

Scholarly Basis of Reform

The class uses Peer Instruction² and Just in Time Teaching Techniques³ in the lecture and activities and laboratory exercises based on familiar phenomena or utilizing everyday items to illustrate new phenomena.

Pedagogical Reforms Implemented

A significant feature of our program is that the structure of the course emphasizes the cooperative nature of scientific research. The class encourages the students to work together. In traditional lecture-based courses, even when the grading is not on a curve, students often still assume they will be graded on the curve.⁴ The competitiveness this engenders makes the classes less attractive to women and minorities, groups which are particularly sensitive to “class climate.”⁵

The main goal of the course was to teach basic physics concepts and to try to develop some intuition as to how those concepts are used in solving problems. Interactive teaching methods were introduced to further these goals. The main vehicles chosen to achieve this were the use of Reading Questions (akin to “Just in Time Teaching”) and of in-class quizzes using H-ITT remotes. A discussion of each of these follows.

Reading Questions – Each week the lead instructor created and assigned three multiple-choice questions related to central topics in the chapter to be discussed in class the following week. The questions would be posted on the web-based homework site used by the class, the software for which was developed in-house for this class in previous years. In this case, the Reading Questions were assigned on a Monday and due before class the following Monday, on which day discussion of the chapter from the textbook would begin in class. Analysis of the number of correct and incorrect responses would allow the instructor to seize on issues needing particular attention. In the majority of cases the Reading Questions indicated that the students were reading ahead and taking in the most important ideas just from that reading, and it seems reasonable to conclude that the Reading Questions themselves were a positive encouragement to them to come prepared to class and were also quite useful in exposing some areas in which large numbers of students came to the material with misconceptions.. For examples scroll to the bottom of the following link: [\[Link to College Physics-Reading Quizzes\]](#). Solutions and statistics on how students performed are available with each quiz. Available also on this page are tests, solutions, study guides and older versions of the H-ITT quizzes (see below).

H-ITT quizzes – In the last class of the week we would do a multiple-choice quiz using H-ITT remotes to review the topics discussed during the week. Each student had a H-ITT remote device and would respond to a series of multiple-choice questions projected on screen. Student responses were also projected and then the correct response would be discussed. This seemed to a particularly popular activity with the students, and was an interesting case in which hard questions were actually enjoyed. Revelation of the correct answer to such questions was always greeted with interest, and with enthusiasm on the part of those who proved correct. The instructor felt an important part in fostering this attitude was that there were no points riding on getting the questions right. 5% of the grade was offered for the H-ITT quizzes, full marks being

obtained for contributing answers to half of the total questions given during the year. This seemed to be more than adequate to encourage participation levels, which were high (over 75% of the class achieved the full 5% allotment, typically by a large margin). It did not seem at all to discourage people from trying to get the answer correct, but probably helped in taking the sting out of hard questions, letting them be opportunities to learn rather than opportunities to lose points. In fact, so little enticement seemed to be necessary with the H-ITT quizzes that plans to offer bonus points for consistently correct responses were discarded. It seemed wiser to use precious bonus points elsewhere, where they could do more good. Areas which seemed, on the basis of the responses, to require further work, would receive some attention the next week during lectures. H-ITT quizzes were also posted to the class website afterwards, for reference. Following on from experience with the previous year's class an effort was made, where possible, to link the questions into separate parts of one larger problem. Given the ability to use Power Point in setting the questions, good use could be made of questions involving figures, graphs and other visual components. For over 80 examples, including answer discussion slides, from the most recent offering, [\[Link to College Physics-H-ITT Quizzes\]](#).

One other activity worthy of mention was the use of **take-home retests** of in-term tests, in which students were permitted to collaborate. They received half-credit for questions answered correctly in the retest, which they missed during the in-class test. This was an experiment born out of frustration that it is very difficult to get students to pay attention to test solutions, even when they are discussed at length in class. This is especially true of poorer students who need it the most. Generally tests seem to be poor learning tools. While they have obvious utility in assessment, it would seem that in-term tests ought to be helpful in learning also. The idea of the collaborative retests was to bribe the students to figure out what they had misunderstood on their own tests and for them to actually learn to do it correctly! Overall the outcome was very positive. The retests were certainly popular with the students, with nearly 100% participation. It permitted test questions which were more conceptually based, since those students who stumbled badly on conceptual aspects of questions would typically not get any points in the test, but had a chance, and considerably motivation, to recover somewhat in the retest. In the final exams at the end of each semester, for which there was no retest, the poorer students actually did much better than they had on the in-term versions of the original tests. This suggests that they had benefited from the retest experience (of course the questions on the final were completely different from those in the earlier tests). The procedure increases the grading burden, since it doubles the number of tests to be graded, but since the questions are repeats, and much more likely to be correct, the extra burden is more like 50% than 100% of the time taken to grade the original test. [\[Link to CP References.htm\]](#)