

Essays on Teaching Excellence

Toward the Best in the Academy

Volume 21, Number 4, 2009-10

A publication of The Professional & Organizational Development Network
in Higher Education (www.podnetwork.org).

Engaging Students, Assessing Learning—Just a Click Away

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Three ongoing challenges for those of us teaching today's college students, especially in large lecture classes, are: getting students engaged in their learning, assessing what learning is actually taking place, and competing with students' technology in keeping their attention. One teaching innovation that holds great promise for addressing these concerns is the use of personal response systems, also known as *clickers*. Clickers allow you to determine the level of student understanding at any given time with relatively little effort, and in the process, use the hook of technology to engage students with class material. In this paper I describe a few examples of ways instructors use clickers to accomplish these ends (for reviews see Caldwell, 2007, and Bruff, 2009).

What are Clickers?

Clickers are handheld devices similar to a TV remote. They allow students to enter responses to questions by sending a radio frequency signal that is picked up by a receiver usually on the instructor's computer. Instructors pose questions, often in a multiple choice format, and students answer by clicking on the number or letter corresponding to the option they choose. Some systems also allow students to type in words. Depending on the specific type of clicker used, software for processing the clicker signal is either contained in the receiver or loaded onto the instructor's computer. The receiver and associated software allow the instructor to see and show (if desired) the composite class data as a histogram.

Using Clickers to Promote Student Engagement

Using clickers allows a range of options in the kind and degree of interaction you have in class. You may use clickers to promote student engagement in a number of ways, such as:

- Giving quizzes over reading assignments or as a way to take attendance
- Testing students' conceptual understanding as part of a peer-learning format
- Taking opinion polls to demonstrate the diversity of views on an important issue
- Posing provocative questions to promote discussion

For example, using clickers to give quizzes is a simple way to hold students accountable for keeping up with reading and general classwork without adding more grading to your load. Each clicker has a unique serial number that can be entered with the student's name into a course management system so that instructors can correlate students with their clickers. Many clicker systems have software that allows response data to be downloaded into other spreadsheet programs or course management systems. Thus each student's response on a quiz is graded and recorded by the software associated with the system.

Using clickers as part of a peer-learning approach is a powerful way to promote conceptual understanding. You pose a content question, and as students vote, you show their responses without revealing the correct answer. Students then discuss their response with a neighbor or a group of students and revote. This approach has been popularized in physics by Eric Mazur at Harvard (1997) and used effectively in other science classes (Caldwell, 2007; Knight & Wood, 2005; Smith, Wood, Adams, Wieman, Knight, Guild, & Su, 2009).

If you wish to know student opinion on a topic covered in class, or if you wish to alert students to the range of opinions on a given topic under consideration, you can pose such questions via clickers. You can then discuss responses with the class or connect their ideas to other aspects of your lecture. Unlike using a show of hands or flashcards for polling, the clicker technology allows an exact tabulation that the whole class can see without revealing individual student views. And students are often much more attuned to and engaged by the use of technology.

This use of the clickers can also be a way to fuel class discussion. For example, you may pose provocative questions, collect student responses, and, analogous to the peer instruction discussed above, ask students to discuss the range of responses with a neighbor, or in small groups, and then revote. You may pose questions that have multiple answers or ones that have no correct answers and list common misperceptions as possible responses. You then question students about the reasoning behind their answers, uncovering misunderstandings or biases that you then address directly via lecture or in student groups.

Using Clickers to Assess Student Learning

As the examples above suggest, one of the advantages to the use of clicker technology is that you have the ability to take a snapshot of student learning. You can record student responses to questions, either those based on content or opinion, and can thus determine where students are in their thinking on an issue at that time. You can also monitor student progress over time. And you can determine relatively quickly if some teaching intervention has made a difference in student thinking.

For example, it can be very difficult to determine if students understand a topic or are following your reasoning, especially in large classes. Clickers provide a quick and relatively simple way to pause and assess student learning. In the simplest case, you might lecture on a topic, ask a clicker question on that topic, and collect student responses. If most of the class answers correctly, you can proceed on to the next subject. If student responses indicate that they are confused on the issue, you may go over points again or provide students with an activity designed to address that idea. The best clicker questions for assessing student learning include as responses common incorrect answers students give that show incomplete understanding or express widespread misperceptions. For example, you may include responses that require students to recognize subtle differences in important lines of thought or distinguish between cause and effect and other faulty lines of reasoning. Requiring students to apply a concept rather than define it provides both of you with a better picture of their understanding.

This use of clickers provides feedback not only to you as the instructor but also to the students. Students are able to see if they understand a topic before a large exam or other major assignment. And they can see how they

are thinking in comparison to their peers. This type of assessment is often called *formative* because its emphasis is on improving teaching and learning.

If you have never tried this real-time assessment of student learning, an initial trial may be a bit shocking. What students find difficult about our disciplines can be surprising. In addition, certain incorrect or naïve ideas that students bring with them from earlier studies or even from childhood can prove very resistant to change. Simply telling students differently often proves ineffective. Thus, the most compelling use of clickers may be in conjunction with peer instruction as described above. The clickers allow both a preliminary assessment of student perception and immediate feedback on the effectiveness of group discussion in correcting or deepening their understanding.

You may also use clickers to evaluate student learning through graded quizzes discussed earlier. This kind of assessment is referred to as *summative* because its role is primarily to document student learning and performance to date. Again, it is important that clicker questions exemplify characteristics of good test questions in general. Consider whether the question you ask is assessing an important learning goal and addressing students' higher order thinking skills. Is it, in essence, a question worth asking and worth grading?

Caveats and Conclusions

The use of clickers is not a magic formula to ensure student engagement and learning. Some instructors note difficulties in getting all students to participate when clicker use is voluntary. And when using clicker questions to document student attendance or to give quizzes, students may freeload off of friends. Instructors may find it challenging as well to construct clicker questions that involve the appropriate level of challenge to engage students.

Clickers do provide a low-risk way to encourage student interaction in class with the benefit of a fun form of technology. Using clickers also provides you with the opportunity to determine the level of class understanding at any given point in time, without an extra burden of grading. These benefits make them well worth a try as you seek to address the ongoing challenges of promoting student learning.

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