The Gentle Art of Questioning

CLICKERS AND OTHER TECH TOOLS FOR STUDENT ENGAGEMENT

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http://STEMclickers.colorado.edu
(will have handouts)

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<table>
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<tbody>
<tr>
<td>A.</td>
<td>STEM faculty</td>
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<tr>
<td>B.</td>
<td>Administrator</td>
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<td>C.</td>
<td>Faculty professional development staff</td>
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<td>D.</td>
<td>Education researcher</td>
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<td>E.</td>
<td>Graduate student or post-doc</td>
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<td>F.</td>
<td>Other</td>
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Show of hands
<p>| | |</p>
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<tbody>
<tr>
<td>A.</td>
<td>I haven’t taught yet</td>
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<tr>
<td>B.</td>
<td>1-5 years</td>
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<tr>
<td>C.</td>
<td>6-10 years</td>
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<tr>
<td>D.</td>
<td>Longer than I can remember</td>
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<tr>
<td>E.</td>
<td>I don’t teach anymore</td>
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Move into groups?
Have you used response systems (clickers) in your teaching?

A. Not at all
B. I’ve seen them used but not yet used them
C. I’ve used them a little
D. I’ve used them a lot
E. I could be (should be?) giving this workshop

Take a clicker & turn it on
If the green light flashes, your vote has been counted
Introducing Me

Science Education Initiative
http://colorado.edu/SEI
Applying scientific principles to improve science education – What are students learning, and which instructional approaches improve learning?

Physics Education Research Group
http://PER.colorado.edu
One of largest PER groups in nation, studying technology, attitudes, classroom practice, & institutional change.

Blogger
http://blog.sciencegeekgirl.com
Why question?

- How many times have you given a lecture and found that students hadn’t followed you?
- Can you rely on students to ask questions if they don’t understand something?
- Can you rely on students to know if they don’t understand something?
- What are the benefits of questioning?
$f(x) = e^{-x^2}$

So clear...

Of course!

2 = 2nd floor
x = 1st floor
e = basement

2 more minutes...

$\rho - x^2$? E.E.E.
Exh? Z.Z.Z.
The toughest thing about asking questions in class is...

A. Writing good questions
B. Getting students to really think about them
C. Getting students to answer the questions / Nobody responds
D. The same students always respond / Not everybody responds
E. It takes too long / I have a lot of content to cover
1. **When and how** we can ask questions
2. About **clickers** as a way to ask questions
3. **Challenges and best practices** in using clickers, discussion boards, and in-class questioning
4. **Writing good questions**
5. **Action plan**

**Learning goals:** Participants will be able to...
A. Explain several benefits of questioning and of using clickers to question
B. Defend the use of best practices in questioning to overcome common challenges
C. Formulate an action plan for questioning that is suitable to their teaching context
Warm-up exercise: Questions in your content

- What questions could you ask to help students achieve your assigned learning goal -- to test mastery and stimulate learning?
- Brainstorm as a group

5 minutes
WHEN to ask? Questioning Cycle

BEFORE
- Setting up instruction
- Assess prior knowledge
- Provoke thinking
- Predict-and-show
- Discover
- Motivate

DURING
- Application
- Analysis
- Synthesis
- Elicit misconception
- Exercise skill
- Evaluation
- “Big picture”
- Demonstrate success
- Review / Recap
- Exit poll

AFTER
- Assessing learning

Credit: Rosie Piller and Ian Beatty.
Some methods of asking questions

- Ask rhetorically
- Target the class (how?)
- Target someone in particular (in what order?)
- Wait and then... (call on whom?)
- Answer your own question
- Leave the question unanswered

Or ask out of class
- Blogs
- Discussion boards
- Homework...

My favorite:
- Target entire class
- Wait
- Vote with clickers
- Call on volunteers
- Encourage responses

Credit: Rosie Piller
Why use clickers to target the class?
An outline of Peer Instruction.
Clickers are a tool for questioning

But not a magic bullet!
Anatomy of Peer Instruction

* See also: Peer Instruction, A User’s Manual. E. Mazur.
How is a clicker question the same or different?*

- Similar in terms of goals
- Multiple choice
- Anonymous (to peers)
- Every student has a voice – the loud ones and the shy ones
- Forced wait time
- You can withhold the answer until everyone has had time to think (choose when to show the histogram)

* From other types of in-class questions

What does this tool help us to do?
Which of these could be clicker questions?

BEFORE
Setting up instruction
- Motivate
- Discover
- Predict-and-show
- Provoke thinking
- Assess prior knowledge
- “Big picture”
- Demonstrate success
- Review / Recap

DURING
Developing knowledge
- Check knowledge/comprehension
- Application
- Analysis
- Evaluation
- Synthesis
- Elicit misconception
- Exercise skill

AFTER
Assessing learning
- Exit poll

Credit: Rosie Piller and Ian Beatty.
U. Colorado clicker resources...

Videos of effective use of clickers

http://STEMvideos.colorado.edu

2-5 mins long

Clicker resource page

http://STEMclickers.colorado.edu

- Instructor’s Guide
- Question banks
- Workshops
- Literature / Articles
Let’s try it

Which superpower would you rather have? The ability to...

A. Change the mass of things
B. Change the charge of things
C. Change the magnetization of things
D. Change the boiling point of things
Example question: Math

Your sister in law calls to say that she’s having twins. Which of the following is the most likely? (Assume she’s having fraternal, not identical, twins)

A. Twin boys
B. Twin girls
C. One girl and one boy
D. All are equally likely
Example question: Survey

If you were walking down a road and passed a piece of trash, would you pick it up?

A. Yes  
B. No  
C. It depends
Exercise #1  What could possibly go wrong?

- You ask students a question, and ask them to discuss.
- You then ask them to share their answers and reasoning in a whole-class discussion.
- What could possibly go wrong? 😊

In groups of 3-5 brainstorm some of the challenges you imagine, or outstanding questions.

Organize into challenges regarding (1) writing/asking questions, (2) peer discussion, (3) explaining the answer and (4) other.

What is a possible solution?
What are some challenges/things to consider when posing a clicker question?

- Ask several times during lecture
- Ask challenging, meaningful questions
- Don’t post until ready
- Give time to read (read silently)
- Don’t read question out loud
2. Peer Discussion

Why is peer discussion important?

• Students learn more deeply by teaching each other
• Makes them articulate answer
• Lets you see inside their heads

What are challenges / how can you help make it work?

• Make it clear why you’re doing this
• Circulate and ask questions / model
• Use questions they want to discuss
• Allow enough time (2-5 mins)
3. Wrap-Up Discussion

Challenges?
What might you do to facilitate an effective wrap-up discussion?

- Establish culture of respect
- Consider whether to show the histogram immediately
- Ask multiple students to defend their answers
- Why are wrong answers wrong and why right answer is right
Effects of increased wait time

- **Changes in student behavior:**
  - More students respond
  - More students respond without being asked (unsolicited)
  - Student responses are longer
  - More alternative explanations are offered
  - Student confidence increases
  - There are more speculative responses
  - Students ask more questions

- **Other changes (on teacher!):**
  - Quantity of questions decreased
  - Quality of questions increased
  - Expectations of slower students were revised
  - Teacher reactions to answers were more appropriate

Rowe, Mary Budd (1974)

All from a few more seconds!
Giving the answer stops student thinking!
**Discussion boards / blogs**

**The motivation question:** How do you encourage students to participate? How do you create an authentic audience? How do you make this an integrated and motivating part of the course?

- Make expectations for participation clear
- Post interesting questions
- Provide incentive (intrinsic better than extrinsic) for reading and writing

*Search Derek Bruff’s blog for “Randy Bass” and/or “social pedagogies”*
We’re going to practice writing questions now

- Remember those questions from the warm-up?
- In groups of 3-4, choose one (quickly) that you will write a multiple choice version of

1 minute
Gallery Walk

- Read briefly over the “tips for writing clicker questions” handout. Which is going to be most challenging for you?
- As a table, look at the “example questions” trio that I have given you. What’s a common theme(s)? Write the themes down on the sheet.

*When you’re done, circulate to see the themes of questions on other tables. Shop for ideas for your own questions!*
Exercise #2: Multiple choice questions

- In groups of ~3, pick a question from the Warm Up exercise, and write a multiple choice version of it.
- If you have time, write another question from another part of the questioning cycle!

7 minutes
Action Plan

- Take a few minutes to write down your action plan to implement ideas you heard about in the workshop
References & Resources

• **Clicker Resource Page from the Science Education Initiative:** [http://STEMclickers.colorado.edu](http://STEMclickers.colorado.edu). Has clicker question banks (in the sciences), an instructors’ guide, and videos of classroom use. Useful books (such as Eric Mazur’s *Peer Instruction*) are cited there.

• **Workshop handouts** will be uploaded to the above website.


• Other materials (particularly sample clicker questions and goals of clicker questions) adapted from **Ian Beatty’s** Technology Enhanced Formative Assessment (TEFA) program. [http://ianbeatty.com/crs](http://ianbeatty.com/crs)

• **Cited research:**

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[http://STEMclickers.colorado.edu](http://STEMclickers.colorado.edu) *(will have handouts)*

Thanks!
Learning Goals

- **Biology:** Recognize the components of a cell and describe why each is necessary for the function of a cell
- **Physics:** Identify the different ways that light can interact with an object (i.e., transmitted, absorbed, reflected).
- Chemistry
- Earth science
- Math
What Do I do if...?

What can you do if you ask questions and...

• There is no response
• The same people keep raising their hands
• The answers are called out before everyone has a chance to think
• The answers take too long
• Someone gives a wrong answer
• Only some students are prepared
• ?

We’ll discuss in Workshop #2.
For now: Many of these challenges are addressed by clickers