

# Writing Great Clicker Questions



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***Clickers are not a magic bullet  
Their effectiveness depends on how they're used!***

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# Tips for Successful “Clicker” Use

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*Including recommendations from members of the Carl Wieman Science Education Initiative*

More than 1,000,000 clickers are in use nationwide, and over 17,000 at CU. Data gathered during the past few years makes it clear which uses of clickers lead to success, and which lead to failure. **Success** means that both the faculty member and students report being satisfied with the results of using clickers.

Clickers have many possible uses: Find out if students have done assigned reading before class; measure what students know before you start to teach them and after you think you’ve taught them; measure attitudes and opinions, with more honest answers if the topic is personal or embarrassing; get students to confront common misconceptions; facilitate discussion and peer teaching; increase student’s retention of what you teach; transform the way you do demonstrations; increase class attendance; improve student attitudes. **None of these are magically achieved by the clicker itself.** They are achieved – or not achieved – entirely by what *you* do in implementation.

## TECHNICAL POINTS:

- Try and get your school to adopt one clicker brand. Students **hate** being forced to buy more than one clicker!
- RF (radio) clickers are easier and cheaper than infrared ones.
- Simpler clickers (e.g. iClicker) have fewer implementation problems.
- Test your registration system before students do. Deliberately make some mistakes and see what happens. Check early in the semester that all responses are getting credited.

## Practices that lead to Successful Clicker Use

1. Have clear, specific goals for your class, and plan how clicker use could contribute to *your* goals. Do not attempt all the possible uses described above at one time!
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. Students highly resent this.
3. Practice *before* using with students. Remember how irritated you get when A/V equipment fails to work. Don’t subject students to this.
4. Make clicker use a regular, serious part of your course. If you treat clicker use as unimportant or auxiliary then your students will too.
5. Use a combination of simple and more complex questions. Many users make their questions too simple. 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. Show some prospective questions to a colleague and ask if they meet this criteria.
6. If one of your goals is more student participation, give partial credit, such as 1 point for any answer and 2 for the correct one, for some clicker questions. With some questions it is appropriate to give full credit to all students, such as when multiple answers are valid or when you are gathering student opinions.
7. 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 proven method of increasing learning. Have students answer individually first; then discuss with those sitting next to them; then answer again.

8. Stress that genuine learning is not easy and that conceptual questions and conversations with peers can help students find out what they don't really understand and need to think about further, as well as help you pace the class. Students tend to focus on correct answers, not learning. 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. My students came up with the phrase, "No brain, no gain."
9. Use the time that students are discussing clicker questions to circulate and listen to their reasoning. *This is very valuable and often surprising.* After students vote be sure to discuss wrong answers and why they are wrong, not just why a right answer is correct.
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. This maximizes good discussion and learning. There is value in discussion even if a question is difficult and few know the answer initially.
11. 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.
12. Explain what you will do when a student's clicker doesn't work, or if a student forgets to bring it to class. You can deal with that problem as well as personal problems that cause students to miss class by dropping 5-10 of the lowest clicker scores for each student.
13. Talk directly about cheating. Emphasize that using a clicker for someone else is like taking an exam for someone else and is cause for discipline. Explain what the discipline would be.
14. 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.

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Further information and references will be put in <http://casa.colorado.edu/~dduncan/clickers> . I'd like to hear about your experiences, good and bad, and perhaps include them in future editions of my book on how to teach with clickers. [dduncan@colorado.edu](mailto:dduncan@colorado.edu).

## Writing Good Clicker Questions

**Consider the following aspects of a clicker question:**

- (1) **Mechanics.** Is it clear and jargon free? Are distractors tempting?
- (2) **Depth.** Is it testing factual recall or conceptual understanding?
- (3) **Goals.** What is the goal that you are trying to achieve with this question?

**The best clicker questions ....**

- Are often focused on conceptual understanding
- Deal with important ideas in class
- Have common student mistakes as the wrong answers.
- Result in a lot of discussion and debate among the students.
- Require analysis and reasoning (not simple memorization).

	<b>Poor question</b>	<b>Better question</b>
<b>CONTENT</b>	Trivial detail	Important and central idea
<b>DIFFICULTY</b>	Tests memorized fact. Yes/no questions. Plugging in numbers.	Interesting and challenging (but not overly difficult). Qualitative.
<b>DISTRACTORS</b>	Wrong answers are easily recognized among alternatives	Tempting distractors, based on what students often struggle with in material. "Not enough information" is often good to include.
<b>CLARITY</b>	Confusing, unclear, uses jargon.	Clear and conversational.

### Pointers on question-writing

1. **Start with your learning goal.** What do you want students to be able to do? Focus on important concepts.
2. **Emphasize the important of reasoning.**
3. **Use your knowledge of student difficulties** to write the distractors (the "wrong" answers).
  - Students' answers on exams or quizzes are good sources of distractors
  - Or, give the question as an open-ended question, and then use student answers as multiple choice distractors the next time



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## Bloom's Taxonomy “Revised” Key Words, Model Questions, & Instructional Strategies

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*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		

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### 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) <u>PRO CON</u>
infer	What expectations are there?	<i>NOTE: The faculty member can</i>
judge	Read the graph (table).	<i>show them, but <u>they</u> have to do it.</i>
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		

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## HANDOUT 3

### 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

apply  
choose  
dramatize  
explain  
generalize  
judge  
organize  
paint  
prepare  
produce  
select  
show  
sketch  
solve  
use

#### Model Questions

Predict what would happen if  
Choose the best statements that apply  
Judge the effects  
What would result  
Tell what would happen  
Tell how, when, where, why  
Tell how much change there would be  
Identify the results of

#### Instructional Strategies

Modeling  
Cognitive apprenticeships  
“Mindful” practice – NOT just a “routine” practice  
Part and whole sequencing  
Authentic situations  
“Coached” practice  
Case studies  
Simulations  
Algorithms

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### IV. ANALYZE (breaking down into parts, forms)

#### Verbs for Objectives

analyze  
categorize  
classify  
compare  
differentiate  
distinguish  
identify  
infer  
point out  
select  
subdivide  
survey

#### Model Questions

What is the function of . . . ?  
What's fact? Opinion?  
What assumptions. . . ?  
What statement is relevant?  
What motive is there?  
Related to, extraneous to, not applicable.  
What conclusions?  
What does the author believe?  
What does the author assume?  
Make a distinction.  
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 . . .

#### Instructional Strategies

Models of thinking  
Challenging assumptions  
Retrospective analysis  
Reflection through journaling  
Debates  
Discussions and other collaborating learning activities  
Decision-making situations

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## HANDOUT 3

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

#### Verbs for Objectives

appraise  
judge  
criticize  
defend  
compare

#### Model Questions

What fallacies, consistencies, inconsistencies appear?  
Which is more important, moral, better, logical, valid, appropriate?  
Find the errors.

#### Instructional Strategies

Challenging assumptions  
Journaling  
Debates  
Discussions and other collaborating learning activities  
Decision-making situations

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### VI. CREATE (SYNTHESIS)

(combining elements into a pattern not clearly there before)

#### Verbs for Objectives

choose  
combine  
compose  
construct  
create  
design  
develop  
do  
formulate  
hypothesize  
invent  
make  
make up  
originate  
organize  
plan  
produce  
role play  
tell

#### Model Questions

How would you test. . . ?  
Propose an alternative.  
Solve the following.  
How else would you . . . ?  
State a rule.

#### Instructional Strategies

Modeling  
Challenging assumptions  
Reflection through journaling  
Debates  
Discussions and other collaborating learning activities  
Design  
Decision-making situations

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#### Web References:

- <http://www.coun.uvic.ca/learn/program/hndouts/bloom.html>
- <http://www.fwl.org/edtech/blooms.html>
- <http://apu.edu/~bmccarty/curricula/mse592/intro/tsld006.htm>
- <http://152.30.11.86/deer/Houghton/learner/think/bloomsTaxonomy.html>
- <http://amath.colorado.edu/appm/courses/7400/1996Spr/bloom.html>
- <http://www.stedwards.edu/cte/bloomtax.htm>
- <http://quarles.unbc.edu/lsc/bloom.html>
- <http://www.wested.org/tie/dlrn/blooms.html>
- <http://www.bena.com/ewinters/bloom.html>
- <http://weber.u.washington.edu/~krumme/guides/bloom.html>

#### References:

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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## Different Goals of Clicker Questions

(credit to Ian Beatty, U. Mass Amherst; See next pages)

### 1. Setting up instruction

- Assess prior knowledge
- Provide feedback to teacher about student ideas
- Provoke thinking about something new
- Stimulate discussion
- Predict and show
- Induce cognitive conflict
- Give students a voice (i.e., survey on their opinions/preferences)

### 2. Developing knowledge

- Elicit misconception
- Exercise cognitive skill
- Build conceptual structure
- Drive assimilation
- Provide feedback to students about their own learning
- Provide feedback to instructors about student learning
- Focus students on the key ideas
- Improve motivation (keep student confidence and interest)

### 3. Assess learning

- Status check / exit poll
- Find limits of knowledge
- Demonstrate success
- Review a topic
- Increase student accountability (e.g., reading quiz)



# Ways of Using TEFA

*The TEFA question cycle can be useful in multiple phases of the instructional process, serving many diverse goals*

*Ian D. Beatty, Scientific Reasoning Research Institute, University of Massachusetts Amherst*



*Technology-Enhanced Formative Assessment (TEFA)* is a rich pedagogic approach that is intended for frequent and flexible use throughout instruction. It can be used as an occasional “drop-in” activity, but much of its power is manifest only when it is woven into the fabric of a course, changing the classroom dynamic and helping to realize TEFA’s four key values of question-driven instruction, dialogical discourse, formative assessment, and meta-level communication.

## GENERAL TEFA OBJECTIVES

TEFA “question cycles” (q-cycles) can address one or more

of these general objectives:

- learn about students’ knowledge and thinking;
- help students become more aware of their own knowledge and thinking;
- set up subsequent instruction;
- provoke, open, motivate, ground, or contextualize discussion of a topic;
- catalyze small group discussion and peer learning; and
- precipitate student realizations or insights.

Few q-cycles will address *all* of these objectives, but most cycles should be designed and conducted with at least one such objective explicitly in mind.

## SETTING UP INSTRUCTION

TEFA can be used to prepare the ground for subsequent instruction, setting up a fertile context and providing the teacher with information about where students are starting from. The following q-cycle uses serve this phase of instruction.

**Assess prior knowledge:** find out what students already know, think, believe, or perceive about a topic or situation. Do this to find out what real-world experiences instruction might build upon, what language students might have to work with, what prior beliefs or mental models may have to be integrated or confronted, etc.

**Provoke thinking about something new:** ask a provocative and interesting, but approachable, question to “open up” a new topic or subject. This gets students into a mind-set for forming and evaluating new ideas, and generates raw material for instruction to work with. It can also create a need for upcoming content ideas.

**Stimulate discussion:** spark debate by presenting a sufficiently rich context for discussion and a thorny or divisive

point to explore. The resulting discussion can motivate subsequent instruction, or itself be an opportunity for learning and teaching.

**Predict-and-show:** require students to predict the results of a demonstration or experiment, discuss their reasoning, do the demo, and the discuss why the reality might have differed from predictions. This pattern enhances the effectiveness of demonstrations.

**Induce cognitive conflict:** deliberately back students into the realization that two of their beliefs, perceptions, ideas, interpretations, or models conflict, thus creating a “teachable moment.”

#### DEVELOPING KNOWLEDGE

Targeted TEFA q-cycles can also be used to directly impact students’ knowledge.

**Elicit a misconception or dangerous belief:** get students to manifest a particular misconception or belief that will hinder their understanding if allowed to persist. Make such latent ideas explicit and help students confront and dispatch them.

**Exercise a cognitive skill:** pose a question that engages students in a specific cognitive activity or “habit of mind” in order to strengthen and habituate that activity or habit. This use emphasizes *how* students think about the question, rather than *what* they think about.

**Build conceptual structure:** Pose a question and follow up

with discussion that has students hone or extend a concept by challenging its limits of applicability; differentiate similar concepts; recognize a relationship between concepts; or apply a concept in a new or newly broadened context.

**Drive assimilation:** provide an opportunity for students to try out, wrestle with, improve their understanding of, and develop ownership of new knowledge.

#### ASSESS LEARNING

During and after instructional activities, TEFA can be used to gauge learning progress, informing both teacher and students.

**Status check/exit poll:** at the close of an activity, class, or topic, pose a question asking students to self-evaluate their degree of comfort with or understanding of the material just addressed. It benefits students to explicitly consider this, and the results help the teacher adjust subsequent instruction.

**Find the limits of knowledge:** using a set of questions or one sufficiently rich one, explore how robust students’ command of specific ideas or skills is. Identify both what they *can* and *cannot* do.

**Demonstrate success:** help students realize the progress they have made by asking questions that they will most likely succeed at, and then have them reflect upon and articulate the knowledge that they used to succeed. This boosts morale and helps students “own” their knowledge.

**Review a topic:** run through several quick question cycles about previously-covered material, both to refresh it in students’ minds and assess mastery of that material. This mode can be used in preparation for a summative exam.

#### CAVEATS

These three categories of uses are not independent or absolute, but merely a convenience for thinking. Some uses may very plausibly belong to more than one category. And many TEFA questions can and should serve more than one use.

This list of possible uses for TEFA question cycles is not exhaustive; TEFA is flexible enough to be of use for almost any instructional purpose. We have known teachers who integrated TEFA questions into laboratory activities: sometimes to prepare the context, sometimes for closure at the end, and sometimes to gather formative information to guide mid-course corrections. In a sense, the elements of TEFA are a powerful toolkit with many potential uses.

<sup>1</sup> See TEFA Note #01, *What is TEFA?*

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