

A Collection of gifts



Issue 13 Fall 2013

Great Ideas For Teaching

13.1 In This Issue...

Denise Stephenson

This issue is brought to you by your math and science colleagues. As in the ways of these disciplines, it is a tightly focused issue on one type of teaching technique, with three differing implementations yielding different results. Have you heard of clickers? How about TPS or think-pair-share? Curious about how to implement clickers in your discipline? Do they seem like more technology than you need? Would you rather use a thumbs-up approach? Perhaps color-coded cards to hold votes and debates? By reading three short articles in this edition, you can consider if these techniques could help you engage students in creating knowledge, challenge students to think more deeply, track students' knowledge for particular issues, and create a more interactive learning environment in your classroom.

First up, **Scott Fallstrom** from Mathematics takes on formative assessment by having students give him the finger, well, actually the thumb. Scott asks a question and students vote by aiming their thumb in one of three directions based on whether they fully understand a concept, would like more practice, or are rather lost. In moments he can decide whether it's time to move on or dig in his heels and find more ways to explain and explore the material.

Next, **Pierre Goueth** and **Theresa Bolaños** from Chemistry describe not only how they use clickers in the classroom, but several of the useful reports that they can generate from the electronic student input gathered during a class. Further, they offer tips for how a faculty member new to this technology can begin using them, and then develop and personalize that use over time.

Finally, **Rica French** of Astronomy, explains how she implements think-pair-share using a single, folded sheet of paper with four color-

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13.3 Use of Clickers in the Classroom

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13.4 Think-Pair-Share With Flashcards: Low Tech, High Return

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Submissions

Submissions are always welcome. There is rolling on-line publication and print distribution during FLEX week.

Please submit work to M/S 9 or dstephenson@miracosta.edu



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coded numbers. She also offers precise language meant to make implementation successful. Rica demonstrates how the reasoning students do in answering questions and then trying to persuade each other of those answers develops deep discussion of complex concepts and leads to students recognizing their own abilities to create knowledge.

If you haven't tried these Great Ideas For Teaching, you might want to give one or more of them a go. All provide classroom interactivity, the ability for faculty to check that learning is happening, and possibilities for adapting lessons to respond to student knowledge. How can you lose?! 🎁

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13.2 Giving Formative Assessment a Big Thumbs-Up!

Scott Fallstrom, Mathematics

When first hired, I attended a large number of workshops with the goal of knowing what services were offered and where to find them. One seminar led us to the Writing Center where Denise Stephenson gave us some GIFTs—actually, she gave us all the GIFTs (a binder with all previous articles). I thumbed through and noticed that not one GIFT was from a mathematics instructor. These times they are a changin’.

In many observations I have done, it is very common to see teachers ask students “Are there any questions?” For many of those faculty members, part-time or full-time, there is a noticeable silence and awkwardness as students make a decision about what to do. Occasionally, there are groups of students where this approach works, and dialogue and discussion commences. In my own experience, it is more dependent on the group of students than the teacher or teaching style necessarily. I found it to be less than effective, as I wasn’t getting any of the information I wanted from the students. I wanted to know more than if they had any questions. I wanted to know how well they thought things were going—how well did they feel they understood the ideas.

Clickers are one way of obtaining information, often about pre-loaded questions, but I was looking for something dynamic that could be used with little preparation on their part. I read one article about having students hold up fingers to represent their level of understanding, but

teaching math, I anticipated that students at times would hold up only one finger... and if frustrated, the wrong one finger. I adopted a method that I’ve used now for the past few years with quite a bit of success. Instead of asking for questions, I ask students to rate their confidence. Thumb up: “I feel that I really understand this and am comfortable with you moving on.” Thumb down: “I feel really uncomfortable moving on and am highly confused by this concept.” Thumb to the side: “I’m in the middle, and perhaps you could do another problem or let us do a problem to see if I really do understand.”

The benefits were immediate—I could instantly see the whole class and their responses. It allowed me to modify my lesson plan and give an extra example when needed. With that extra example, I could move around the room and observe students’ work. This was also invaluable as it allowed me to quickly see how the students’ work related to their self-assessment. Some students were thumbs-up but making mistakes. Many students were thumbs-sideways but just lacked confidence, and it was a chance for me to reinforce their good habits. It also allowed some one-on-one time for those students who were thumbs-down.

It isn’t a quiz. It’s not graded, but implementing this can give you better feedback from your class. In turn, this impacts how you present topics, how you explain, and how you deal with student questions. Believing that a set activity will work for each group of students is a losing proposition. Being dynamic and able to change how you present topics for each group can help them feel more like a member of a community of learners instead of an audience. Active learning is best, and this type of formative assessment allows for quick feedback on how students feel their understanding is progressing. 🎁

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13.3 Use of Clickers in the Classroom

*Pierre Goueth and Theresa Bolaños,
Chemistry*

What are clickers?

The best way we have found to introduce clickers to our students the first day of class is to tell them that these are the devices used in the show “Who Wants to Be a Millionaire.” This brings a smile to their faces and generates interest in the device before it is even handed out!

What do these devices do for you as an instructor?

Clicker usage is quite versatile as instructors can use them to take attendance, ask questions or redirect students’ attention back to the classroom discussion. According to Greer and Heaney, 10 years of data demonstrated that attendance in their Geoscience course Geosc 020 fell below 50% by mid-semester, even with regular quizzes meant to improve attendance. When they used the clickers, they built in 15% of the grade (the same percentage the quizzes had been) for clicking responses to questions regardless of correctness. “We observed that daily lecture attendance rates were as high as 90% in the middle of the semester and mean attendance for the course ranged from 81% to 84% over the four semesters assessed.”¹

One apprehension instructors have about introducing clickers is that this will take some of their lecture time. The only answer we have for that is what good is it to finish the chapter/program if we are not confident that our students are getting what we are teaching? Best practices recommend asking 4 - 5 questions on average per

one hour lecture time. With the ever decreasing attention span of our students, it is great to have a teaching tool that not only allows both instructors and students to assess learning in real time, but also allows them to be present and engaged for sixteen plus weeks in our classroom.

The benefits of using clickers are many. Clickers make the learning environment active and nonthreatening to all students. Indeed, all can participate; all can answer questions without being embarrassed for having the wrong answer, as the entire polling process is anonymous.

Clickers can be used to assess prior knowledge of concepts, which can lead to the discovery of misconceptions and gaps in students’ knowledge. For this to be done effectively, we ask clicker questions before going over concepts that we suspect are prone to misconceptions by students, and from that we can gear the explanation more effectively towards rectifying the misconception.

This brings up another advantage this tool has to offer, namely instant feedback. Whether used for checking prior knowledge or for checking students’ understanding of concepts being discussed, clickers can help the instructor immediately assess student comprehension and therefore make a decision on how to proceed with lecture.

For example, in instances where two answers have been selected nearly equally, we had students explain to their peers why they chose a specific answer. This discussion between two peers continues for a short time, and then the students are once again asked to answer the original question. In general, when we have had them “re-vote,” the percentage of correct answers increased and students’ understanding seemed to have strengthened, as they were able to articulate or “teach” the concept to one another.

If data for students’ answers of clicker

questions are saved each semester and analyzed, an instructor could compare his effectiveness in teaching a topic in the new semester, by comparing to the same concept in past terms. If self-reflections on teaching provide optimization of our future lecture on the same topic, students will have more successful learning experiences. This positive gain should equate to a deeper understanding by students, the goal of all instructors!

And finally, after the session is over, and if a daily report is generated, instructors can quickly identify struggling students and encourage those who consistently score poorly to seek additional help in office hours or refer them to the appropriate support center: Math, Tutoring, or Writing.

Report Uses

When an instructor uses clickers, many different reports can be generated. These reports can be created daily, weekly, after each chapter, or at the end of the semester. There are many different types of reports possible, including graphical reports by question asked. These reports relate a specific question to the percentage of students' chosen answers with the numbers of students for each answer on a pie, column, or bar chart. Alternatively, participant-graded results can be shown with the student name or device number, followed by their answer for each question. Because sessions are saved at the end of each lecture, reports can be created from each saved session any time and stored wherever the user wants it (flash drive, desk top, etc...). Learning how to build reports and how to save them requires practice, but is fairly easy.

Besides the many benefits listed above, saved reports can also serve as warning to the instructor as they prepare for class, that a topic might be difficult to grasp in view of previous students responses. Clicker data can be used by the instructor to gauge student understanding, if instructors compare how students did on clicker questions versus overall test scores.

Getting Started

Faculty who have never done this may wonder: Where do I get the questions to pose to students? Do I need to re-invent the wheel? Well, yes, if you really want to, but materials are readily available to instructors to aid them in this process. The quickest way to start is to use questions from an electronic test bank or textbook questions that you will improve over time. This is a starting point and it is a good one. Open up the material, then copy and paste the publisher questions into your own presentation, exactly where you want them. It is that easy!

The Basics

The set of clickers we use were funded by either the Dean of Math and Sciences or through a MCC Foundation grant. During the first day of class, we assign one clicker per student in alphabetical order and they are to use the same clicker throughout the semester. This saves us time in coding each student name to each clicker for the semester.

Many instructors worry it is difficult to set-up and routinely use the clickers. Often the unknown is enough to send an instructor in the other direction! There is a hardware and software component, but implementation is a relatively painless process from beginning to end. Our AIS staff installs the software on the classroom computer, the small RF receiver box is quickly connected to the classroom computer using a provided cable and student data can be saved on a personal flash drive, allowing analysis to occur in your office or at home at a future time. The clickers are quite portable and are stored in a travelling case that can be utilized by several instructors during a day.

Students like the clickers and request them, if we are slow to make them available to the class. Gone are the static days of learning; as we ask our students... "Who wants to be a millionaire?" ❏

Notes: 1. See Lisa Greer Peter J. Heaney, *Journal of Geoscience Education*, v. 52, n. 4, September, 2004, p. 345-351, also available at http://www.nagt.org/files/nagt/jge/abstracts/Greer_v52n4.pdf

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Great Ideas For Teaching

13.4 Think-Pair-Share With Flashcards: Low-Tech, High Return

Rica Sirbaugh French, Physical Science

You've probably seen or heard about the active learning method known as "peer instruction" or "think-pair-share" (TPS). The technique is research-validated in numerous disciplines as a powerful tool to help students learn at a deep, conceptual level by constructing their own knowledge. It also works for any class size...no kidding. My collaborators at the Center for Astronomy Education (CAE)¹ are successfully² using the technique with flashcards (not clickers!) at the University of Arizona in classes of 700+. Regardless of class size, it goes something like this:

- 1) Pose a cognitively engaging multiple-choice question to the students. It should challenge them to think beyond the superficial layers and have the ability to foster deep discussion. (What creates deep discussion? Consider the following: How long would the conversation continue before students were convinced of the correct answer? How many steps of reasoning must they go through in order to arrive at the correct answer?)
- 2) The students think about and ultimately vote on the answer as individuals.
- 3) The results of the vote dictate your plan of action which often times—as the name indicates—has the students discussing

their reasoning with their neighbors and taking a second vote.

Also popular in the research on TPS is the ever-present debate: clickers vs. flashcards—which is "better"? While it's largely a matter of personal preference, the well-versed instructors will tell you that it should always be about proper implementation of the technique and the pedagogical value added to your course, not the technology itself.

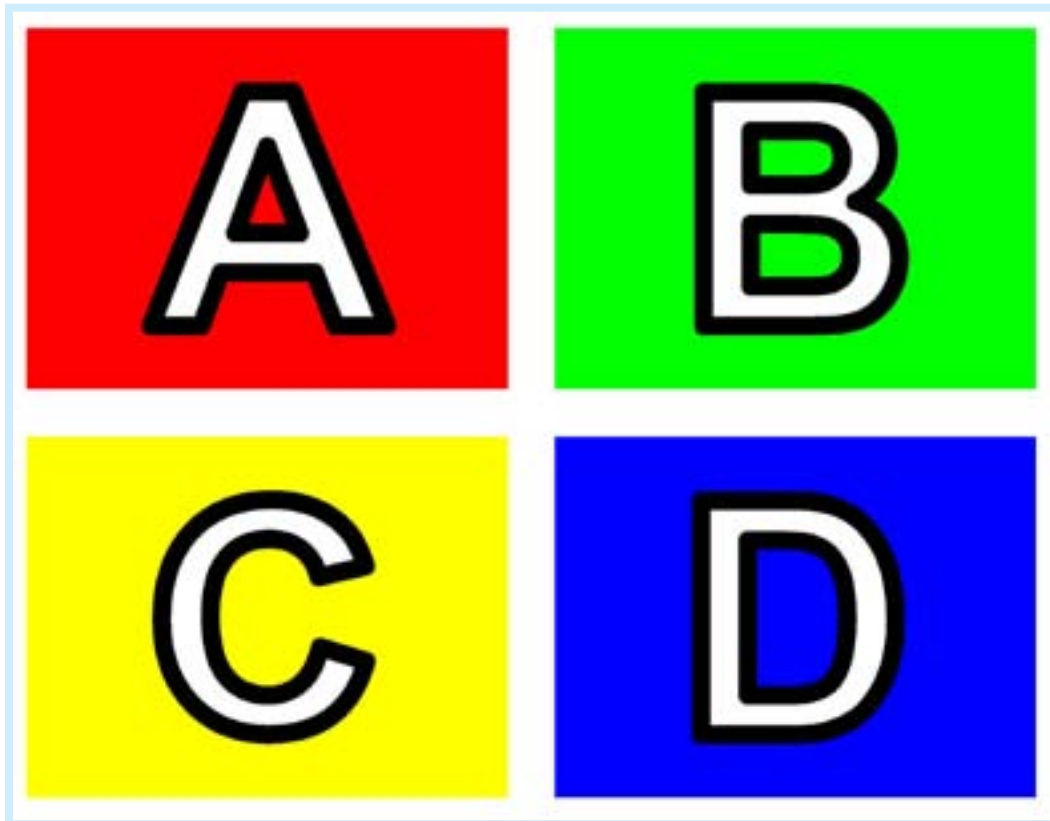
Like my collaborators at CAE, I have had experience with and conducted research on both tools. Also, like each of my collaborators, I now harbor a special fondness for one tool over the other. While a few of them are still staunch proponents of clickers, most of us are overwhelmingly fans of flashcards, myself included.

Regardless of the tool in use, there are two rules for voting that are required to maintain the integrity of the technique: (1) simultaneity and (2) anonymity. Since the students first vote individually, it is critical that they not be influenced by others. I remind my students that this is a free chance to be honest with themselves and see what they really do and do not understand before being graded (exams, homework, etc.). I do not grade any aspect of TPS because I don't want them to give just any answer for the sake of getting points. It's part of my job to help them see and experience the importance of participating legitimately for learning.

To ensure that voting is both simultaneous and anonymous students must be told precisely when to show their votes and how to hold the cards. The correct way to vote with a flashcard means holding it right up against your chest. This ensures that the votes are anonymous with respect to the other students; only the individual student and the

instructor can see the card. Holding it in any other position means it's now possible for other students to see or figure out what letter you are holding up.

I use an ABCD card: a single sheet of 8-1/2" × 11" paper with color-coded letters in large print. I give everyone a card on the first day of class then



A sample of the ABCD card. Students hold up a letter to discreetly answer questions.

post the PDF on the course website so they can print replacements at will. Voting A, B, C, or D means simply folding the card so that you show only the appropriate letter. Option “E” can be selected by folding it so that the back (only white) is displayed.

Here’s an implementation scenario that has been research-validated right down to the specific words used for certain prompts:

- 1) The multiple-choice question is displayed on the classroom screen while everyone reads and thinks about it silently.
- 2) You do the same as your students: focus your attention on the question, read it

slowly to yourself just as they are, then silently go through each step in the reasoning necessary to arrive at the correct answer. This accomplishes two goals: it validates the experience for the students by showing them this is a real question

that even you have to take the time to read and work through; and it ensures you give them an authentic experience by not reading the question to them. Reading the question aloud wastes time—they’re just going to read it again to themselves when you’re done. And despite your best intentions, you inadvertently give away clues via your vocal inflections and body language when you read aloud. Besides, you won’t always be there.

They must learn to think it through for themselves.

- 3) When you are finished with step 2, or you hear the rustling of cards being folded, turn to the class and ask, “Does anyone need more time?” I suggest you use these specific words. That is the precise question you need the answer to. If even one student signals yes, give it to them; it shows how important it is for them to really try and give a legitimate answer. I typically count to ten slowly to myself.
- 4) Turn to the class and say “prepare your

votes.” If they haven’t already done so, this is their signal to fold the card to the letter they want to show. In the beginning when I am “training” them in the technique, I tell my students to be a little stealthy about it. “It’s anonymous and you don’t want anyone mooching off of you, right?” After a few class periods of implementation they of course get the hang of it and know that “prepare your votes” also means to keep it a secret.

- 5) To ensure students vote simultaneously, say “show your votes on the count of three” or something similar. On “three,” they should be holding their cards close up against their chests as previously described. I also train my students to keep them up until I tell them what to do.
- 6) Use the percentage of correct answers to determine your course of action.

A. If 80% or more got the question right then it’s enough to move on. You do always need to validate their correct response but resist the urge to simply tell them the answer yourself. It’s much more pedagogically valuable if it comes from them. For example, I typically say something like “Wow, that’s really good! The color of the right answer is…” and they are trained to yell out what color they voted (it’s much less confusing than trying to hear the letter, all but one of which sound very much alike). If I don’t get the level of confidence in the yell that I know I saw in the votes, I’ll make them do it again: “That wasn’t very convincing. Let’s try that again. The color of the right answer is…” and they will typically step it up. (Besides, who doesn’t enjoy permission to yell during class?)

This is a powerful moment for those who

didn’t get it right: when their incorrect “blue” or “green” responses were drowned out by a sea of people yelling “RED!” they just saw that not only was the question a fair one to ask but that nearly the entire class got it right...except for them. Those who got it right also become conditioned that I, as the instructor, am not the source of answers: they can do this too and need to learn to trust in their thought processes. This is, of course, why it is critical to always validate the correct response and not leave them wondering.

There are numerous other ways to debrief votes. If you want to reinforce a concept after they’ve called out the right answer, don’t just launch into another lecture; have them tell you the key pieces of reasoning.

B. If less than 80% of the class gets it right, it’s time for a discussion. First, do not reveal anything about the distribution of votes! In doing so, you would bias their discussion and might inadvertently give away the answer. There would be little if any deep engagement required on their parts to get it correct, which leads them to not engage deeply enough to know why that is the answer. They just know it’s right, so they’re done thinking about it.

Also, if less than 50% are correct, don’t assume it’s because they don’t understand. You don’t know that to be true. Couldn’t some of them just have misread the question? Read “west” when it actually says “east”? Somehow thought that arrow pointed up and not down? There’s nothing wrong with letting a “rainbow” talk it out. They’ll vote again afterwards, and you’ll take it from there.

While still holding up their votes say, “When I say ‘go’ you have 60 seconds to

convince your neighbors that you're right. Just because you have the same answer doesn't necessarily mean you're right so you'd better explain your reasoning. You have 60 seconds. Go!" Be clear that their purpose is to convince each other. You don't want them just to have a discussion: "Hey man I got 'A'; what did you get?" "I got 'B'." "Okay, cool." You need them to do precisely what you said: convince their neighbors that they're right. It forces them to own up to the answer they chose, defend it, and try to debunk others' different answers. The instructions also require them to explore if they have the same answers for the same reasons since ultimately the reasoning is key.

You have also created a sense of urgency by telling them they have only 60 seconds (no time to waste off topic). If they're slow to start, begin counting backwards, "59, 58, 57..." That works like nothing else does. (Just like saying "go" is magic compared to other terms you might try there).

As they're talking, I'm walking around the room, listening closely and getting ideas for new questions and multiple-choice distractors! I might not use the full 60 seconds if I hear the conversation dying down. Alternatively, I might give them more than 60 seconds if I hear rich discussions still ensuing. When I'm satisfied with the discussions, I'll give them a warning, "You have ten more seconds." By this time I've returned to the front of the room, and now we're ready to re-vote. Repeat numbers 4 and 5 to vote again.

At this point, you're probably up to the 80+% level and can proceed as in "A" above. If not, there are still options

available. Do you see any patterns in the distribution? Bimodal? Predominantly wrong because they fell for the distractor that you know means they still didn't notice that arrow? Here are some things you can say to get them to help you understand what's going wrong: "Did we all notice that this arrow points down and not up?" You might hear a chorus of "Oh!" Time for another vote. "Is there something about the question that I can clarify for you?" You might be able to dispel confusion to their satisfaction and vote again. Then again, you might realize there is actually a problem with the question (it happens!) or maybe this question is just too complex right now, and you need to back up to one that covers only the core idea they seem to be struggling with.




Now for the pros and cons of clickers and cards. Probably the biggest drawback to using clickers instead of cards is the inability to tie a vote to a specific individual in real time. Sure you can assign the same numbered clicker to the same student all term, but how long does it take you to see exactly who is selecting what answers? Can you tell that the pocket of incorrect answers is all in one corner of the room? The real-time benefit of the cards here is unmatched. Patterns are easily identifiable and you can do something about it right then and there. Additionally, CAE has conducted research showing that there are small but statistically significant increases in learning gains for classes using cards over those using clickers.³ There is some evidence to show that the students are more vested in trying to do well when they know the instructor can see their votes in live class.

One plus for clickers is the ability to save the data. This sounds like a clincher and if you're doing research using the numbers it very well may be. But be honest with yourself: how often are you really going to refer back to the data? Do you really need the exact numbers? Or would jotting

down a quick note about that question suffice?

Then there's that argument of using the clicker to assign participation credit. I mentioned before how I don't grade any part of TPS and wouldn't advocate for it. While some (even CAE collaborators) do, there's so far no correlation of credit with learning gains that we know of. Of course the students get really good at "gaming the system" when they know points are earned just by pressing a button on a remote control in anonymity. Besides, there are tons of other ways to assign participation credit that span the gamut from those with real pedagogical value to some as easy to grade as looking at a clicker roster.

What about cost to the students, set-up time, techno-glitches, dead batteries, forgotten/lost clickers, and the ability to insert new questions on the fly? Cards easily win all these rounds.

Granted, some of the more user-friendly clicker systems are making it easier to insert questions on the spur-of-the-moment. However, the instructor still has to set up the receiver properly. The cards are always ready to go. If a student forgets his/her card, s/he can "give me the finger" (or fingers: , , , etc.) during that class period. Because it's harder to call out the color of the right answer when you voted with two fingers instead of "green," they usually make a new card pretty quickly.

Regardless of the method of voting you use with TPS, make sure to maintain the integrity of the technique by practicing proper implementation.

Happy voting! 🎲

Notes

1. See <http://astronomy101.jpl.nasa.gov>
2. Student learning gains on validated concept inventories are directly in line with gains achieved by students in smaller classes nationwide.
3. Learning gains measured using validated concept inventories.