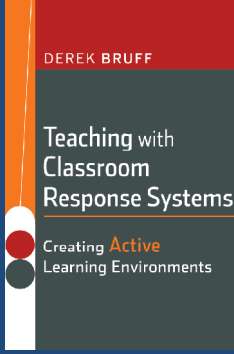


Teaching with Clickers and Classroom Voting

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Teaching Mathematics with Classroom Voting, MAA Notes Series

Edited by Kelly Cline and Holly Zullo

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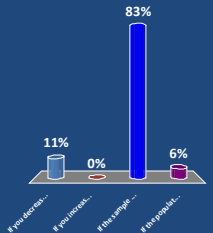
Agenda

- Demonstration
- Your Experiences
- Examples of Clicker Questions
- Frequently Asked Questions
- Classroom Voting and Other Uses
- Wrap-Up

Demonstration

Suppose you construct a 95% confidence interval from a random sample with mean 100 taken from a population with unknown mean and known standard deviation, and the interval is fairly wide. Which of the following conditions would NOT lead to a narrower confidence interval?

1. If you decreased your confidence level
2. If you increased your sample size
3. If the sample mean were smaller
4. If the population standard deviation were smaller



Condition	Percentage
If you decrease...	11%
If you increase...	0%
If the sample mean...	83%
If the population standard deviation...	6%

A Few Other Clicker Vendors



i-clicker



Qwizdom

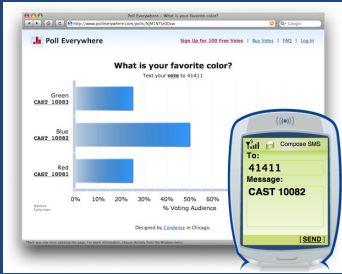


eInstruction



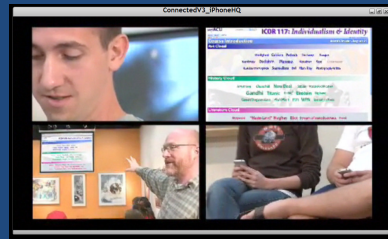
InterWrite PRS

Next Generation Clickers



Cell Phones as Clickers
 Poll Everywhere
www.polleverywhere.com

Next Generation Clickers

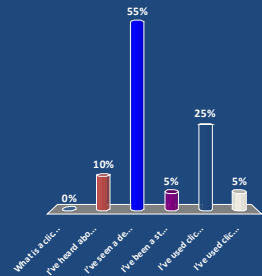


Smart Phones as Clickers
 Abilene Christian University's
 mLearning Initiative
www.acu.edu/connected

Your Experiences

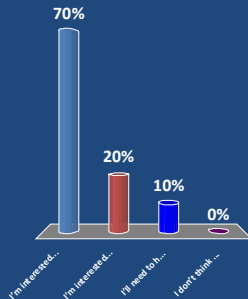
What is your experience with clickers?

1. What is a clicker?
2. I've heard about clickers, but I have not seen them used.
3. I've seen a demo, but not used them.
4. I've been a student in a class that uses clickers.
5. I've used clickers a small amount in my own classes.
6. I've used clickers extensively in my own classes.



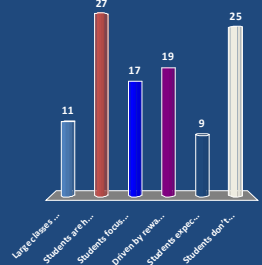
Which best describes your attitude towards teaching with clickers?

1. I'm interested in using them regularly.
2. I'm interested in experimenting with them a little.
3. I'll need to hear more about them before deciding to try them.
4. I don't think I'll be using clickers anytime soon.



Which of the following are the most significant challenges to engaging students with course content? (Select your top three.)

1. Large classes make it easy for students not to engage
2. Students are hesitant to speak up in front of their peers
3. Students focus on taking notes in class, not engaging
4. Driven by rewards (grades, jobs), students don't have much intrinsic interest
5. Students expect to succeed by memorizing and regurgitating
6. Students don't prepare adequately for class



In which courses might you be most interested in using clickers? (Select your top three.)

- College Algebra / Precalculus
- Single-Variable Calculus
- Multi-Variable Calculus
- Linear Algebra
- Differential Equations
- Statistics
- Other

Course	Number of Votes
College Algebra / Precalculus	22
Single-Variable Calculus	32
Multi-Variable Calculus	12
Linear Algebra	14
Differential Equations	4
Statistics	6
Other	17

Examples of Clicker Questions

Precalculus

Which of the following graphs could be that of $y = ab^x$ if $b > 1$?

Option	Percentage
A	75%
B	13%
C	7%
D	4%

Source: *ConceptTests to accompany Calculus, 4th ed.*, by Hughes-Hallett et al.

Response Data: K. Cline, MA121, F '06

Calculus

You were once *exactly* three feet tall.

- True
- False

Source: GoodQuestions Project, Cornell University

Calculus

A boat is drawn close to a dock by pulling in a rope as shown. How is the rate at which the rope is pulled in related to the rate at which the boat approaches the dock?

- They are equal.
- One is a constant multiple of the other.
- It depends on how close the boat is to the dock.

Option	Percentage
1	15%
2	50%
3	10%
3	75%

Source: *GoodQuestions Project, Cornell University*

Response Data: H. Zullo, MA131, F '06

Linear Algebra

Which subsets of the set of vectors shown here are linearly dependent?

- u, w
- t, w
- t, v
- t, u, v
- None of these sets are linearly dependent.
- More than one of these sets is linearly dependent.

Source: Project Math QUEST, Carroll College

Differential Equations

A branch sways back and forth with position $f(t)$. Studying its motion you find that its acceleration is proportional to its position, so that when it is 8 cm to the right, it will accelerate to the left at a rate of 2 cm/s^2 . Which differential equation describes the motion of the branch?

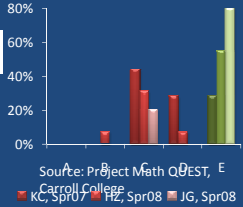
(a) $\frac{d^2 f}{dt^2} = 8f$

(b) $\frac{d^2 f}{dt^2} = -4f$

(c) $\frac{d^2 f}{dt^2} = -2$

(d) $\frac{d^2 f}{dt^2} = \frac{f}{4}$

(e) $\frac{d^2 f}{dt^2} = -\frac{f}{4}$



Intro to Proofs Course

“If $A \subseteq B$, then $A \cup C \subseteq B \cup C$.”

What is the best first sentence of a formal direct proof?

- (1) Assume $A \cup C$.
- (2) Assume $A \subseteq B$.
- (3) Let $x \in B \cup C$.
- (4) Let $x \in A$.
- (5) Let $x \in A \subseteq B$.
- (6) Let $A = \{1, 2, 3, 4\}$ and $B = \{2, 4, 6\}$.

Source: Patti Frazer Lock, St. Lawrence University

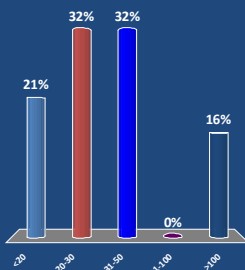
Frequently Asked Questions

What questions do you have?

- Clicker distribution logistics?
- Technical problems?
- Ratio of lecture to classroom voting?
- Tradeoffs in how you use your time?
- Credit / grading? Cheating?
- Student motivation?
- What about students who get the wrong answer?
- Pre / post testing?
- Clicker questions on the final?
- Time investment – start-up, ongoing?
- Using textbook questions?
- What do clicker questions convey about the nature of mathematics?
- Writing / selecting questions?

How many students do you have in a typical class?

1. <20
2. 20-30
3. 31-50
4. 51-100
5. >100



Class Time?

- Questions aren't “extras.” They replace portions of lecture.
 - At first used as assessment after lecture
 - Now use as primary means of delivering information
 - Students can answer questions about many topics without introduction
 - Use lecture to clarify and summarize
- Move on if voting results indicate understanding
- We maintain same pace, give same exams as before

Grading?

- Arguments for:
 - Motivates students to participate
 - Awards points for an activity useful to student learning
- Arguments against:
 - Creates unnecessary pressure
 - Puts emphasis on answers, not discussion
 - Not necessary because knowing that they might be called upon motivates participation
- Bottom line: need student participation
 - When a student participates, other students benefit
 - More complete clicker data is useful

Strategies for Implementing Classroom Voting

Read the handout on implementation strategies and discuss in your small groups.

- Which strategies do you think would be particularly effective with your students?
- What questions do you have about the strategies listed on the handout?
- What other strategies would you suggest for implementing classroom voting?

Homework Assignment

- Visit the Project MathQuest site (mathquest.carroll.edu) or Derek's site (www.derekbruff.com)
- Find 2-3 clicker questions from the sites (directly or through links) that would be useful in one of your courses.
- Be prepared to share these Wednesday morning

Things to think about when selecting questions

- Where does this question fit in my class period – what must I tell the students before they can answer this?
- Is this question likely to promote discussion among students? Why?
- Is this question likely to provide useful information about student learning? Why?
- What cognitive skills will students need to answer this question?

Contact Information

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