The Gentle Art of Questioning

WRITING GREAT CLICKER QUESTIONS

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Agenda:
1. Thinking about questioning
2. About clickers and peer instruction
3. Writing great clicker questions
4. Overcoming common challenges
5. Action plan

Workshop developed using materials from SEI and Rosie Piller
Exercise #1: Why question?

1. Why do we question our students?
2. When might you use questioning in your classes?
3. For what purposes might clickers be an appropriate questioning tool?
Question Cycle: Before / During / After

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

### 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 account 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

<table>
<thead>
<tr>
<th>Test knowledge of facts</th>
<th>Test their ability to evaluate</th>
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<tbody>
<tr>
<td>- What are the three types of...?</td>
<td>- Here are two solutions. Which is more appropriate and why?</td>
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<tr>
<td>- Can you define...?</td>
<td>- Which of these is more important?</td>
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</tbody>
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<thead>
<tr>
<th>Test comprehension of concepts</th>
<th>Provoke them to synthesize their understanding.</th>
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<tr>
<td>- Which statements support...?</td>
<td>- How would you test...?</td>
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<tr>
<td>- What examples can you think of?</td>
<td>- Propose a way to...</td>
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</tbody>
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<table>
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<th>Test applications of concepts</th>
<th>Elicit a misconception</th>
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<tr>
<td>- What would happen if...?</td>
<td>- Ask questions where a common student misconception will result in a particular response</td>
</tr>
<tr>
<td>- Which of the following are X?</td>
<td>- Exercise a skill</td>
</tr>
</tbody>
</table>

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<tr>
<th>Help them analyze what they are learning</th>
<th>- How would you...?</th>
</tr>
</thead>
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<td>- Based on the symptoms, what would you say is going on?</td>
<td>- What is the relationship between...?</td>
</tr>
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<td>- What is the relationship between...?</td>
<td>- What is the next step in this problem?</td>
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See also the Bloom’s Taxonomy handout for question stems
What is special about clicker 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)

* From other types of in-class questions
Anatomy of Peer Instruction

* See also: Peer Instruction, A User’s Manual. E. Mazur.
Peer instruction helps students learn

Research shows that:

- Students can better answer a similar question after talking to their peers
- Peer discussion + instructor explanation of question works better than either one alone
- Students like peer instruction
- Peer instruction classes outperform traditional lectures on a common test

See http://STEMclickers.colorado.edu for various references
Exercise #2: Core Philosophies

In groups of 3-5, brainstorm your answers to the question, “What are the underlying principles that make this work?”.

- Why might this be an effective teaching strategy?
- What must the instructor believe in order to embrace this strategy?
- What must the students believe in order to “play the game” effectively?
Challenges: The toughest thing about using clickers...

- What are some of the key challenges and solutions that were discussed?
1. Ask Question

What are some challenges/philosophies/solutions related to asking the question?

Philosophies
• Questions are integral to lecture
• Students can learn by considering a question

Best practices
• Ask several times during lecture
• Ask challenging, meaningful questions
• Don’t post until ready & give time to read
Tips for writing clicker questions*

*particularly for use with peer instruction

- **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
Other tips on question writing

Jot down any ideas you got from discussion, or the gallery walk, here.
Exercise #3: Question goals

- What is the instructional goal of this question?
- Can you improve this question at all?

What causes the seasons?
A. The change in the earth’s distance from the sun during the year
B. The tilt of the earth’s axis
C. Changes in the sun’s brightness
D. Changes in clouds
E. None of the above
Bloom’s Taxonomy Verbs

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<th>Bloom’s Levels and Associated Verbs</th>
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<tbody>
<tr>
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<td>Evaluation:</td>
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<td>Synthesis:</td>
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Credit: Jenny Knight, University of Colorado, Boulder, October, 2011

* Original by Bloom (1956). Recently, Anderson and Krathwohl (2001) A Taxonomy for learning, teaching, and assessing have suggested that synthesis should be level 6 and evaluation should be level 6. Many put these two levels into practice simultaneously using 5/6 as the Bloom’s level.

2
Exercise #4: Bloom’s level

- What is the Bloom’s level, roughly, of this question?
- Can you “Bloomify up” the level of this question, using the Bloom’s verb sheets?

**What causes the seasons?**

A. The change in the earth’s distance from the sun during the year
B. The tilt of the earth’s axis
C. Changes in the sun’s brightness
D. Changes in clouds
E. None of the above
2. Peer Discussion: Challenges

Philosophies:
• Students learn through discussion
• Students need to know that you value their ideas & that it’s safe to share

Solutions:
• 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)
• Focus on reasoning in wrap-up
3. Wrap-Up Discussion. Challenges?

Philosophies:
• Student ideas are important
• Students need to feel safe

Solutions:
• Establish culture of respect
• Consider whether to show the histogram immediately
• Ask multiple students to defend their answers
• Emphasize reasoning: Why are wrong answers wrong and why right answer is right
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

- **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 at [http://blog.sciencegeekgirl.com](http://blog.sciencegeekgirl.com)


- 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)

Thank you!