Focal Points

the College of Arts & Sciences

Tennessee Technological University

Vol. 13, No. 2 | A Newsletter Supported by the Terry Martin Stonecipher Fund | November 2008

Special Issue: the Award for Research and Creative Activity

Research and creative activity is celebrated in the College of Arts & Sciences through an established faculty award. The award recognizes a significant research publication or creative project appearing during the previous two years and receiving expert critical review at the regional (i.e., multi-state), national, or international level. A faculty committee, chaired by the Associate Dean, selects the annual recipient, and this year the winner is Professor John Shriner, Department of Physics. In the following essay, Professor Shriner describes the research upon which the award was based.

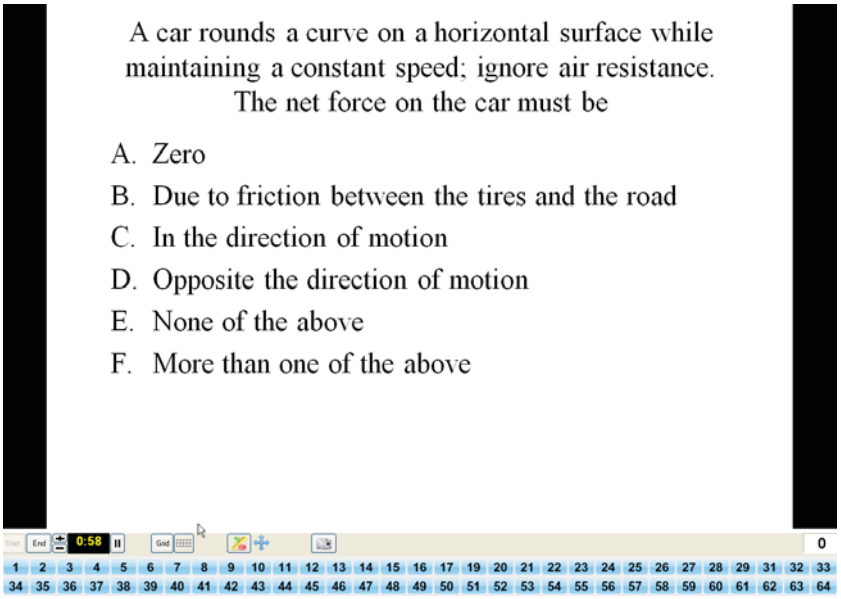
--Kurt Eisen, Interim Assoc. Dean

Physics Department

How do you know as a teacher when a class understands a new concept? If you have a small enough class, you can of course ask each one a question that will provide you feedback, but many of our classes are not that small. Homework can help answer this question, but it is difficult to grade large amounts of homework in large classes simply due to lack of time. Exams can address this issue, but those must be limited in number because of time constraints; a lack of understanding of a basic idea may not be discovered for several weeks. In addition, you (as well as the students) would truly prefer to identify and correct misconceptions before the exam.

It has been demonstrated repeatedly that "active engagement" of students – their direct involvement in the learning process as opposed simply to listening and taking notes – during instruction enhances learning. The goal thus becomes to involve the students in their own learning in a fashion that provides timely feedback to the instructor. One method was outlined a number of years ago by Eric Mazur of Harvard and subsequently described by him in his book *Peer Instruction: A User's Manual*.[1] The instructor poses questions to the class in multiple choice format, requires that the students respond, and then asks the students to discuss the question in small groups (i.e., with their neighbors in the classroom) and respond again. The method of response can range from extremely low tech (either just raising their hands or using prepared flash cards) to computer software and hardware that allow the students to communicate wirelessly with a classroom computer. I have been utilizing this approach for a number of years in my introductory physics course, first just asking students to respond by raising hands and then moving through two generations of wireless classroom response systems (aka "clickers"). I find that the clickers provide at least four significant improvements over just having students raise hands. (1) They allow the students to answer anonymously; a significant number didn't want to answer when they would be identified with an answer. (2) Students cannot (at least not as easily) just respond as someone else did or as they see the majority of the class doing. (3) At the end of whatever time is allowed (usually 1 minute) for answering the question, if I am using a projector (and I do), I can display the overall percentages for each answer; thus students get some feedback on what other people think (without knowing which people gave which answer). When they answer a second time, they can also see if the class response changed significantly after their group discussions. (4) These systems provide me with the responses from each student and allow me to assign a grade if desired. The software handles the grading with a rather small investment of time required on my part. A sample question used this semester as the student would see it is as shown in Figure 1:

[1]Eric Mazur, *Peer Instruction: A User's Manual*, Prentice Hall, 1997.



Left:
Figure 1. A sample question for an introductory phsyics class. The numbers at the bottom will change color to indicate which students have responded.

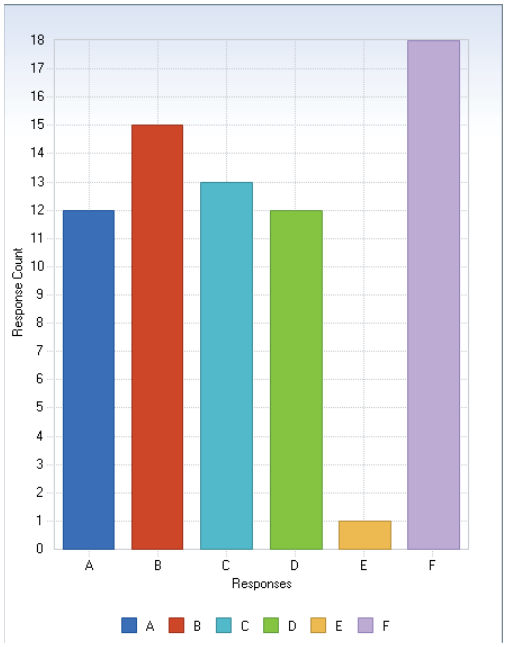


Figure 2. Frequency of answers given by students to the question in Figure 1 prior to small group discussion. The correct nswer in this particular case was choice B.

Overall responses can be presented to the class in a variety of ways, including graphically. The responses for the first attempt at this particular question are shown in Figure 2:

This process does provide the rapid feedback that is the original goal. If most students provide a correct answer to a particular question, we move on to another topic. If a significant number are incorrect (as was ultimately true in the example illustrated), then I can discuss the relevant concepts in the context of the question they have been thinking about. I try to pose these questions 2-3 times per class, to engage students as well as simply to provide a change of pace.

The major challenge for the instructor utilizing this approach is choosing good questions. It seems best for the questions to be difficult enough that several different answers are likely to be chosen – there is little gained from the discussion process if everyone already agrees on an answer. When the classroom is buzzing with discussion, I know that they are involved. When students settle on a correct answer after discussion, I cannot help but feel that they've learned something from the process and that I probably wouldn't have gotten them to that point in two more minutes of traditional lecture.

The approach should be adaptable to any size course in any discipline. One can utilize the clickers to take roll, to survey opinions if you provide options in a multiple choice format, or to ask for numerical answers. One can even have students take exams this way. The latest technology means that 1000 students can be handled almost as easily as 50, and many students seem to enjoy using the system. Further, since the University now has a contract for one such system, there is no monetary cost to the faculty member's department.

In summary, the use of wireless classroom response systems allows me to get a better idea of my students' understanding of particular topics. The students are involved, they seem largely to enjoy and learn from the process, and the system can be implemented with no financial impact on the department and modest time requirements on the faculty member.

Focal Points is published once or more per year by the College of Arts and Sciences at Tennessee Technological University, a Constituent University of the Tennessee Board of Regents. The newsletter is designed to foster community within the college and to inform friends and alumni. TTU: /An EEO/AA/Title IX/Section 504/ADA university 358-505-07

Editor, Paul Semmes, Interim Dean
Editorial Assistant, Glenda Pharris

College of Arts and Sciences
Tennessee Technological University
Box 5065
Cookeville, TN 38505-0001

(931) 372-3119
Fax: (931) 372-6142
e-mail: FocalPoints@tntech.edu

College Staff
Kurt Eisen, Interim Associate Dean
Colleen G. Harris, Executive Aide to the Dean
Susan Maddux, Coordinator of General Education Events
Edith Duvier, Director, Student Success Center
Lisa Rice, Executive Aide, Student Success Center