Essays on Teaching Excellence

Toward the Best in the Academy

Volume 21, Number 3, 2009-10

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

Multiple-Choice Questions You Wouldn't Put on a Test: Promoting Deep Learning Using Clickers

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Classroom response systems ("clickers") can turn multiple-choice questions—often seen to be as limited as assessment tools—into effective tools for engaging students during class. When using this technology, an instructor first poses a multiple-choice question. Each student responds using a handheld transmitter (or "clicker"). Software on the classroom computer displays the distribution of student responses. Although many multiple-choice questions found on exams work well as clicker questions, there are several kinds of multiple-choice questions less appropriate for exams that function very well to promote learning, particularly deep learning, during class when used with clickers.

One-Best-Answer Questions

Consider posing a question that requires students to weigh evidence for and against each of several answer choices—a question that asks students to select the one "best" answer among competing alternatives. In a literature class, students might be asked to select the option that best explains a character's motivation in a particular point in a play. In a nursing class, students might be asked to select the best course of action given incomplete information about a patient's condition. Such *one-best-answer questions* have more than

one defensible answer—although some answers may be more reasonable than others.

These questions would not make sense on exams without essay questions to supplement them, but they can function very well to promote discussion during class. After having students respond to such a question, an instructor might then use the distribution of student responses to structure a classwide discussion of the question, a discussion in which students share reasons for and against the various answer choices given in the exercise. The instructor can then guide this discussion in ways that show students the standards of evidence of the discipline, standards used to make the kinds of evaluative decisions required by the one-best-answer question.

Using clickers to facilitate this kind of activity has two key advantages. One is that by requesting all students to commit to an answer to the question at hand, all students are more invested in participating in the subsequent discussion and are more likely to have generated some ideas to share in that discussion. The other is that the results display can show students that the question is a difficult one—particularly when more than one answer choice turns out to be popular—and thus worthy of discussion.

Student Perspective Questions

Student perspective questions can be useful clicker questions, as well. These questions ask students to share their opinions and personal experiences. For example, a political science instructor might ask students about their views on current events, a psychology instructor might ask students if they have a close friend or family member with a particular medical condition, and a biology instructor might ask students about their personal views on evolution. These kinds of questions can help students connect sometimes-abstract course material with their own lives. They can also help students understand each other better. Students are sometimes surprised to see how many of their peers agree or disagree with them on particular topics. This can embolden some students to speak up in class discussions, knowing that there are others present who agree with them. It can also encourage some students to more seriously consider perspectives different from their own.

When asking student perspective questions, the ability of clickers to allow students to respond anonymously about sensitive topics is important. Simply asking for a show of hands would likely result in misleading results to questions like these. Moreover, the perspectives of all students are displayed to the class, not just those of the relatively few students willing to share their perspectives verbally. An instructor could poll his or her students on their opinions and experiences using online surveys and the like, but doing so via clickers provides an immediacy to the data thus generated that can engage more students.

Misconception Questions

Many instructors in the sciences use clickers to ask *misconception questions*, multiple-choice questions designed to surface and address common student misconceptions about particular topics. For example, a chemistry instructor might show students two identical flasks with different amounts of water inside and ask which flask, if any, has the highest vapor pressure. Students are likely to vote that the flask with more water has the higher vapor pressure. However, since vapor pressure depends on temperature, not volume, the correct answer is that the vapor pressure is the same for both flasks. This question is designed to address a common misconception about the relationships among the three variables vapor pressure, volume, and temperature.

Well-designed misconception questions are answered incorrectly by 30 to 70 percent of students. Many instructors who see this kind of result engage in what Harvard University physics professor Eric Mazur calls *peer instruction* (Mazur, 1997). Students are asked to discuss the question in pairs, sharing their reasons for their answers with each other and attempting to come to consensus on the correct answer. Then the students vote again on the clicker question. This pair discussion time is valuable because it gives students a chance to learn from each other. Often, a peer's explanation of a tough question can be more helpful to a student than an instructor's explanation. After the second vote, the instructor then leads a classwide discussion of the question, guiding that discussion to focus on reasons for and against the various answer choices.

Misconception questions work well on exams, of course. However, the expectation (or, at least, hope) is that many students will answer these questions correctly on an exam. When used during class with clickers, the expectation is that many students will answer them incorrectly, creating an opportunity for students to stretch their mental models. Mazur and his collaborators have assessed this teaching method using pre- and post-tests and have found significant evidence that it improves student conceptual understanding (Crouch & Mazur, 2001). Their results have been replicated in a variety of science courses and institutions (Fagen, Crouch, & Mazur, 2002).

Peer Assessment Questions

Many instructors have students assess each other's work. Unfortunately, students can often be hesitant to publicly critique each other, which means that when, for instance, an instructor invites a class to give feedback on a student presentation, the resulting discussion often does not involve the kind of critical analysis and constructive criticism the instructor would like to see. Having students assess each other's work using clicker questions, however, allows them more easily to surface the more critical opinions of their peers' work.

For example, in her history courses at Mount Royal University, Kori Street has her students evaluate each other's class presentations using clicker questions (Bruff, 2009). Her students assign a letter grade assessing the quality of a student's sources, the strength of the student's arguments, or the clarity of the student's presentation. She finds that by having students assess each other's work in these categories using clickers, her students are more able to provide honest, constructive feedback since the clickers provide a degree of anonymity. The display of results of these clicker questions, in turn, promotes more engaged class discussion. When students find out, for instance, that 40 percent of them feel that the student's sources were not very strong, it becomes safer for the whole class to discuss the quality of those sources. Since Street's clicker questions are tied to her grading rubric, the discussions they generate serve to teach students about the standards of her discipline.

Why Clickers?

Why use clickers to ask the kinds of questions described above? Clickers allow students to respond anonymously, making it safer for students to share their perspectives and take risks since their peers are not aware of their individual responses. However, instructors can track student responses using clickers, creating accountability for participation during class, which in turn increases participation. When more students can respond to a question honestly, more students are prepared to engage in subsequent discussion. The display of results, that classroom response systems makes possible, provides further motivation for meaningful discussion as students become aware of divergent views. This blend of advantages is difficult to achieve with other in-class response mechanisms.

It should be noted that clicker questions can only set the stage for deep learning. It is during the independent thought, small-group discussion, and classwide debates that deep learning actually occurs. Well-designed clicker questions, however, can be effective tools for motivating and preparing more students to engage in those useful activities.

References

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