



i>CLICKER CASE STUDY: UNIVERSITY OF NORTH DAKOTA

Biology Professor Uses Active Learning Methods to Transcend Memorization and Increase Their Understanding of Coursework

Challenge:

A university biology professor struggled to adopt active learning methods in class due to the burden of grading large numbers of assignments.

Solution:

i>clicker provided a way for the professor to help students to think about biological processes and apply their knowledge instead of focusing on memorization of terminology.

Benefits:

Students are able to adopt methods of learning that are more accessible and thus increase their understanding of concepts and its application in real world situations. Likewise, the professor receives direct and instant feedback about student understanding and participation.

An introductory biology course leverages i>clickers as a means for conceptual understanding and a necessary foundation for problem-solving ability.

Motivation For Using i>clickers

- To increase interaction with the class as a whole.
- To gain immediate feedback on the extent to which students grasp concepts.
- To instantly record individual responses on weekly quizzes.

Technology Implementation & Usage

Obtaining/Registering i>clickers: The department purchased a complete set of clickers to provide 1 to every student to use as a requirement to complete the course. Registration was completed via the roll-call feature.

Taking Responsibility: It was up to students to remember to bring their clickers to class. Extra clickers were on hand for those who forgot to bring them.

Classroom Technology: Weekly quiz scores recorded with i>clickers were integrated with Blackboard; the i>clicker stand-alone software and floating tool bar work well with anything that is projected onto the screen.

i>clicker Grading Policy: Clickers are used to record quiz responses and to aid in discussion/review activities without awarding for class participation.

Daily Use/Questions Asked: Students are typically asked to respond to about 3 concept questions during class.

“ I have found that students learn more by interacting with other classmates during quizzes than they do sitting at the computer in the solitude of their home.

Jeff Carmichael, Department of Biology University of North Dakota

Question Examples:

(1) To combat misconceptions.

Example. *Plant cells contain chloroplasts, while animal cells contain mitochondria.*

- A. True
- B. False

This question is open to interpretation, but it does raise the common misconception that plant cells contain ONLY chloroplasts (they also have mitochondria and undergo cellular respiration, just as animal cells do).

Example. *A blood cell is placed in an isotonic solution. Which way will water move across the cell membrane?*

- A. The net movement of water will be out of the cell.
- B. The net movement of water will be into the cell.
- C. Water will move neither into nor out of the cell.
- D. Water will move into and out of the cell at about equal rates.

Many students tend to choose "C," which represents another common misconception. Water can still pass into and out of a cell, even when in an isotonic solution.

Question & Answer Format: Students are generally encouraged to discuss questions with other students before responses are requested. The class is asked to discuss the question as a group, and a student is asked to voluntarily explain why they chose a particular answer (focusing on the wrong answers first).

These questions are given only for discussion/review purposes. The weekly quiz questions are written by the professor and taken from the textbook test bank. i>clickers are also used during a review session before each exam to present approximately 30 true/false questions. Answers are discussed in hopes of identifying problem areas before each exam.

(2) To encourage student self-correction. i>clickers have also been quite valuable in getting students to identify and correct their misconceptions based on class responses to strategically written connected questions.

Example. *Students are presented with an image of a cell undergoing cell division (mitosis). Then they are asked to answer the following question:*

How many pieces of DNA would be found in the skin cell below if it were from human skin?

- A. 46
- B. 23
- C. 92
- D. 184

Student responses are projected to the class, and the vast majority enters choice "A," probably because they know that humans have 46 chromosomes. Choice "A" is not the correct answer, but I don't tell the class that; instead, I show the same image with a different question:

Has the "S-phase" of mitosis (DNA replication) occurred in this cell?

- A. Yes
- B. No

Again, student responses are projected, and the vast majority chooses "A." Choice "A" is the correct answer, and is reminded of the implications of DNA replication. The class is then shown the same cell and again presented with question #1. This time, most students make the connection between their response to question #2 and the number of pieces of DNA within the cell. The majority of the class chooses choice "C" (92 pieces of DNA), which is correct. Only after seeing 2 separate but connected questions do they grasp the idea that chromosomes consist of 2 pieces of DNA (despite the fact that these ideas were just addressed in class). Students are reassured when they see class responses and realize that they are not the only one with misconceptions.

Course Overview

Course Title/Subject: General Biology I and General Biology II.

Typical Enrollment/Student Information:

~ 200 students per class in the Fall and the Spring. These introductory courses are designed for biology majors, but the vast majority of students are majoring in another field. The courses satisfy general education requirements and are required by a few majors other than biology.

Course Structure: These 3-credit courses are generally taught 3 days per week (50 minutes per class) and do not have a teaching assistant (TA) assigned to them. Several sections of each class are taught, each enrolling up to 200 students (4 sections of General Biology I in the Fall and 2 or 3 sections of General Biology II in the Spring).

Traditionally, these courses have been taught with the standard lecture/note-taking format. However, these courses have been restructured as a team-based learning (TBL) format. Activities include weekly lectures, learning assignments for each chapter, individual and team-based quizzes, and investigative case studies.

The learning assignments include a few questions that simply ask students to find information in their textbook, while others require students to explain processes, apply knowledge, and interpret data. The learning assignments are not collected or graded but are used as the basis of the weekly quizzes.

Course/Student Challenges: Historically, active learning activities were not possible (mainly because grading large numbers of assignments would be extremely time consuming). Freshmen level students also typically struggle with learning methods feeling the need to memorize terms even though they might not comprehend fundamental concepts. It is also difficult to know how well students are grasping these concepts.

Course Grading Policy: The final exam is worth 50% of the total points for the course; the midterm exams, 20%; the online homework and reading quizzes, 20%; discussion section participation, 5%; and in-lecture participation using the clickers, 5%.

Results

Successes

- ▶ **Inspired a More Dynamic Classroom.** i>clickers contributed to a more dynamic and interactive class, as well as increasing student learning. Students were more engaged and seemed more likely to ask direct questions and discuss issues than they had in the past.
- ▶ **Easy Assessment of Student Understanding.** i>clickers allowed for easy implementation of in-class grading of quizzes which helped students identify their learning gaps and misconceptions before exam time as well as begin to think about the material that would aid in exam taking.
- ▶ **Elevated Student Performance.** Using i>clickers and a team-based approach to teaching has resulted in higher exam scores than in classes taught without.
- ▶ **Increased Student Interest.** An end-of-semester survey completed by 108 students revealed that students seemed to value the clickers. In fact, 92.6% of students either agreed or strongly agreed that i>clickers were an effective tool towards making the class interactive. Over 81% of students also either agreed or strongly agreed that it was helpful to see other students' responses to the clicker-based questions. A majority of students (80.6%) agreed or strongly agreed that clickers should continue to be used in General Biology.

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Jeff Carmichael, Department of Biology
University of North Dakota

Conclusion

i>clickers were extremely reliable and accurate. As a professor, it is easily adopted and can quickly and accurately record responses from 200 students which is extremely effective for use during weekly quizzes. Additionally, knowing that the quizzes would be given and graded motivated students to come to class prepared and was encouraged to be able to provide clickers to students at no cost to the students.

Institutions should standardize clickers. to be used by most (if not all) faculty for students to wholeheartedly embrace the use of clickers in class.

Instructors should allow ample class time up-front to simply “play” with the clickers and become comfortable with their reliability. It's not recommended to have a large portion of a grade based on clicker activities (at least not until instructors are comfortable with the reliability of their clickers and their ability to download scores and add to Blackboard or any other course management system).

The technology should be as transparent as possible, and instructors and students should not let minor glitches get in the way of effective learning. Instructors should be prepared to spend a little extra time with their class if they decide to use clickers because minor challenges do periodically arise. Nevertheless, the benefits of clickers far outweigh any challenges or extra time required as part of their implementation, and they should be embraced as a valuable tool in the college classroom.