Make clickers work for you…

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Upcoming travel to: SF Bay Area, LA, W. Virginia U., Pittsburgh, Chicago

There are **handouts** for this session that may be helpful at blog.sciencegeekgirl.com
(see "presentations" tab)

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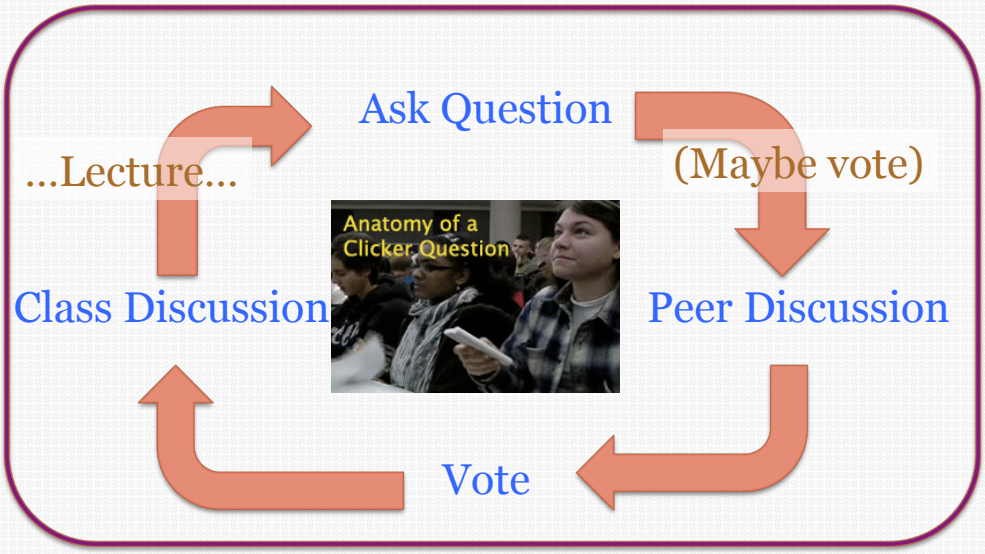
Anatomy of Peer Instruction



* See also: Peer Instruction, A User's Manual. E. Mazur.

CU's Science Education Initiative

Resources on **Clickers** and **Instruction**

CU's Science Education Initiative (SEI) is a 5-year $5M investment by the University of Colorado to catalyze and support significant, sustainable improvements in undergraduate science education. The SEI funds departments to take a four-step, scientific approach to undergraduate education, by establishing what students should learn, measuring what students are actually learning, use instructional approaches guided by research on learning, and disseminate and adopt what works.

Clicker Resource Page

http://STEMclickers.colorado.edu

Set of online resources on using clickers and peer instruction, including clicker question banks, literature references, workshop materials, and helpful links. Includes a downloadable "Instructor Guide to Clickers" on best practices in clicker use, based on experience and research.

Clicker Video Page

http://STEMvideos.colorado.edu

A set of short, high-quality videos giving an inside look into our classrooms, including tips and techniques, the research behind clickers, and use in upper-division courses, plus a video on group work in college settings.

Other Instructor Resources

- An **Instructor Resource page** with articles and white papers on research-based techniques to help students learn, at http://www.cwsei.ubc.ca/resources/instructor_guidance.htm
- A **Learning Goals page** with resources and strategies for writing and using learning goals in instruction, at http://www.cwsei.ubc.ca/resources/learn_goals.htm

For more information, visit **http://colorado.edu/sei.**
The SEI Outreach coordinator is Stephanie Chasteen, at Stephanie.Chasteen@colorado.edu.

Tips for Successful "Clicker" Use

Clickers have many possible uses: **None of these are magically achieved by the clicker itself.** They are achieved – or not achieved – entirely by what *you* do in implementation.

Practices that lead to Successful Clicker Use

1. Plan how clicker use could contribute to *your* clear, specific goals for your class.
2. You **MUST MUST MUST** explain to students why you are using clickers. If you don't, they often assume your goal is to track them like Big Brother, and force them to come to class.
3. Explain what you will do when a student's clicker doesn't work & talk directly about cheating.
4. Practice *before* using with students. If you are a first-time clicker user, start with just one or two questions per class. Increase your use as you become more comfortable.
5. Make clickers a regular, serious part of your course, don't treat as unimportant or auxiliary.
6. Use a combination of simple and more complex questions. The best questions focus on concepts you feel are particularly important and involve challenging ideas with multiple plausible answers that reveal student confusion and generate spirited discussion.
7. If one of your goals is more student participation, grade lightly (or not at all) for correctness; otherwise students tend to focus on getting a correct answer, not learning (see below).
8. If your goal is to increase student learning, have students discuss and debate challenging conceptual questions with each other. This technique, *peer instruction*, is a straightforward and proven method of increasing learning.
9. Explain that *it is the discussion itself that produces learning* and if they "click in" without participating they will probably get a lower grade on exams than the students who are more active in discussion.
10. Compile a sufficient number of good clicker questions and exchange them with other faculty. The best questions for peer discussion are ones that around 30-70% of students can answer correctly before discussion with peers.
11. Watching one class or even part of a class taught by an experienced clicker user is a good way to rapidly improve your clicker use.

Practices that lead to Failure

1. Fail to explain why you are using clickers.
2. Use them primarily for attendance.
3. Don't have students talk with each other.
4. Use only factual recall questions.
5. Don't make use of the student response information.
6. Fail to discuss what learning means or the depth of participation and learning you expect in your class.
7. Think of clickers as a testing device, rather than a device to inform learning.

If you believe that the teacher, not the students, should be the focus of the classroom experience, it is unlikely that clickers will work well for you.

Be prepared . . . Effective clicker use with peer discussions results in a **livelier and more interesting class**, for you as well as the students! Expect good results immediately but better results as you become more experienced with clickers. This is the usual experience nationwide.

When can we ask questions?

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BEFORE
Setting up instruction

Motivate
Discover
Predict outcome
Provoke thinking
Assess prior knowledge

DURING
Developing knowledge

Check knowledge
Application
Analysis
Evaluation
Synthesis
Exercise skill
Elicit misconception

AFTER
Assessing learning

Relate to big picture
Demonstrate success
Review or recap
Exit poll

Credit: Rosie Piller and Ian Beatty.

When to ask questions 1: Before & After

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Before Instruction

- **Motivate** students
  - Why is it important to…?
  - What might we want to…?
  - What kinds of things can go wrong?
- Help them **discover** information
  - What do we have to take into acount when we…?
  - What needs to happen when you…?
  - Predict and show: We have seen that X happens when we do Y. What do you think will happen when…?
- Assess **prior knowledge** or **provoke** thinking/discussion
  - What do you think about…?
  - Would you/do you…?
  - What do you think will happen if…?

After Instruction

- Have students **recap** what they have learned
  - What steps did you go through to solve the problem?
  - What are the most important things to remember?
  - Exit poll: What did we learn today?
- Ask them to relate information to the **big picture**
  - How does this lead into the next topic?
- Demonstrate **success** and **limits** of understanding
  - *Ask questions that students have built an understanding of during the class.*
  - *Ask questions that go beyond what was done in class*

See also the Bloom's Taxonomy handout for question stems

When to ask questions 2: During

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- Test **knowledge** of facts
  - What are the three types of…?
  - Can you define…?
- Test **comprehension** of concepts
  - Which statements support…?
  - What examples can you think of?
- Test **applications** of concepts
  - What would happen if…?
  - Which of the following are X?
- Help them **analyze** what they are learning
  - Based on the symptoms, what would you say is going on?
  - What is the relationship between…?
- Test their ability to **evaluate**
  - Here are two solutions. Which is more appropriate and why?
  - Which of these is more important?
- Provoke them to **synthesize** their understanding.
  - How would you test…?
  - Propose a way to…
- Elicit a **misconception**
  - *Ask questions where a common student misconception will result in a particular response*
- Exercise a **skill**
  - How would you…?
  - What is the next step in this problem?

See also the Bloom's Taxonomy handout for question stems

How is a clicker question the same or different?*

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* From other types of in-class questions

- 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)

What does this tool help us to do?

PI Step #1. Ask Question

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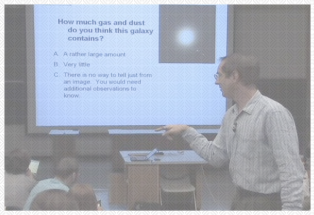
What can you do when asking a clicker question to help students process it?



- 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

PI Step #2. Peer Discussion

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Why is peer discussion important?

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

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)
- Make wrap-up discussion focus on the reasoning

PI Step #3. Wrap-Up Discussion

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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

Tips for writing clicker questions*

*particularly for use with peer instruction

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- **Don't make them too easy**. You can ask multiple choice questions at higher levels of Bloom's! Don't just test memorized facts.
- Use questions that will **prompt discussion.** Interesting questions that students can't answer on their own are more likely to spur productive discussion.
- Use questions that emphasize **reasoning or process** over the right answer. Students need to be convinced that understanding strategies will get them a good grade.
- Use **clear wording** so that students understand what they are being asked. Keep revising.
- Write **tempting distractors** using your knowledge of student difficulties**.** For example, look at student answers on exams or quizzes, or first give the question as an open-ended question to generate common wrong answers.
- **Consider creative questions.** You can survey your students, ask them how well they understand, break problems into parts, or use pictures or graphs in the answer choices.
- Good sources of questions:
  - Questions your students ask you or that you overhear
  - Common analogies you use as a teacher
  - A series of connected questions to lead students through reasoning
  - Interpret graphs, data, pictures, etc.
  - Discussion questions where there is no one right answer

See also "Tips for successful clicker use" handout

Action Plan

What will you do to implement ideas you heard about in this workshop?

OR what key ideas will you share with a colleague? (See Clicker Tips sheet for summary!)

1.

2.

3.

References & Resources

Web and blog: http://sciencegeekgirl.com
Email: stephanie.chasteen@colorado.edu

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

- **Clicker Resource Page from the Science Education Initiative:** 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.
- Many materials in this workshop (particularly the questioning cycle and the participant exercises) were adapted from **Rosie Piller**, Making Students Think: The Art of Questioning. Short papers published in: Computer Training & Support Conference, 1995; ISPI International Conferences, 1991 and 1996; ASTD National Conference on Technical & Skills Training, 1990. Related workshop description at http://www.educationexperts.net/mstworkshop.html.
- 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
- **Cited research:**
  - Rowe, Mary Budd. "Wait-time and rewards as instructional variables... " Journal of Research on Science Teaching, vol. 11 (2), pp. 81-94, 1974.

Thanks!

This sheet helps you write questions at an appropriate depth.

Bloom's Taxonomy "Revised" Key Words, Model Questions, & Instructional Strategies

Bloom's Taxonomy (1956) has stood the test of time. Recently Anderson & Krathwohl (2001) have proposed some minor changes to include the renaming and reordering of the taxonomy. This reference reflects those recommended changes.

I. REMEMBER (KNOWLEDGE)

(shallow processing: drawing out factual answers, testing recall and recognition)

Verbs for Objectives	Model Questions	Instructional Strategies
choose	Who?	Highlighting
describe	Where?	Rehearsal
define	Which One?	Memorizing
identify	What?	Mnemonics
label	How?	
list	What is the best one?	
locate	Why?	
match	How much?	
memorize	When?	
name	What does It mean?	
omit		
recite		
recognize		
select		
state		

II. UNDERSTAND (COMPREHENSION)

(translating, interpreting and extrapolating)

Verbs for Objectives	Model Questions	Instructional Strategies
classify	State in your own words.	Key examples
defend	Which are facts?	Emphasize connections
demonstrate	What does this mean?	Elaborate concepts
distinguish	Is this the same as. . .?	Summarize
explain	Give an example.	Paraphrase
express	Select the best definition.	STUDENTS explain
extend	Condense this paragraph.	STUDENTS state the rule
give example	What would happen if . . .?	"Why does this example. . .?"
illustrate	State in one word . . .	create visual representations
indicate	Explain what is happening.	(concept maps, outlines, flow
interrelate	What part doesn't fit?	charts organizers, analogies,
interpret	Explain what is meant.	pro/con grids) PRO| CON
infer	What expectations are there?	*NOTE: The faculty member can*
judge	Read the graph (table).	*show them, but they have to do it.*
match	What are they saying?	Metaphors, rubrics, heuristics
paraphrase	This represents. . .	
represent	What seems to be . . .?	
restate	Is it valid that . . .?	
rewrite	What seems likely?	
select	Show in a graph, table.	
show	Which statements support . . ?	
summarize	What restrictions would you add?	
tell		
translate		

III. APPLY

(Knowing when to apply; why to apply; and recognizing patterns of transfer to situations that are new, unfamiliar or have a new slant for students)

Verbs for Objectives	Model Questions	Instructional Strategies
apply	Predict what would happen if	Modeling
choose	Choose the best statements that	Cognitive apprenticeships
dramatize	apply	"Mindful" practice – NOT just a
explain	Judge the effects	"routine" practice
generalize	What would result	Part and whole sequencing
judge	Tell what would happen	Authentic situations
organize	Tell how, when, where, why	"Coached" practice
paint	Tell how much change there	Case studies
prepare	would be	Simulations
produce	Identify the results of	Algorithms
select		
show		
sketch		
solve		
use		

IV. ANALYZE (breaking down into parts, forms)

Verbs for Objectives	Model Questions	Instructional Strategies
analyze	What is the function of . . .?	Models of thinking
categorize	What's fact? Opinion?	Challenging assumptions
classify	What assumptions. . .?	Retrospective analysis
compare	What statement is relevant?	Reflection through journaling
differentiate	What motive is there?	Debates
distinguish	Related to, extraneous to, not	Discussions and other
identify	applicable.	collaborating learning activities
infer	What conclusions?	Decision-making situations
point out	What does the author believe?	
select	What does the author assume?	
subdivide	Make a distinction.	
survey	State the point of view of . . .	
	What is the premise?	
	State the point of view of . . .	
	What ideas apply?	
	What ideas justify the conclusion?	
	What's the relationship between?	
	The least essential statements are	
	What's the main idea? Theme?	
	What inconsistencies, fallacies?	
	What literary form is used?	
	What persuasive technique?	
	Implicit in the statement is . . .	

V. EVALUATE (according to some set of criteria, and state why)

Verbs for Objectives	Model Questions	Instructional Strategies
appraise	What fallacies, consistencies,	Challenging assumptions
judge	inconsistencies appear?	Journaling
criticize	Which is more important, moral,	Debates
defend	better, logical, valid, appropriate?	Discussions and other
compare	Find the errors.	collaborating learning activities
		Decision-making situations

VI. CREATE (SYNTHESIS)

(combining elements into a pattern not clearly there before)

Verbs for Objectives	Model Questions	Instructional Strategies
choose	How would you test. . .?	Modeling
combine	Propose an alternative.	Challenging assumptions
compose	Solve the following.	Reflection through journaling
construct	How else would you . . .?	Debates
create	State a rule.	Discussions and other
design		collaborating learning activities
develop		Design
do		Decision-making situations
formulate		
hypothesize		
invent		
make		
make up		
originate		
organize		
plan		
produce		
role play		
tell		

Web References:

- http://www.coun.uvic.ca/learn/program/hndouts/bloom.html
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Anderson, L. W. & Krathwohl, D. R. (2001). A Taxonomy for learning, teaching, and assessing.
Bloom, B. S. (Ed.). (1956). Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. New York: Longmans.
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