Peer Instruction in the Lecture Setting

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The Practice

Students read the relevant course material before each class; instructor-generated notes outlining the major concepts are the primary source, with the text acting more as a complement to the notes and as a source of problems. While some class time is spent with the usual experimental demonstrations, for the rest of the class time the students are presented with short, primarily qualitative questions designed to develop their conceptual understanding of the material. In the large, first-year class these questions are multiple-choice. Students are given about a minute to decide on the best answer, and then about 5 minutes to discuss the answer with nearby students. The class then votes on the correct answer, which gives both the students and instructor instant feedback on their understanding. Following the vote, the instructor gives the correct reasoning and a general discussion of both the correct and incorrect reasoning ensues before moving to a new question. The vote and preceding peer discussion considerably enhances interest in the instructor's explanation while reducing the likelihood of a passive "I knew it all along" stance to the material.

A similar format is used in upper-year classes, except that the questions are not multiple-choice and the instructor cruises the class looking for the difficulties in understanding. If the class has common problems, the instructor will give a brief clarification to the whole class.

Guiding Principles Behind the Practice

1. Regardless of how well they do on numerical problems, students who do not understand the material conceptually do not have a sufficient grasp of the subject.

2. In order to really understand a new concept, students must incorporate it into their existing conceptual framework. Discussing the new concepts with their peers is an excellent means to accomplish this integration because they can ask the fundamental questions most relevant to their personal understanding, and do so without fear of taking an inordinate amount of the class time or risk of embarrassment in the large class.
3. In a conventional lecture, probably 90% of the time is spent transferring information which the student can easily obtain from the written page, leaving only about 10% class time to spend on the areas which students traditionally find most difficult. It is better to focus on the difficult material and its integration with the students' existing conceptual frameworks.

Sources of Inspiration or Influence for the Practice

Numerous studies of physics teaching over the last 20 years (for example, Wilson, 1997) have shown that students need training in understanding the concepts, and that they accomplish this better when they use class time to interact intellectually with their professor and their fellow students rather than merely listening and taking notes in lectures. The approach described above for the first-year course follows that described by E. Mazur (1997) of Harvard University. He showed that students taught with this method obtained an exam grade up to 7% higher than those taught by the same instructor with a conventional lecture format.

Frequently Asked Questions About the Practice and Responses

1. How much work does this approach compared to that for the lecture format?

   Preparing questions for peer instruction/discussion takes much less time than preparing lectures for the first time. The preparation of questions for the first-year physics course is greatly assisted by using the question bank provided in .pdf form by Mazur in his book (see below), but for the first year or two of the course you will want to add to these.

   The time involved for preparation of notes to distribute before class depends greatly on the reading that you want the students to do before each class. If you already have legible notes that can be photocopied, or if the textbook is truly readable, then the work is obviously much less than if you have to prepare legible notes from scratch.

2. Do students still come to class when you provide the notes before the class?

   Attendance is at least as good as for conventional lectures, and the students who do not attend at least end up with a good set of notes. Most students recognize that attendance at classes is much more important in this format than in a lecture format. While in the latter they can obtain from friends notes which they believe to summarize everything that happened, they recognize that it is not easy to substitute for the active interaction involved in the peer discussion of the instructor-generated notes and questions.

3. How do you get the students to read the notes before the classes?

Various techniques have been tried. Mazur has used two approaches: (1) in-class tests on what has been covered in the assigned reading (not an understanding of it), and (2) requiring students to submit before each class, on the web, answers to questions that would require them to read the material. However, fear of embarrassment in front of their peers is probably the main motivator; but even students who do not come prepared learn substantially from the approach.

For More Information (References and Links)

Wilson, J. (Ed.) (1997). Conference on the introductory physics course: On the occasion of the retirement of Robert Resnick. New York: Wiley.

Mazur, E. (1997). Peer instruction: A user's manual, 1/e. Upper Saddle River, NJ: Prentice Hall.

Web site for the Galileo Project at Harvard, including Mazur's Peer Instruction.