

## Why I Like Clicker Personal Response Systems

By Eric Ribbens



I agreed to use clickers as part of my interest in case study teaching when I joined an investigation into the use of clicker personal response systems to teach cases in large introductory biology courses. For those of you unfamiliar with the devices, a clicker is a handheld remote that students use to enter their responses to multiple choice questions. The question is displayed on the classroom overhead screen, usually within a PowerPoint presentation, and a receiver connected to a computer at the front of the room collects all student responses, grades and stores each response, and (when requested) highlights the correct answer and displays a bar graph showing how many students chose each option. My initial exposures to clickers were exciting. In particular, I became rather intrigued with the idea of using clickers, not just as a new fancy way to run a quiz, but for their potential when combined with innovative aspects of teaching such as case studies. I use various forms of active learning such as case studies, small group work, and demonstrations. In particular, I am a heavy case user with up to 13 cases a semester in my smaller 20-student introductory biology courses; however, I have not figured out how to use cases with large sections of students. The entire experience sounded like an interesting intellectual challenge. I was wrong. Instead, clickers have substantially altered my teaching. I teach

differently now, my students have a different educational experience, and I will not give up my clickers. Here's what happened.

In Fall 2006, I explored different brands of clickers. After evaluating several brands, I chose einstruction as the company I wanted to work with. I liked the sales rep and felt that I would get good support from the company. We had some glitches getting started in Spring 2007. Students ignored my instructions for registering and logging into the account I had set up for our class, and instead registered on the web via the instructions on the clicker box. This resulted in them paying an additional \$10 in fees, which einstruction had to reimburse. I also had difficulty establishing my course account and getting the hardware activated, partially because of conflicting instructions from the sales rep and the support staff, and partially because I didn't read the hundreds of pages of instructions.

Thus, it wasn't until the middle of the second week of class that we were ready to use clickers. After a day of practice, we began the use of clickers for real. Using PowerPoint presentations that I had previously developed for standard lectures, I began writing and adding clicker questions. I didn't know exactly what I was trying to accomplish, but I did know that if I was going to use clickers effectively, I needed to use them extensively during every class.

I began by writing questions as multiple-choice quizzes: how well did my students know something we had learned? My first real insight came when we reviewed cell organelles. I asked students to identify pictures of organelles, and discovered that they could not distinguish between nuclei and mitochondria nearly as well as I expected. The combination of clicker questions with images allowed me to efficiently explore the visual aspects of biology. Even more profound, however, was my fumbling attempt to backtrack along my planned course sequence. If students should know cell organelles, and clickers told me they did not know them as well as I expected, then thoroughly reviewing organelles and organelle identification was pedagogically appropriate. Inadvertently, I had stumbled into new teaching territory.

By the time we reached genetics, I had new confidence using clickers. The software was working reliably, and I had begun to trust it. My students had also relaxed and discovered a new interest in biology. Attendance was 20% higher than it had been two years ago. In an early 9 am lecture section, I had no sleeping students. Most significantly, a new classroom dynamic began to develop. I had found a rhythm of interspersing clicker questions into my lecture, so that as student interest began to flag a set of clicker questions reinvigorated them. An interesting group dynamic

also began to develop. I'd put up a question, the class would hush as students read through the question and entered their answer, first one or two, then a steady stream. As the stream diminished to a trickle, students began talking about the question.

"I thought the answer was C. What did you choose?"

"C? No way. You must have done that Punnett Square wrong. Here, let me show you what I did."

Occasionally, I encouraged these conversations by telling them to turn to a neighbor and agree on a common answer. Within a few weeks, it was not uncommon for me to have 120 students vigorously debating biology. Can you imagine a large group of students arguing about biology? How much would you pay for that in your classroom? I was thrilled, even if I sometimes wished I had earplugs. When I announced that I was ending the question and the last stragglers posted their answers, the room hushed again. We all waited eagerly for the software to calculate and display the answers.

*"Option A: 67 students. Option B: 35 students. Option C: 8 students. Option D: 2 students." I learned to use these response profiles to modify my teaching.*

*"95% of you got this one right: good! We don't need to review it then, so let's move on."*

*"Ouch. Only 14 of you picked Option C, which is the right answer. We need to talk about this. Why is Option A wrong? Let's click back to the previous slide ..."*

The students learned. They were getting instant feedback: did they really

know the material or not? I pointed out that if they didn't know it now, they certainly wouldn't know it in three weeks on the exam. However, even more important: they found out what their peers knew. Discovering that everyone else in the room understood something but you didn't penetrated their previously impermeable self-esteem.

*"Almost everyone can calculate gametes except me. I better study this." A small trickle of students asking me to help them understand began to appear during office hours.*

Other tentative students built confidence in themselves when they discovered they knew as much or even more than their classmates.

*"I got that right and 64 didn't? Oh my God, how did that happen?"*

I had also begun to mix new kinds of questions into my course. "Is Mendel's second law true or not? Answer: it is for chromosomes, but not for genes." A vigorous debate ensued. "The textbook says it is true! How can you disagree?" Students rose to the alluring bait, striking eagerly. My only rule was that we had to respect each other. After ejecting one student for losing his temper and shouting at me, we discovered an acceptable debate style. And the students learned.

I firmly believe that science is a rigorous method for thinking, not a collection of facts; a way of exploring the world instead of a way of accumulating pieces of information. My students usually disagree, and try to shoehorn everything down into a flashcard sound byte. These new kinds of case questions challenged them, breaking through the flashcard mold. Some of my questions had no right answer, and

others were intentionally ambiguous. I still used questions to assess their understanding of topics, but increasingly I abandoned my well-trodden lecture paths to encourage them to think through problems.

"What if the Hardy-Weinberg assumptions can't be met? Should we, (a) throw the theory out? (b) recalculate  $p$  and  $q$ ? (c) infer that evolution is happening? (d) give up? (e) find different assumptions?"

Slowly, the students discovered that it really was possible to think through a problem. Even more, the clickers gave them a new investment in the answer. If they thought the theory should be thrown out, how many of their peers would agree? What would I think? They became impatient, eager to find out the rest of the story.

Oh, I reinforced that shamelessly. After the first test, when the class scored 8% better than my last large lecture section had two years before, we celebrated with boxes of Girl Scout cookies, sold to me eagerly by my daughters. The initial grumbles about clicker costs quickly disappeared when I pointed out that \$30 was a cheap investment if you got a letter grade higher. And indeed, they did do better.

I started beginning new topics with a leading question. "Why do females usually determine sexual selection? (a) Males have bad judgment. (b) Males prefer cute females. (c) Females want babies more than males do. (d) Females can have fewer offspring." Students wanted to know if they were right, so they paid attention as we explored sexual selection.

"Sickle cell anemia is a serious disease. Therefore, normally we would expect that evolution would select against sickle cell alleles."

## FIGURE 1

### A collection of things I'd like to share.

- When you use clickers, you need to manage your student expectations. Point out that their grades should go up. Be positive and encouraging, and work hard to make sure they work.
- Students want clickers to make a difference. In my course, all of the clicker questions collectively are 10% of the course grade after I drop their lowest 10% of the clicker questions. I've found 10% of the course is high enough that they take the clickers seriously, low enough that my colleagues don't think that I'm substituting easy questions for "real work," and dropping 10% of the questions is a good way to manage students who forget their clicker or the clicker doesn't seem to be working.
- Use clickers throughout class instead of just at the beginning and the end. It's more fun, it will break up your lecture, and students will become more engaged.
- Don't see clickers as simply a new way to give quizzes, and don't be afraid of some chaos. I let my students use their textbook, discuss the questions with each other, etc. In my opinion, if they have to look up the answer, that's learning, and as they argue with each other they are teaching each other! I tell students not to simply share answers, but to work together, and we've developed an effective group dynamic. Knowing that I trust them empowers them.
- Be open to change. Clickers can expand your repertoire of teaching skills, make your teaching more interactive, and your classroom will not be the same. I spend less time talking and more time listening and watching. They spend less time learning from me and more time learning from each other and by themselves. In particular, instant feedback is a powerful adjuster.
- Know your subject. If you mark the wrong answer as correct, someone will catch you. Admit your mistakes and fix them, but don't make too many of them.
- Be prepared for questions from your colleagues. "Are you just pandering to the couch potato generation?" "How do you use those things?" "Isn't it just a new way to do scantrons?"
- Be creative. I use clickers now even in my small classes. Combine clicker questions with visuals. Use clickers to collect data or to ask personal questions.
- Clicker questions are not just conventional multiple-choice questions. Weave graphics into them. Use them to point back at material just covered, and forward towards topics coming up. I use fairly simple clicker questions as reviews and confidence builders, and difficult clicker questions as interest generators and challenges for my good students. Do not see clickers as simply quizzes or tests.
- Learn, and have fun!

I pushed students to make predictions, and then we'd explore further. I'd put up a graph, and ask them to make predictions. I'd tell them a theory, and ask them to make predictions. The inquiry process became our jungle gym, and as we crawled around on it they began to really appreciate that theories should not be discarded unless a better theory is available, and to see the interplay

between careful speculation and experimental rigor. No, they were not transformed into Galileos or Einsteins. But they learned.

I'm not a clicker expert. I hope I will be someday. I wandered into clickers expecting them to become another tool in my toolbox. Instead, I've found that clickers have somehow taken over my toolbox, rearranged my other tools, and started

acting as an expert assistant. My biology class got better grades. I had about the same number of Ds and Fs, and only a few more As. But the large, soft middle of my course developed new tone and bulged up from Cs into Bs. Overall, my students averaged about 8% higher, and I believe they learned the material better. Attendance increased about 20%, and students seemed to enjoy the course experience more.

However, the big impact has not been on them, but on me. Suddenly I had a large new window into their abilities. Watching them struggle through clicker questions, I realized that it was my bright students who answered my discussion questions in previous years. Clickers forced every student to engage the material, and forced me to watch them. Because it was easier to give and grade quizzes, I gave more quizzes, which meant that I had a much richer set of data exploring their mastery of the content. Most importantly, I now had instant feedback. Within seconds of asking a question, I knew how they answered it, and I learned to use this feedback to make my lectures much more interactive. I began using phrases such as "Well, let's find out if we need to go over this more." As they discussed questions, I wandered up and down the aisles eavesdropping, and I worked what I heard into the course conversation. And, I learned.

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