

Challenge:

To improve overall course performance due to lack of interest in subject, counterintuitive nature of certain topics covered, and low attendance.

Solution:

i>clickers foster learning and participation in large lectures with customized application and immediate feedback to responses.

Benefits:

i>clickers provide immediate formative assessment feedback for both the instructor and students, and stimulate discussions during large lectures previously difficult to be improved.

Statistics course applies i>clicker technology to increase student attendance, create a positive impact on student perceptions of the course, and improve overall exam scores.

Motivation For Using i>clickers

- To foster learning and participation in course lectures
- Encourage student discussion
- Obtain formative assessments
- Incorporate student data into classroom

Technology Implementation & Usage

Obtaining/Registering i>clickers: i>clickers are a requirement for the course. Students are responsible for purchasing their i>clickers and registering them on the i>clicker website.

Taking Responsibility: Synchronized the registrations with the course roster using the i>grader software.

Classroom Application: Overall, found i>clickers very easy to use, and the system worked seamlessly with other technology. In the classroom, use PowerPoint presentations and write on the document camera. Classroom has 2 projectors, which show the students slides and written work simultaneously. PowerPoint presentations are saved on the USB drive that contained the i>clicker software and carried the drive and the base station to the classroom, where it was plugged it into the computer cart and ran everything off the base station and USB drive.

“ i>clickers added considerable value to my large classroom, and I would highly recommend them to other faculty.

Jennifer J. Kaplan, Department of Statistics & Probability, Michigan State University, East Lansing

Generally, have the clicker questions on PowerPoint slides so that the question is captured via screen shot by the i>clicker software. When questions are running off the document camera, the page is dated and the question is recorded. Students were encouraged to bring a graphing calculator to class, but it was not required. Based on an informal poll at the beginning of the semester, the course is taught under the assumption that all students had access to a graphing calculator and brought it to class. The university has Angel course management software. Used the course management website to upload the presentations and communicate with students, and used the online grade book. Did not upload each session's

results to the online grade book or course management website because of the way the i>clicker points are calculated, so students had to e-mail for their daily i>clicker counts.

i>clicker Grading Policy: Use a medium-stakes scheme for awarding i>clicker points. Students needed to answer 75% of the questions for the day and at least 1 had to be correct to earn that day's i>clicker points. Students are permitted to miss up to 3 days during the semester without losing any i>clicker points. Some students who forgot their i>clickers began turning in their answers on paper (Did not encourage this behavior). Generally, assigned a half-day of credit to those papers. Points are awarded based on the proportion of days on which the student participated in i>clicker questions.

Daily Use/Questions Asked: Use i>clickers in every class. The distribution of the number of i>clicker questions per class is bimodal; on “low-clicker” days, tended to ask 2 to 5 questions, and on “high-clicker” days, asked 9 to 12 questions. There were roughly an equal number of “high-clicker” and “low-clicker” days.

Question Examples: Used i>clickers to present 3 different types of questions: 1) questions designed to highlight common conceptual misunderstandings in statistics; 2) questions designed as review questions for topics already addressed; and 3) questions that were part of a class activity to help students learn a concept. For types 1 and 2, either wrote the questions or modified items found in the publicly available database of statistics assessment items on the website of the Assessment Resource Tools for Improving Statistical Thinking (ARTIST): <https://app.gen.umn.edu/artist/index.html>. Generated type-3 questions based on activities done in previous semesters.

Example of a question designed to highlight common conceptual misunderstandings (type 1):

Students in a statistics class designed a survey about spending habits and gave it to a random sample of 300 students, and 282 responded. Please read and evaluate the following statement. There are over 4000 students at the college. Therefore, the results of the survey may not be valid for drawing conclusions about how all students at the college spend money.

- A. Agree: 282 is too small a percentage of 4000 (7%) to allow us to draw conclusions about the population.*
- B. Agree: you should have a sample that is at least 50% of the population in order to make inferences.*
- C. Disagree: 282 is a large enough number to use for these purposes if the sample of students is random.*
- D. Disagree: if the sample is random, the size of the sample does not matter.*

Example of a review question (type 2):

In a study to assess whether aspirin reduces the risk of a pregnant woman developing hypertension, 34 pregnant women were randomly assigned to receive a low dosage of aspirin every day, while 31 pregnant women received a placebo every day. Of those in the aspirin group, 4 developed hypertension during their pregnancy, compared with 11 of those in the placebo group.

This study is:

- A. a controlled experiment.*
- B. an observational study.*

Identify the explanatory variable in this study.

- A. Whether the woman had aspirin or a placebo.*
- B. Whether the woman developed hypertension during pregnancy.*
- C. Whether the woman was pregnant.*
- D. How much aspirin the woman took.*

Example of an activity using clickers (type 3): Initial clicker question:

On September 11, 2002, the New York State lottery winning number was 911. How often do you think the lottery number matches the date?

- More than once a year. About once a year. Once every 2–3 years. Once every 4–5 years. Less than once every 5 years*
- A. More than once a year*
 - B. About once a year*
 - C. Once every 2–3 years*
 - D. Once every 4–5 years*
 - E. Less than once every 5 years*

Course Overview

Course Title/Subject: Introductory Statistical Methods (STT 200; an algebra-based introduction to statistics).

Typical Enrollment/Student Information: ~120 students per class. Each semester, there are about 6 sections taught, so total enrollment for the course is usually between 600 and 700 students (taught 1 section in Fall 2007). This is a service course for non-majors. It is the “catch-all” course, as the department also offers introductory courses for scientists, business majors, etc. The largest major represented is pre-nursing, but there are also a number of criminal justice, journalism, communications, psychology, and packaging majors. The course fulfills the university mathematics requirement. There are usually more upper classmen than lower classmen, but this year my section consisted of one-third freshmen, one-third sophomores, and one-third upper classmen, with only a handful of seniors.

Course Structure: This is a 3-credit course. Students meet for lecture 3 times a week for 50 minutes. In addition, they meet a teaching assistant (TA) in a recitation section 1 day a week for 50 minutes. There are 4 recitation sections, each with about 30 students. The i>clickers are used in lecture but not in recitation. This course does not include the use of computer technology or computer labs; instead, the students use graphing calculators.

Course/Student Challenges: Most students enroll in this course to fulfill their university mathematics requirement or a requirement for their major; in other words, they are taking the course because they must, not because they are interested in learning the subject. In addition, research in statistics education and psychology has shown that certain topics in probability and statistics are counterintuitive. Furthermore, students’ incorrect intuitions have been shown to be quite resistant to change. Finally, in the initial conversations with the department’s senior faculty, many asserted that students have difficulty with the STT 200 course material because they do not attend class.

Course Grading Policy: Grades are determined by various factors: weekly homework assignments, 3 midterm exams and a final exam, and i>clicker participation. Collectively, there are 525 possible points for the semester: homework—100 points (20%); each midterm—75 points (14%); final exam—150 points (28%); and clickers—50 points (10%).

Activity:

Even if we can't figure out how to calculate the probability that the lottery number will match the date (either because it is a difficult problem or because we haven't yet studied probability), we can still estimate the frequency with which it happens through SIMULATION.

- Identify component to be repeated—choosing a 3-digit lottery number.
- Explain how outcome will be modeled—using the 3-digit numbers that could be lottery numbers.
- Explain how you will simulate the trial—by having the calculator randomly choose a 3-digit number: `randint(0,999)`.
- State clearly what the response variable is—whether the number generated by the calculator matches the date—924.
- Run several trials—each student will do the simulation 10 times and write down the number of matches to today's date.

Clicker question to collect data:

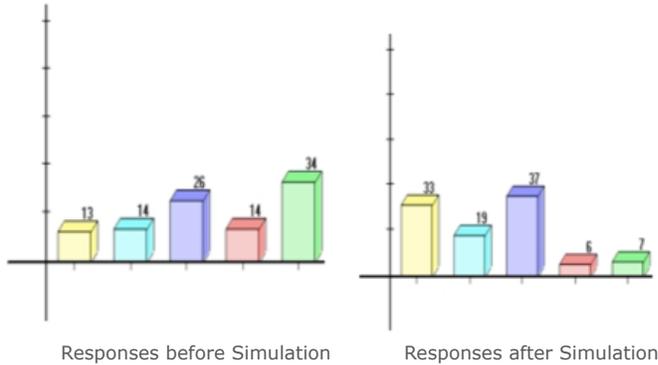
How many times did you get 924?

- A. Never
- B. Once
- C. Twice
- D. Three Times
- E. Four Times

The results were that 6 students out of 100 matched the date 1 time and 1 student matched the date twice. So, out of 1000 trials, we had 8 matches.

At that point, present the initial i>clicker question to wrap up the activity.

How often do you think the lottery number matches the date? (Bars for more often are on the left.)



In general, show the i>clicker question and then open the voting. Watch to see how quickly the responses come in. If the responses are slow, encourage students to talk to each other to help in choosing an answer. Once all answers are in, usually show the class the distribution. When most students have given a correct response, usually say something like "good job" and, before moving on, explain the correct answer briefly for the students who were incorrect. When the responses are more uniformly distributed across the answer choices, solicit comments from the students about why they chose a particular response and have students explain the reasoning. Sometimes, if can tell from the base station that many students are responding incorrectly, give them hints about the problem to consider so they can change their response before the polling closes.

Results

Successes

- ▶ **Met Goals For Larger Lectures** The use of i>clickers has addressed the issues that were previously encountered in teaching large lecture classes. At this time, however, do not have data to support those feelings. Do have some measures by which one might judge the use of i>clickers (following).
- ▶ **Maintained Sizeable Attendance** The mean attendance (as measured by the number of i>clickers recorded during class) for the first 2 months of the course was 100 students (of 120 students enrolled). The standard deviation was 6.5 students. The minimum attendance was 84 students and the maximum was 111 students. Although do not have data to compare pre- and post-clicker attendance, the majority of the students came to classes when i>clickers were used and participated in i>clicker activities. There was also a correlation between attendance and number of points earned for the semester, but it may be that those attending class consistently were stronger students overall (as their GPAs might suggest).
- ▶ **Created Collaborative Environment** The mid-semester course evaluation form included the statement: "Clickers are a valuable learning tool." Eighty-six students either strongly agreed or agreed. Among the free responses, there were 36 positive comments and 12 negative comments (see Challenges) about clickers. The most common positive comments were:
 - i>clickers help with understanding (11).
 - i>clickers increase participation and interactivity (11).
 - the clicker questions are a good self-check of progress (8).
 - the clicker questions are good practice for tests (4).

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Challenges

One issue that surfaced this semester (and that needs to be resolved before teaching another large lecture) is that some students did not engage with the question or activity and, instead, chose a random answer. This issue is evident because students chose, for example, option E when there were only 3 or 4 possible responses. In most cases, these students did not affect the overall learning in the class, but there was 1 day in particular that an activity did not have the intended outcome, and so it did affect student learning.

Asked the students to select a random sample using a calculator simulation and to then create a 95% confidence interval from their sample. The i>clicker question was "Did your interval cover the true populations proportion?" It was expected that 95% of the students would respond "Yes," but only about 80% did. After class, 1 of the students said that many students had not actually participated in the activity and had randomly chosen an answer.

In the future, might be able to solve the problem by adding a third response option, "I haven't yet completed a confidence interval." This would provide an opportunity for students to feel they have earned the i>clicker point without a judgment about why they did not have a response. There were also some negative responses about the i>clickers on the evaluation form distributed to students. The most common negative responses were that the i>clicker questions took too much time (3) and they weren't similar enough to the homework and test questions (3). One student requested that the correct answers to the i>clicker questions be available online after class.

Conclusion

In the future, would not even consider teaching a large lecture class without i>clickers. Would like to explore the possibility of using i>clickers that allow students to enter numeric responses because it would expand the possible types of in-class activities and data collection. On the other hand, reluctant to give up the ease of use of the software that comes with the i>clicker.

Recommendations for Optimal Results

One issue to be addressed with faculty new to i>clickers is the time factor. It was found that each i>clicker question requires 1–2 minutes for students to complete and then 1 or 2 minutes for discussion. This takes longer than presenting and reading from a slide. On the other hand, although the i>clicker question takes more time, it engages students with the material and presentation in a way that copying a slide or listening to the instructor talk does not. Of course, the change in timing might require a few classroom adjustments. For instance, had the TA done many of the problems previously used as class examples in the recitation sections. In addition, the TA did some of the activities that are better suited to smaller groups or from which did not have a good method for collecting responses via the i>clickers in lecture. Because the i>clicker system offered many benefits to the classroom, certainly did not mind making these minor adjustments. Overall, i>clickers added considerable value to the large classroom, and would highly recommend them to other faculty.