.

The four students sitting near him broke out in laughter, one exclaiming, “You know it doesn’t work that way, man.... *His* right answer isn’t *your* right answer,” followed by more laughing.

The first speaker smiled a bit then offered in an overly deliberate voice, enunciating each word as if it was memorized from some often heard script, “Okay, okay. ‘Can you explain your reasoning on this question?’” —then in a quicker, lighter tone, “Cause the system is telling us we did something wrong and we can’t figure it out.”

In response, a girl from the group he was speaking to rose from her seat, leaned over the desk, and began offering an explanation.

Ellen scanned the room looking for the adult in this group, and found Ms. Hannah working in the back with a trio of students. As Ellen approached, Ms. Hannah was asking the trio, “So which one would sink if you placed it in water?”

One of the students called out “The wood. It’s heavier.”

Ms. Hannah made a note and looked back at the student and asked, “So you think that it’s the weight, the mass, that determines if something is going to float?” Before the student could respond, Ms. Hannah took notice of her newest student.

When you think of online assessments, you, like Ellen, may envision students sitting alone in front of a computer screen silently clicking on answers to computer-generated questions. In this chapter we encourage you to consider a different use of online assessments—one that encourages collaboration and problem solving.

This chapter examines online assessments, and we hope to help you explore how these assessments might be useful in your science classroom. Although there is a wealth of computer-based assessment tools (such as homework and exam generation programs that accompany many science textbooks), the focus of this chapter is on a specific form of online, interactive assessments: specifically, web-based practice assignments in which students submit their work for computerized grading over the internet. These systems allow you to choose problems from a large bank of questions to assign to your class. They provide students instant feedback on the correctness of their responses, they give students the opportunity to re-attempt and correct answers, and they develop a unique assignment for every student. These programs even grade assignments for you. Online assessments can enhance science instruction by tapping into students’ interest in computers and providing instant feedback on their efforts. They also provide valuable internet interaction and computer skills.

Although much of what we’ve just talked about is exactly what you would expect when thinking about online assessments, we want to describe a different aspect of such assessments. Just as the student from the introductory vignette observed, online assessments can go beyond simply having the student complete problem-solving drills. Assessment systems can allow students an avenue to talk through their growing science understandings, as well as providing you a venue to listen in on students’ science ideas. In this chapter you’ll get to see how online assessments can be an important tool in reform-based science.

Where can you find online assessments for science? Some large textbook publishers provide an online assessment feature if their book is adopted. Other publishers offer assessment packages to be used throughout the school year for a fee (see *i-know* by McGraw Hill and *Quiz Lab* by Pearson Education). *Diagnoser Tools* is a freely available, web-based assessment program that provides formative research-based assessments for a large number of science concepts (www.diagnoser.com/diagnoser).

On the high end of such programs are CAPA (Computer-Assisted Personalized Approach) or OASIS (Online Assessment and Integrated Study), which include a vast array of question banks and student responses. These programs are powerful but do take a bit of investment in terms of coming to understand how to use them.

Because of this, they can best be accessed through a local college or university, many of which use these programs in their undergraduate science courses.

Other than the system itself, associated costs of online assessments revolve around the actual hardware the students work on. Although students at home can use these assessments, decreasing the hardware requirements for your school, some groups of student have an easier time accessing up-to-date systems than others. Aside from the problem of differing access for students, the strengths of such programs are the discussion they can generate. If student discussion is your goal, then having a group of computers with simultaneous internet access is a must. Some classrooms may have access to multiple computers, but in most cases you'll need to access your school's computer lab. Although becoming familiar with any of these systems represents an investment (either in time or funding), we are excited by the way we have seen teachers take advantage of these systems through encouraging students to vocalize comprehension so their teachers can listen in.

What the Research Says

There is a growing body of research investigating the use of online assessment technologies, mostly conducted in college science courses. For example, in an early implementation of computerized homework in a large college physics course, Hudson (1985) reported a dramatic reduction in the number of course dropouts. He argued that this reduction was due to the value of homework in physics courses and the role of feedback in shaping student learning and success in the class. Hudson argued that the immediate assessment and instant feedback of these computerized homework systems clearly aided these students' learning and success in physics, thus decreasing their potential to drop out.

Walberg, Paschal, and Weinstein (1985) conducted a large-scale synthesis of a number of studies and found that homework that was graded or commented on had a large effect in shaping student learning, whereas homework without feedback had only a small effect on student learning. Based on this, we suggest that the strength of online assessment comes from its use of *feedback*. Because online assessments allow for immediate feedback, they can help shape student learning.

A significant benefit from the use of online assessment programs in the traditional sense is the amount of time and energy you, the teacher, saves. That said, research also indicates that these systems initially *increase* a teacher's workload. It's only after you create the initial problem sets and become used to the system that your workload is reduced (Morrissey, Kashy, and Tsai 1995).

In one of the few studies on online assessments in secondary schools, Hassler and a number of colleagues (Hassler et al. 2004) focused on the use of CAPA in high school physics. In their research they compared the learning of students who used

online assessments and students who had traditional homework assignments. They determined that students' overall satisfaction regarding the value of homework increased as a result of using online assessments for a unit of science.

Online assessment systems can provide more practice for students along with immediate feedback, shaping student learning as they work to correct mistakes. However, there are potential drawbacks to this use of these systems:

- ▶ Some programs offer limited feedback.
- ▶ There is always the danger of multiple submissions by students so that they can use a “trial and error” approach to problem solving instead of a close analysis of knowledge applications.
- ▶ When used inappropriately, such systems may contribute to further impersonalization of a course, as a human grader is replaced with a computer.

Online assessments, when carefully selected and employed, can enhance student science learning, but as teachers we must be careful in our selection and use of these tools.

Guidelines for Best Practice

We think of “best practices” as those you employ as you teach science with the reforms in mind (AAAS 1990; NRC 1996). Such practices include the focus on a small number of important concepts so that students can develop a meaningful, applicable knowledge of those concepts, instruction based on student's prior knowledge, the use of student sensemaking of activities (through writing, talking, and argument) in building an understanding of scientific concepts. We suggest that you select and use online assessments in ways that allow students to make sense of scientific phenomena. The science reform documents call for classroom talk that is rich, that includes many voices (and not just that of the teacher or text), and that builds on itself to arrive at new conclusions.

What would the use of an online assessment look like in a reform-based classroom? In the classrooms we've studied, online assessments were employed by the teacher as a review for the students, as a means for her to check their understanding of a unit—a check informed in part by their discussions around the questions as well as students' answers to the questions themselves. In order for the teacher to listen in, the sessions were held during class in the school's computer lab. Although the labs were large enough to allow for one student per terminal, students in these sessions often worked with partners, and these partners felt free to ask others in the room for help—as was suggested in the opening vignette. By listening into the students' conversations, the teacher quickly assessed areas in which they struggled and needed more support. In addition, the teacher had the opportunity to circulate,

speaking with individual students to further understand their knowledge—information that was essential in honing classroom instruction.

Here are some guidelines that should inform the selection of an appropriate online assessment package in a reform-based classroom:

(1) Make sure there is a wealth of content to draw upon in the package.

The package should address a number of the science concepts you plan to teach, as well as having a large question bank for each of these concepts. The investment (both in terms of computer support and individual attention) required for a new system to become familiar and easy to use is simply too demanding to warrant a system that cannot be used on a consistent basis throughout the school year.

(2) Make sure the problem sets are randomized.

As shown in the introductory vignette the randomized nature of problem sets allows for students to work in class groups because the “right answer” will be different for everyone. Randomized sets allow students to discuss and focus on conceptual issues and less on pursuit of a single “right answer” (simply because there is no single right answer).

(3) Make sure that the feedback provided by the system is meaningful to your students and serves to shape student thinking.

The Diagnoser project asks students multiple-choice questions about a phenomenon, then follows their answer with another question designed to elicit their reasoning. This allows the student and teacher to recognize the students’ understandings in an explicit manner. The CAPA program will tell the student if the answer is correct or incorrect, and if incorrect it can display feedback, hints, explanations, and links to other course material.

(4) Make sure the system has flexibility so that it can be adapted for the students’, classroom’s, and teacher’s needs.

The system should allow you to adjust the amount of attempts students can use to answer questions. A multitude of “skill-level” questions need to be available in order to adjust to the learners and types of instruction.

Once you’ve *selected* a program, here are some guidelines for your *use* of it:

(5) At the beginning, use the technology during class sessions at the school’s computer lab, assigning two or three students to a computer.

Allow for student talk during these work sessions. In turn, you should take advan-

tage of the time to listen into student sense-making and conducting one-on-one discussions with students.

(6) Assign online assessments as class work rather than homework, given the digital divide seen in many of our more economically diverse or disadvantaged classrooms.

This allows online assessments to be time for group sensemaking and prevents this technology from furthering the achievement gap of students from low-income homes.

(7) Model how to approach the questions and their answers several times before students attempt this work on their own.

By this, you can emphasize that the goal in working on the problem sets isn't to get the right answer by any means, but to check the soundness of student thinking.

(8) Be willing to “stick with it” and ask for support when needed.

It takes a good deal of time for teachers to become familiar and comfortable with an online assessment program. Consider adopting such programs as a department and be willing to discuss their use during the first year of use so you can work out the “kinks” in the system. Don't judge the effectiveness of a program based on one or two months of use.

Examples of Best Practice

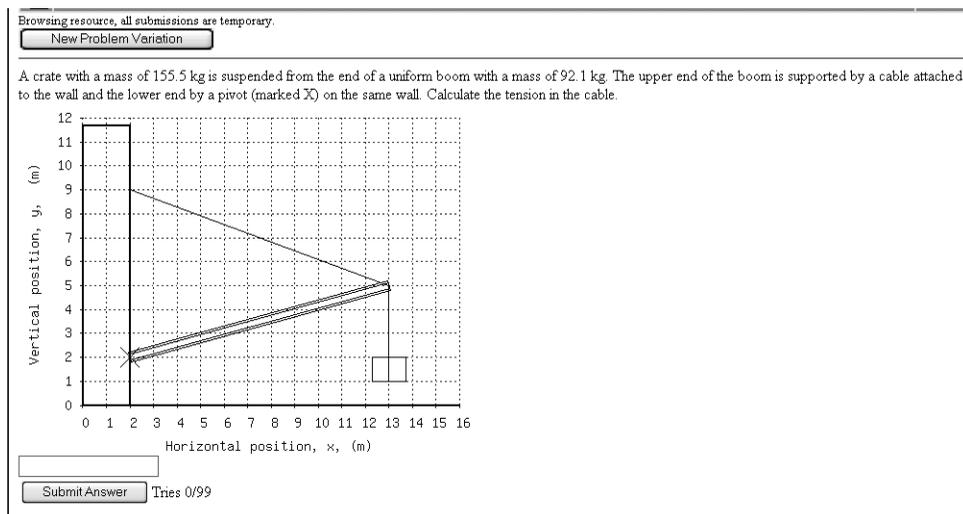
In this section, we will discuss one example of an online assessment system that we are well acquainted with, pointing out what about its structure allows it to be useful in the secondary science classroom, as well as describing how it can be employed to optimize student understanding of science content.

We conducted a study on the use of CAPA in a middle school science class (Sybol and Southerland 2005). In this classroom, online assessments were used as a method of reviewing and reteaching concepts to students during school hours. As in the opening vignette, online assessment sessions were conducted in the school's computer lab, which provided the ability for students to work individually. But during these sessions, we noticed that students often “attacked” the problem sets together. When they needed help, they discussed the problems and equations with the other students in the class, something that happened all the time during our observations. The teacher had been using online assessments for several years. Why? She explained that this particular program fit her goals, and we noticed that her particular use of it also fit with the way she had her students “talk” in science.

The typical “talk” in this classroom was interactive, including many students' voices, all of which were in search of a single correct answer. In addition, one of the

Figure 1

Screenshot from CAPA online assessment.



teacher's more general science teaching goals was to increase student collaboration. This goal was met through the online assessment, as during these sessions students were constantly collaborating with peers to answer problems. The online assessment also increased students' experiences with computers and the internet and increased their confidence in science activities.

Another of the benefits of this system is that it generates individualized student assignments. This feature allows for unique problems for a student, but with consistent concepts and principles being addressed for all the students in a class. This feature of generating individual assignments allows for students to work together in order to construct an understanding of the concepts but prevents them from simply sharing answers. This system provides instant feedback on students' responses, allowing them opportunities to reattempt and correct answers. The "no penalty" feature encourages students to understand, prompts students to correctly solve all the problems, and discourages students' random guessing. The intent here is to prevent students from relying on trial and error to achieve a correct response without developing an understanding of the underlying concepts. The characteristics interact in ways that allow students to quickly reshape their thinking.

The teacher in this classroom was accustomed to online assessments. Much of the initial investment of time and energy was already completed for her, so at the time of our observations her online assessment use had almost become second nature. This particular teacher valued understanding her students' thinking, and used their "talk" around the assessment problems to decide if the material had been

adequately taught. Therefore, she ignored the myriad tasks sitting on her desk and used this time to focus on her students' sensemaking. In this regard, our teacher was different from many of her coworkers. Other teachers in her school began using the same online assessment program as an easy way to assign homework or to provide easy-to-record grades. Many of these teachers were far more used to having their voice primary in the classroom and were not used to listening to their students' thinking, and so they saw little value in listening to students think. Because of their preferred style of teaching, they found this online assessment didn't fit well in their classroom. It is not surprising that these same teachers stopped using the online assessment years ago.

Conclusion

What can we learn from this analysis of online assessments as tools of instruction? It is important to recognize that no one system fits all teachers. Online assessments must be selected based on how well they mesh with your own beliefs and common teaching practices. If there is not a suitable mesh, then you'll end up discarding the system. Based on this, systems need to be selected by teachers (not "handed down" to teachers). You need to select the program in terms of how well it fits your own teaching goals and the kinds of classroom talk you value.

Although online assessments can be an important part of a reform-based science classroom, it is important to recognize that these same tools can also be used in the pursuit of low-level knowledge, as a means of "drill and kill," and other forms of rote learning. If you are only using online assessments for individual homework assignments or as a means of testing students, then it is likely these tools will do little to deepen the understanding students have of science knowledge.

We close by urging you to look past the obvious in your consideration of online assessments. Yes, they have the potential to provide students with useful feedback and to decrease some aspects of your teaching work. But, more importantly, they can be a vital important tool in allowing you to listen in on your students thinking—thus providing invaluable information with which to craft your science instruction.