



University of Colorado
Colorado Springs

i>CLICKER CASE STUDY: DEPARTMENT OF CHEMISTRY UNIVERSITY OF COLORADO

Chemistry Professor increases student participation rate by 100% and encourages peer interaction and collaboration

General and Organic Chemistry courses utilize i>clickers to obtain formative assessment and increase student participation.

Challenge:

Without a vehicle to encourage independent textbook preparation before class, individual student comprehension of reading assignments could not be enhanced or tracked at the start of each lecture.

Solution:

i>clickers have revolutionized lectures by providing more interactivity and timely feedback in the classroom.

Benefits:

The professor can customize his methods of testing utilizing the various product options that fit the course structure.

Motivation For Using i>clickers

- To increase student discussion in lectures
- To collect formative assessment results for students & respective professors
- To improve student participation during lectures
- To ensure student timeliness and attendance

Technology Implementation & Usage

Obtaining/Registering i>clickers: i>clickers are required for select chemistry courses purchased by students from the university bookstore. As several science departments use i>clickers as part of their course materials and lectures, on a per-course basis, using the i>clickers is inexpensive for students to apply them to multiple courses.

Classroom Application: Students are required to register their i>clickers through the roll call (in-class registration) software feature.

i>clicker Grading Policy: As part of the chemistry courses, i>clickers are used in conjunction with WebCT (a course management system), document projectors, Web resources, and PowerPoint, where i>clicker questions are directly incorporated.

Daily Use/Questions Asked: Two types of questions asked with i>clickers - straightforward/definitional questions and questions more conceptual in nature. During initial use, questions from a publisher's test bank of multiple-choice questions were applied, but modified over the years.

“ Clickers have caught on like wildfire across the campus with adoption spanning the Colleges of Business, Education, and Nursing, with other use in the Colleges of Letters, Arts & Sciences, and Engineering & Applied Sciences.

David Anderson, Department of Chemistry University of Colorado, Colorado Springs

Question Examples: 2-4 clicker questions are posed per lecture to achieve the following goals:

(1) Application. These questions require a knowledge of key course topics their application or use.

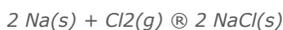
(a.) Sample Question

Sodium dithionite has the chemical formula $\text{Na}_2\text{S}_2\text{O}_4$. Based on this information, the formula for iron (III) dithionite is:

- A. FeS_2O_4
- B. $\text{Fe}(\text{S}_2\text{O}_4)_2$
- C. $\text{Fe}_2(\text{S}_2\text{O}_4)_3$
- D. $\text{Fe}_2(\text{S}_2\text{O}_4)_3$
- E. $\text{Fe}_3(\text{S}_2\text{O}_4)_2$

(b.) Sample Question

How many moles of sodium chloride can be produced from the reaction of 3.35 moles of sodium with 2.13 moles of chlorine gas?



- A. 1.68 mol
- B. 2.13 mol
- C. 3.35 mol
- D. 4.26 mol
- E. 5.48 mol

(c.) Sample Question

A chemist sets up two beakers of distilled water under the same room conditions in the laboratory. One beaker is boiling vigorously, and the other is boiling gently. Which of the following statements is true?

- A. The temperature of the vigorously boiling water is higher.
- B. The temperature of the gently boiling water is higher.
- C. The temperature of the water in both beakers is the same.
- D. The boiling points of the water in the two beakers must be different.
- E. The temperature in the vigorously boiling water is not uniform.

(d.) Sample Question

Assume that the following endothermic chemical reaction is at equilibrium.



All of the following will increase the ratio of products to reactants in the equilibrium mixture except:

- A. Increasing the temperature.
- B. Increasing the volume.
- C. Decreasing the pressure.
- D. Addition of solid carbon.
- E. Addition of water.

Course Overview

Course Title/Subject: General Chemistry I & II and Organic Chemistry I & II

Typical Enrollment/Student Information:

500, ~5% chemistry majors for General Chemistry

200, ~15% chemistry majors for Organic Chemistry

Course Structure: Each course is 75 minutes in length with 5 credits (1 for lab) attributed to General Chemistry I & II, and 3 credits attributed to Organic Chemistry I & II. Lab for General Chemistry is integral, while for Organic Chemistry it is applied as a 2 credit course. iClickers here are used as part of the lecture.

Course/Student Challenges: General Chemistry: stoichiometry, nomenclature, metathesis reactions, acid-base equilibria, buffers, and titrations.

Organic Chemistry: multi-step syntheses, mechanisms, multi-step syntheses, and mechanisms.

Course Grading Policy: General Chemistry: i>clickers: 10% Homework: 10% Quizzes: 10% Exams: 50% Lab: 20%

Organic Chemistry: i>clickers: 12.5% Homework: 12.5% Quizzes: 12.5% Exams: 62.5%

Results

- ▶ **Obtained Formative Assessment** i>clickers provide students with a formative assessment of their comprehension of course material. Correlations between exam and quiz grades are examined with i>clicker results - proving that i>clicker questions provide students with formative feedback about their understanding of course content.
- ▶ **Generated Assessments in Real Time** i>clickers provide formative assessments in real time to the lecturer over the course of a semester. As a result, students' comprehension was assessed as content was being addressed, making for more efficient use of class time.
- ▶ **Increased Interactivity** Students actively participated in answering questions throughout course lectures, increasing overall engagement. 100% in participation was observed during courses, as all students used their iClickers throughout the duration of material covered.
- ▶ **Created Collaborative Environment** Due to the encouragement for students to discuss questions among themselves before answer submissions, a collaborative learning environment was created, previously difficult with course sizes of 120+ students.
- ▶ **Improved Attendance Before** i>clickers, 60% to 70% of students came to class on a typical (non-exam) day, while after i>clickers, 85% to 90% of students were in attendance. On a survey given to students, about 71% of General Chemistry students and 57% of Organic Chemistry students indicated that they came to class more often because of clickers.

“ Students value i>clickers providing insight into their process for answering questions (both right and wrong) with the help of interactive feedback for improved clarification.

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Conclusion

i>clickers have been enormously successful. They have revolutionized lectures by providing more interactivity and timely feedback in the classroom. iClickers have also engaged students, improved learning, created a more collaborative classroom, increased attendance, and allowed delivery of more efficient lectures.

With the benefits derived from using iClickers in course lectures, it is remarkable to also see more and more of fellow colleagues using them as well. Moving forward, there is no doubt that iClickers will continue to be recommended from one department to the next.

According to feedback obtained from students:

General Chemistry students thought that clickers had:

- helps students achieve deeper conceptual understanding (98% agreement)
- makes class more interesting (94%)
- improves student grades on tests and exams (82%)
- fosters peer collaboration (80%)
- encourages students to come to class better prepared (59%)

Organic Chemistry students thought that clickers had:

- helps them learn organic chemistry (96%)
- encourages them to work collaboratively (88%)
- helps students to clarify concepts (81%)
- makes class more interesting (79%)