

The I-Clicker and I

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This essay reports experience with clickers in teaching The Science of Sound, a distribution-requirements course for students at Michigan State University who have chosen major fields of study unrelated to science or technology.

I began using clickers in teaching an undergraduate course about two years ago. Since then I've discovered some things about clickers — mostly by accident. This essay tells about those serendipitous discoveries.

My course is a science course for undergraduates who need a science credit to graduate. Each term there are about 100 students, and although they are an interesting group of people, it must be said that they come in with inadequate backgrounds in mathematics and science. Needless to say, they are not particularly happy to be in this class. Therefore, my first problem is to get them to come to class — every Tuesday and Thursday for 80 minutes. Half of this problem is remedied by holding a quiz every Thursday. Students come because of the quiz. That leaves the Tuesday problem. The Tuesday problem is mitigated by clickers. Every time a student answers a clicker question he or she gets one point, whether the answer is right or wrong. If the answer is right the student gets an additional point for the question. Students also come to class on Tuesday to get the clicker points.

A second problem is to keep students awake for 80 minutes. Students lead hectic lives, and I found that they often used class time to sleep. An instructor droning on about an arcane topic is just the sort of background noise one needs for a good snooze. Although my observations lack the rigor of a controlled experiment, I believe that frequent clicker questions have essentially eliminated the problem of sleeping in class. You can't click the clicker if you are asleep.

When I first began to use clickers, I carefully prepared three or four clicker questions, each with five optional answers, to be presented at strategic times during a lecture. But I discovered that while I lectured new clicker questions would come to mind, often in response to puzzled looks from students. I started asking those clicker questions too, and although I might not come up with five options, I could always manage a few options, or at least *True-False*. Now, I still prepare three or four clicker questions, but a typical lecture will actually include a dozen, most of them spontaneous.

Spontaneous clicker questions have been made

possible by Eric, the TA for the course. It happens that my course requires a lot of demonstrations, including a TV camera on the instrumentation, and Eric handles most of that. Now Eric also keeps track of the clicker questions as well as the right answers. It takes him only a few minutes after class to enter the right answers into computer so that students get appropriate credit for their answers for the day.

With Eric's help, everything in class has become much more Socratic. Large segments of a lecture consist of one clicker question after another. I don't have to prepare them in advance, and I don't have to interrupt the flow and use class time to record the spontaneous questions or their correct answers.

From time to time in the past, I've experimented with formats in which students were supposed to be teaching other students. Most of these experiments proved to be inefficient use of class time, partly because the blind are often not the best leaders of the blind. One day it occurred to me to ask a clicker question that was mostly a matter of opinion, and I invited students to share their opinions with their neighbors seated to the left and right before making a clicker response. I found that the buzz-buzz around the room helped to get the students more involved. As a result of that experience, students are now invited to discuss all clicker questions with one another before responding. It makes the class more lively, and not a lot is invested in this student-student teaching.

Is it fair to let students discuss questions given that their responses play a role in their final course grades? It is not grossly unfair because clicker responses count for only ten percent of the final grade. (Informally, students are advised to pick their neighbors wisely.) Does it work? I find that if the students have 15 or 20 seconds to answer a question (this happens often during long stretches of clicker questions) there is no real discussion. A limit of 30 seconds is enough to get some discussion, but to get significant discussion seems to require 60 seconds — and an interesting question.

Science lectures often include demonstrations of physical phenomena, but a recent study reported in the *American Journal of Physics* (Crouch et al., 2004)

concluded that students do not gain much from passively watching the instructor do a demonstration. However, the study reported significant positive effect of lecture demonstrations if students had to predict what would happen before the demonstration was done. Apparently this kind of involvement, with the uncertainty of whether one's prediction is right or wrong, is involvement enough for positive learning. Now clickers afford an opportunity for students to make predictions for demonstrations with the added advantage that their predictions become a matter of record. If that builds a little more tension, so much the better.

Some lecture demonstrations are more experimental than others – particularly demonstrations of illusions or perceptual ambiguities as can occur in optics, acoustics, and experimental psychology. Then clickers become more than a teaching aid. They become a potential research tool. Although they do not provide anonymity, they provide the confidentiality required by institutional review boards. Classroom research using clickers should go beyond simple perceptual questions because the conditions do not normally allow for informed consent.

As often as not, my clicker questions concern material that has not yet been covered in lecture, though it *has* been covered in the reading assignment for the day. It is probably standard procedure for instructors to recommend that students do the assigned reading from the text book, course pack, or web page before coming to lecture. We tend to think that students get more out of class if they do the reading first. I'd observe that if students know that they will have clicker questions about the reading, they are more inclined to do it. The value of clicker questions is that each question counts, but there are so many questions that none of them counts very much. My colleagues who use clickers observe that the responses to clicker questions provide valuable feedback to the instructor. After lecturing on a topic, the instructor can ask a pointed question, get an immediate response, and discover whether the lesson sunk in. I would not disagree, but I find value in asking questions first and answering them later as an integral part of lecturing.

In last Tuesday's lecture we were working through a calculation of the reverberation in a large room, and I ran out of time. Although the problem had been thoroughly introduced, we'd only barely begun to solve it. That case of bad timing turned into another lucky accident. I sent the students e-mail restating the problem and giving them six specific, quantitative questions to answer about the solution. The email told them that those specific questions would be the first six clicker questions in the next lecture. The result on the following Thursday was almost 100%

correct responses on those six questions. Apparently, I'd stumbled upon a way to get students to do homework without actually having to grade the homework.

After four semesters using the clickers, I conclude that the clickers have made a night-and-day kind of difference in my undergraduate science class. Specifically, the students sleep at night and not during the day — at least not in my class — not anymore. The clickers have led to far more innovation than I ever imagined when I first began to use them. I also think that I'm just beginning to discover the versatility of this educational technology, and I look forward to learning more.

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REFERENCES

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