

**i>clicker Pedagogy Case Study**  
**Kevin Patton, PhD**  
**Department of Life Science**  
**St. Charles Community College**

**COURSE OVERVIEW**

**Course Title/Subject:** Anatomy & Physiology I (BIO 240) and Anatomy & Physiology II (BIO 241).

**Typical Enrollment/Student Information:** ~48 students per class. Overall, there are 240 students per semester, divided into 5 sections. My students are freshmen and sophomores who are in or preparing to enter a health-related program, such as nursing.

**Course Structure:** I teach a 2-semester sequence, so I typically have the same group of students for a full academic year. Most sections meet twice a week for an hour and 15 minutes, and 1 evening section meets weekly for one 2 ½-hour session. These are lecture sections, and the course has an associated laboratory (lab) course, which meets 2 hours a week (taught by an instructor other than myself). I have full responsibility for teaching the classes; there are no teaching assistants (TAs).

The course is taught as a “web-enhanced” course, and each semester consists of 7 to 9 units. Students must prepare for each unit by completing:

- A textbook reading assignment.
- One to 3 online, narrated “preview” tutorials (with ungraded, automatically scored interactive quizzes).
- An online “learning outline,” which they bring to class.

Each unit also includes class lectures. During class, I discuss select sections of the outline using PowerPoint presentations. The presentations are very visual and include animations and video clips. My slides have very little text (bulleted or otherwise) because the students already have the outline there in front of them—and I want to use all the available projected space to show the images to their best advantage. I supplement the lectures with occasional demonstrations in front of the class. I also sometimes hand out to the students small demonstration items (such as models, bones, toys) to handle or play with, which help them learn a principle, or feel some texture. For example, to illustrate energy transfers between molecules, I pass around a little spring-loaded toy frog with a suction cup on its bottom—pushing the frog down to suction to the table represents phosphorylation (adding phosphate to ADP to form ATP, for example) and then its sudden springing up represents the release of energy when the phosphate group is removed. (It’s goofy, I know, but they love it . . . and they “get” the principle.)

Finally, after the lectures on each unit, students take an online test. Students can take each test up to 3 times, and I apply their highest score to their overall course grade. Using randomized question sets, each attempt is unique for the individual (and also, therefore,

for the whole class). The online tests are open-book, open-note, open-web, ask-your-doctor-if-you-dare, open-whole-wide-world, and they require submitting an answer before the next item appears (with no possibility of returning to an item). Some of the items involve basic knowledge, while others involve critical thinking and/or application. For example, students might be presented with anatomical structures or processes that must be arranged in their correct order. They might also be given short case studies. Some are (dissected) anatomical specimens or medical images never before seen by these students, and they must be correctly identified. Students are encouraged to print out their results (incorrect responses are scored but without corrections) and find the correct responses to all questions before attempting to retake the test. They are further encouraged to work in peer groups (of their own choosing) outside of class to correct their previous attempts.

In addition to individual unit assignments and tests, there are 2 in-class exams (midterm and final), which are machine-graded.

Students also have extra-credit opportunities, which involve a combination of outside reading assignments, field trips (for example, Body Worlds III was recently in town), and video presentations (PBS Nova, for example)—all of which require completing either an online quiz or a short paper. These options are carefully laid out to either reinforce the core concepts of the course or to supplement related concepts that we don't have time to address in the main part of the course. It's difficult to get an A in the course without significant extra credit, so all students tend to complete at least some of these options.

The way in which I phrase all of the above is crucial to student compliance and participation. To me, the online **tests** are really “homework” but if I call them that, students won't take them very seriously. A “test” they take very seriously! And the **extra-credit** assignments are really “optional/flexible assignments” but if I use that nomenclature, students will dread having to do them. The term “extra credit” takes the pressure off and makes students think they're gaining some sort of bonus—even though they really must do some of these optional activities if they expect to get a decent grade.

I used the clickers in each lecture as a way of giving students the opportunity to earn extra points (more detail is provided in *i>clicker Grading Policy*).

**Course/Student Challenges:** I've been teaching this course for nearly 25 years and have found it entails several challenges. Chief among them is that the course is very dense with information. This information is occasionally difficult to understand, as well. And it all requires the use of specific and elaborate scientific terminology (the anatomical terminology is especially daunting). I estimate that students encounter nearly 2,000 new technical terms over the course of 2 semesters—a larger new vocabulary than they are likely to pick up in a foreign language class. We also have a very short time to address the large number of concepts (with the accompanying terminology).

Another challenge is that given the density of the material, I have to address many concepts in lecture, so there is not much time for easy-paced discussions. (The size of

each class, while not huge, is too large for effective discussions, anyway). I do, however, want to encourage *some* discussion in my class. Given the class size and intimidating content, students are reluctant to interrupt the flow of a presentation with questions or comments. Brief, occasional discussions would allow us to address enough material while giving me the opportunity to see if they are “getting it” and giving them an opportunity to process and apply what they are learning before moving on to a new concept.

My testing approach requires students to practice and apply critical-thinking skills, and they often need some help developing those abilities. A standard lecture format doesn't easily lend itself to that level of conceptual thinking (especially when we're addressing a lot of material in class). The lab portion of the course, usually taught by a different instructor, has some of the same limitations because of the large number of concepts to be addressed in a brief time period.

Another aspect to this challenge is that we are an open-enrollment community college, and this is the first college course for many of our students; this means that the students taking my course have a wide range of abilities and experience. The only pre-requisite for this course is high-school biology or its equivalent (eg, *General Biology* or *Human Biology*) within the last 5 years.

**Course Grading Policy:** Grades are based on a point system. Students earn points via 7 to 9 online tests (each worth 50 points), 2 in-class exams (worth 100 points), and up to 100 optional points (extra credit and clicker participation/attendance points). By building up enough optional points, students might be able to miss an online test or an exam without penalty (no make-ups are permitted) or perhaps skip their final exam. The difficulty of the tests and exams is such that it's hard to get an A without significant optional points.

### **MOTIVATION FOR USING i>clickers**

In a nutshell, I thought a student response system would enliven the classroom environment and thus enhance the teaching/learning experience for my students and for me. I had various more specific reasons for exploring the use of a student response system.

**Assess Comprehension.** First, I wanted to regularly assess whether my students were “getting it.” I've tried other methods of real-time classroom assessment but found them problematic. Just asking 1 or 2 students a question didn't really tell me how *everyone* was doing at that moment. Alternatively, when I asked students to hold up colored cards, many didn't participate. . . or they held up the card that showed they “got it” so they didn't seem stupid in front of their peers.

Clickers give me a consistent and reliable way to occasionally stop presentations for feedback. I'd like students to stop for a moment and think about what they are learning *now*. Clickers also allow me to either pre-plan a question or to ask one that occurs to me

as I lecture. Importantly, I hoped that i>clickers would get everyone to respond—not just a handful of brave souls. When I ask this (or any) type of clicker question, it is correctly answered before we move forward to another concept.

**Develop Critical-Thinking Skills.** I wanted a way to “reveal the tricks” of my trick questions. That is, clicker questions provide a way to ask some of the questions that I *know* students will have difficulty with . . . and give me the opportunity to show them that they will have difficulty *while showing them how to reason and solve the problem*. The demonstrated solution could involve my guiding the class or 1 or more students walking the rest of us through their solution. The solution might involve skills in analyzing the question, or it might involve skills in drawing together concepts in a new way. This technique also allows me to point out common misconceptions and thus help my students clarify their thinking about troublesome concepts. Thus, i>clickers provide a way to develop critical-thinking skills alongside the core content.

By the way, on the first day of class, I walk them through *Bloom’s Taxonomy*—sort of like an illusionist revealing how a trick is done before performing it. Then, when we run headlong into a “tricky” clicker item that requires a higher-level thinking skill, we can identify its nature and thus more easily figure out “how it is done.”

**Help Me Adjust Lectures As Needed.** Using a student response system would make quick reviews more meaningful. At the beginning of a lecture, I can ask 1 or 2 questions to determine how much students learned in the online “preview” tutorials (or whether they even looked at them) and whether they recall some previous concepts needed to fully understand new material for that day. I can then shift my focus slightly or provide some additional background if needed (or give them sage advice about being well prepared for class each day).

**Record Attendance.** My least-motivating factor for using clickers—but certainly on my list—was that I don’t have to take time or use any special effort to record attendance. I am occasionally asked to verify a student’s attendance, and with 248 students, I can’t remember who was in what class on which day. Besides that, I’m amazed at how often I simply forget to record attendance! Now I don’t have to remember because it’s built into my clicker usage. An added bonus is that students do seem to attend class more regularly than before I used the clickers.

## **IMPLEMENTATION**

**Obtaining i>clickers.** i>clickers are listed as required on the book list for my course. Students must purchase the devices and bring them to every class. Students can purchase clickers from our college bookstore, which stocks new and (more recently) used clickers. If desired, students can sell their clickers back to the bookstore (they get half of what they paid) at the end of 2 semesters (my students use their clickers for 2 semesters).

I opted not to use a classroom set of clickers for several reasons. I wanted to record attendance data, and considering that all of my students in all sections are in the same

Blackboard Campus Edition (WebCT) roster and can attend lectures other than their assigned section, a classroom set would be problematic. I was fearful that clickers might accidentally leave the classroom for days or weeks at a time. And I did not want the disruption or hassle of making sure the clickers were distributed and then collected every day. I also didn't have a budget for this experiment, so a classroom set was not financially practical.

I do have a few extra clickers, which I carry with me to class in case someone has forgotten his/her remote. Fortunately, they usually don't, especially after I point out that carpenters don't often leave their hammers at home when they go to a job site.

**Registering i>clickers.** I want students to have their own clickers so I can record their attendance. I've tried several available methods to synchronize the clickers with the course database, and they're all easy; however, with my class size, I think I prefer that students register their clickers online via the i>clicker website. Then all I have to do is press 1 button in i>grader, and the names all come flowing into my database without any problems.

**Classroom Technology:** Along with i>clicker, I make extensive use of PowerPoint within class. Other in-class technologies include video clips, animations, and images. All of my classroom presentations are done with the use of a Smart Board interactive projection system plus a regular dry-erase whiteboard. Outside of class, I use Blackboard CE extensively for testing/quizzing. I also maintain my own course web page.

**i>clicker Grading Policy:** Students' i>clicker participation is recorded, and they are awarded up to 50 extra points in the course. Students earn what are called "participation points" in i>grader (the i>clicker grade book software). With just a few keystrokes, I upload this participation or "attendance" data every week (or couple of weeks) to Blackboard CE. The software could also tally points based on their actual vote choices (by assigning extra points for correct responses), but I don't need or want that information. Aside from participation points earned, I want my students' responses to be anonymous. I believe that if they are not scored on accuracy, students are more likely to take risks in answering—and less likely to copy someone else's response when they're not sure. I want to know students' "real" responses, and I want them to feel safe in being wrong; the in-class clicker questions are a perfect opportunity to be wrong and learn from it, as part of the formative assessment and learning process.

As stated earlier, students get up to 50 extra-credit points for the semester for using their clickers. Using the scheme outlined in the following table, students will get 50 extra-credit points if they answer at least 90% of the total number of items presented in the course. If they answer at least 80% of the total possible clicker items, then students will receive 40 extra-credit points. As you can see in the table, students must use their clickers at least half of the time to receive any extra credit at all.

Percentage of maximum clicker points	Extra-credit points added to your course total
90% or above	50
80% or above	40
70% or above	30
60% or above	20
50% or above	10

This not only motivates students to bring their clickers to class but also motivates them to answer *something* for each question.


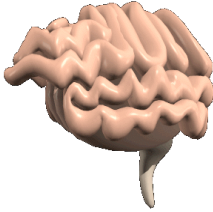
**Daily Use:** I require students to bring their clickers to every lecture, as I pose questions in every class—but only a few so it doesn’t become monotonous. I insert a clicker-question slide into my PowerPoint presentations about every 10 slides (depending on the topic and timing), so students answer a clicker question every 15-20 minutes.

**Questions Asked:** I generally ask questions that provide formative assessment and fall within these broad, overlapping categories:

- Items that assess whether students understand a term or concept (or do they need help?)
- Items that reveal misconceptions about 1 or more concepts
- Items that stimulate discussion of a concept or theory, perhaps by challenging a common cultural bias or dated concept
- Items that apply concepts in a new way to see how high their level of understanding goes
- Items that apply concepts of the course to “real life” to further engage students (such as mini case studies)
- Items that permit students to reveal their opinions anonymously (eg, items about controversial science topics, such as stem-cell research)
- Items that are silly or contain jokes, just to keep the classroom atmosphere light and interesting

Following are a few examples of my i>clicker questions:



Which of these may be adrenergic?



- A. Sympathetic preganglionic fiber
- B. Sympathetic postganglionic fiber
- C. Parasympathetic preganglionic fiber
- D. Parasympathetic postganglionic fiber
- E. Somatic motor fiber

The correct answer is B. This slide facilitates discussion about why this apparently trivial fact is actually very important in understanding the stress response, common drug actions, and other “real-life” applications.

Our senses (when they work correctly) give us an accurate mental image of our physical world.



- A. True
- B. False

The correct answer is B. This slide is rarely answered correctly. We then discuss the notion that sensory information rarely reaches the brain intact, and, once there, is distorted and filtered to exaggerate or eliminate some features of the sensed information. I often have students then find their own visual blind spots (there are 2), and I explain that only the central part of the visual field is in color. We then follow up with some optical illusions.

When presenting clicker questions, I always use the same format, and the slide is linked to a sound file similar to the “Double Jeopardy” tune. So, when students hear the sound and see the slide, they grab their clickers. I sometimes surreptitiously crank up the volume before I get to a clicker slide if I think they need waking up (or if I’m feeling a bit mischievous)!

## **RESULTS**

### *Successes (Students)*

**Utilized Affordable Technology.** Because my students are responsible for acquiring their own clickers, I was concerned about their affordability. Each clicker costs just over \$30 (new) in our bookstore. That's less than 1 month's cell phone bill, so it's not expensive, yet many students have little money left in their pockets after buying textbooks, and we do have some extremely poor students in our population.

According to an anonymous online survey, however, students overwhelmingly replied that they were able to buy new devices without difficulty. In fact, in 2 years, I've only had 1 student not use a clicker—and I'm not sure that affordability was even the issue. Despite this feedback, my plan for the third year is to stock some new and used clickers in our campus library; these units could then be checked out for a semester at a time by those students who truly have difficulty purchasing them.

**Got More Involved.** Because I'd hoped that i>clickers would involve students more in lectures, I used the end-of-semester survey to ask students if they felt more involved. Again, the overwhelming majority said that they did (and I certainly noticed it in class).

**Enjoyed Various Benefits.** In the survey, I presented a checklist regarding attitudes about and experiences with the clicker in class. Their responses confirmed that i>clickers offered multiple benefits to students, as they:

- Helped students get extra credit.
- Enabled students to see how others answered questions.
- Were fun to use.
- Helped students to learn course material, understand tricky and difficult questions, learn new concepts, and review old concepts.
- Were easy to take to class and easy to use.

### *Successes (Myself)*

**Enjoyed User-Friendly Technology.** i>clickers were much easier to use than I thought they would be:

- The pre-lecture setup was easy. All I had to do was scatter a few question slides in my preexisting presentations. The slides themselves were ordinary PowerPoint slides, which required no "fancy moves" to create.
- The program did not require a preliminary installation on my classroom, office, or home computer.
- The program required very little pre-selection of options before using it for the first time.
- When I arrived at the classroom, all I had to do was insert the USB plug, click a few keys, and go.

- I was able to switch back and forth between PowerPoint and other programs (such as internet browsers) and use clickers with all of them.
- The uploading of data into Blackboard CE (WebCT) was extremely easy.
- The teacher's clicker made presentations easier by placing both presentation and clicker functions into 1 unit.
- There were no technical problems with the clickers, receiver system, or software. At first, I did have a few questions about the program's functionality—and these were promptly (and patiently) answered by the i>clicker support line. The clickers seemed to be very sturdy (no failures despite plenty of dropped and otherwise-abused units). The batteries were easily and cheaply replaced AAA batteries, which for most students lasted all semester.

**Connected with Students.** With clickers, I felt more connected to my students because I got regular, focused feedback from them.

**Generated Lively Discussions.** Answers to the i>clicker questions often sparked discussion or review of material that would not have otherwise taken place. The process of using clickers also fostered discussion and collaboration among small groups of students within the larger class during polling.

**Developed Critical-Thinking Skills.** Using clickers gave me the opportunity to demonstrate how to solve tricky questions and helped students to practice answering them.

**Helped Me Customize Lectures by Need.** With i>clickers, I was able to quickly and effectively review previous concepts and gauge the need for additional review.

**Inspired Preparation.** I found that students didn't want to look like loafers and were therefore more motivated to prepare for class knowing that they would get review questions.

**Created Beneficial Lecture Breaks.** Occasional polling of students allowed for natural breaks in the lecture, which required students to focus on their own thought processes in a different way. This allowed us to refresh ourselves and thus stay focused throughout the class time.

**Improved Attendance.** It's hard to quantify this because before using i>clicker, I was notoriously bad about keeping attendance records. But there was a clear and significant increase in the number of students that I observed being in class from day to day. More importantly, they not only seemed more engaged (compared with previous years) but also frequently told me that they felt more engaged (compared with other classes that they were taking). So this represents an increase in *quality* of attendance, not just quantity.

**Increased Student Performance.** I have not done a thorough data analysis, but the overall average course grade has increased a bit while using clickers—as has the proportion of those earning an A. I have also changed some other aspects of the course,

so this cannot be considered to be a finely controlled experiment. The use of clickers, however, has to be *part* of the explanation because the number of students coming to my office or catching me after class to seek help with the “tricky” critical-thinking items (such as case studies) from their online tests has dropped to practically zero! By anticipating their difficulties and using clickers to create a situation where they can make a mistake anonymously, then find a solution collaboratively, I’ve been able to nudge my students farther at a faster pace than by using the online tests alone.

### *Challenges*

When I distributed the anonymous end-of-semester surveys, I asked students if they believed the clickers were a waste of time, a waste of money, and/or a hassle. There were just a few students who selected these options, but with the overwhelmingly positive feedback received, I am not the least bit concerned.

One concern is the time it takes during a class period to ask, analyze, and answer clicker items. As stated earlier, I anticipated this issue by moving some of my lecture material to online “previews.” Without doing so, I probably would have found using clickers to be more of a time challenge. I believe that moving lecture material outside the classroom (to online modules, worksheets, reading assignments, etc.) is well worth the benefits gained by using clickers. The use of clickers in my present format is very manageable, as long as we don’t dilly-dally and move through each clicker item at an acceptably brisk pace.

### **CONCLUSION/DISCUSSION**

I had high hopes for i>clickers, but I was afraid that rather than enhance the classroom experience, the technology would be a hassle for both me and my students and would get in the way of efficient workflow and a pleasant learning environment. That did not happen.

I was afraid that adopting a student response system would require a lot of extra preparation time on my part. It did not. Very little extra preparation time is needed. After the first use in a course, it drops to practically zero prep time.

I was afraid that students would resent buying a clicker. They did not. I was also afraid that they would think it was silly or lame. They thought it was cool (even though you can’t download ringtones into it). I was afraid that students would stop using the i>clicker, or use it once per class to record attendance, then put it away or ignore it. They didn’t. In fact, they thought it was fun and seemed to look forward to using it.

I was afraid that using a student response system would not really generate the kind of feedback that would be consistently helpful—or that it would be only moderately helpful. In fact, it was *surprisingly* helpful. Sometimes I was gratified to learn that everyone “got it,” and other times I was surprised to find that even though I thought we could move on, students really didn’t get it after all. This made me confident that I was tailoring my classroom presentations to each particular group’s needs.

I've always found it hard to get a large group of students in a lecture to think of themselves as a group; however, using clickers seemed to draw them together, and they identified themselves as part of a larger group.

Students seemed to attend class more regularly and perform better on their tests and exams—particularly on the more difficult “critical-thinking” items.

With clickers, we could also monitor changing opinions. By keeping polling open during discussion, we could all see folks change their minds . . . eventually converging on the right answer. Sometimes the group's shifting behavior was a source of amusement for the whole group—especially when a difficult or disputed point was being debated back and forth.

I was pleasantly surprised by the way the anonymity of the system drew everyone in, even those who normally found it very difficult to contribute in a large group.

Using i>clickers has undoubtedly enhanced both my students' and my own classroom experience—and apparently, their performance, as well. I will definitely continue to use them in the future, and I *strongly* recommend that my colleagues give them a try...they just might be surprised by the results.

#### **REFERENCES**

Some of the data in this case study first appeared in an in-service seminar delivered at my college. You can access that presentation at [www.stchas.edu/faculty/kpatton](http://www.stchas.edu/faculty/kpatton).