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Tips for Using a Peer Response System in a Large Introductory Physics Class

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Teaching a large introductory physics course can be a challenge for a young physics instructor, and making a large physics lecture interactive may seem almost impossible. The most difficult part about the large class is that due to its size there is very little real-time interaction between the students and the lecturer. The instructor often does not know how well the students understand the lecture or how actively they are involved in it. The lack of real-time communication might make it very difficult and misleading for both the students and the instructor. Fortunately, recently we witnessed the proliferation of technological tools that can help the instructor get instantaneous feedback during the lecture. One of these tools is the peer response system (PRS).[1]

The PRS consists of a set of receivers installed in a large lecture hall, a number of transmitters used by the students that allow them to submit their answers, and computer software capable of analyzing and displaying this information.[2-5] At the core of the peer instruction technique is a simple concept: The students have to be actively involved in the lecture. To do so, an instructor poses the lecture by asking multiple-choice questions. The students discuss the answers with their peers, then they submit the answers electronically using the PRS. After that, the instructor displays student answers and proceeds with the lecture accordingly. A low-tech version of the PRS can be a set of multi-colored flash cards used by the students to display their answers.[6]

Last school year, I was involved in teaching my first introductory physics course at Rutgers University.[7] More than 150 students enroll in this course every semester, and it is a required course for science (but not physics) majors. To make the lectures interactive, we decided to use the PRS. However, in spite of my expectations of immediate success with this technology, I soon realized that similar to other educational tools, one has to learn how to use the PRS effectively. Although Eric Mazur provides us with ample examples of successful PRS questions, every instructor is in charge of making the PRS implementation fit his or her particular course. In this column, I compiled what we have learned about the effective use of the PRS in an introductory physics class in the hope that it will help other young physics faculty incorporate this technology in their classes.

1. Think carefully about the main concepts of every part of your lecture and create one conceptual multiple-choice question targeting this concept. Try to make the question as clear as possible. Do not overload it with mathematical calculations, since it will require more time to answer and will make more students guess.
2. While coming up with the distractors, use the ones with wrong units, the conceptually impossible, as well as the distractors representing common novice misconceptions. Do not underestimate the power of a humorous response.
3. Do not allow the students to answer the question right away. After posting the question, ask the students to discuss their answer with each other. Walk across the room and listen to student conversations.
4. Only after you see that most of the students came up with their

answer, start the PRS (I usually give the students 30 seconds to input their answer).

5. After the answers are displayed on a large screen as a histogram, make a decision regarding what to do next. If the majority of the students answered correctly, go on. However, if student answers are random or a split between two or three choices, ask a few student volunteers to explain their choice. You can provide hints or point the students in the right direction, but do not give them the right answer yourself. Give the students an opportunity to figure out the answers for themselves.
6. After this discussion, ask the students to input their answers for the second time. Probably, you will see a significant improvement from the first submission.
7. Make the PRS questions part of your assessment. For instance, you can announce in advance that 30% of the exam will be composed of the questions based on the PRS problems discussed in the lecture. This will make the students focus more on the lecture and on the group discussions of the PRS questions.
8. Do not feel disappointed if you spent too much time on one question and did not cover all the material. If you actively involved the students in the lecture, helping them understand rather than memorize the material, you did your job! The students will be able to learn the rest by themselves.
9. Create a learning-friendly environment of mutual respect and responsibility via getting to know your students. Learning students' names from the beginning of the semester can be more powerful than you could think! Knowing your students better will make a large class seem smaller. It will also open doors to their active involvement in the lecture by answering the PRS questions more thoughtfully, as well as justifying their answers more freely in front of classmates.
10. Always remember that the goal of the PRS questions is not punishing the students who could not answer the questions correctly, but helping every one of them to be successful in physics learning via active involvement in the lecture.

The PRS questions we used can be found in the lecture notes posted on the website of the Physics for the Sciences 193-194 course.[7] Additional information about the PRS system we were using and the history of this project at Rutgers University can be found at http://www.physics.rutgers.edu/srs/.

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