FACT SHEET
Technology-Enabled Active Learning (TEAL) Project
Physics I (8.01) and Physics II (8.02)

Introduction

The Technology-Enabled Active Learning Project reformed freshman physics at MIT from a lecture-recitation format to a studio physics model. This reform, which began in 2001 and went to full-scale implementation in 2003, involved a number of different elements:

- The use of active learning pedagogies, including desktop experiments, student collaboration, and a personal response system (PRS)
- Web-based assignments
- A tailor-made classroom consisting of round tables for students to work together, and lectern situated in the middle of the room from which the instructor could control all the technology
- Simulations and visualizations of physics phenomena to aid students’ conceptual understanding.

The goals of the TEAL project were to: transform the way physics was taught in large enrollment courses; decrease the failure rate in introductory physics; move away from passive learning; increase students’ conceptual and analytical understanding of the nature and dynamics of electromagnetic fields and phenomena.

Physics I (mechanics) and Physics II (electromagnetism), both of which are required for all MIT students, are now taught in the TEAL format.

Methodology

The unique learning environment of the TEAL format was assessed for its effect on cognitive and affective outcomes. The research population consisted of 811 MIT undergraduates in small- and large-scale experimental groups and a control group who studies Physics II in the standard lecture/recitation format in the Spring semester 2002. The assessment involved examining students’ conceptual understanding via a pre-test/post-test and comparing results of the TEAL students with the control group. (As of this writing, the teaching of mechanics in the TEAL format has not been assessed.) The effect of the TEAL environment on students’ preferences regarding the various teaching methods was also investigated using a survey as well as focus groups. Finally, the interactions of the students while working in their small groups was studied through classroom observations.

*This Fact Sheet is based on Dori, Y.J. and J. Belcher (2005). “How Does Technology-Enabled Active Learning Affect Undergraduate Students’ Understanding of Electromagnetism Concepts?” The Journal of the Learning Sciences, 14(2):243-279. Professor Dori was the lead assessment researcher on the TEAL project.
Major Findings and Discussion

As cited above, one of the TEAL project goals was to decrease the students’ failure rate. This objective was achieved: The failure rates in the two TEAL experimental groups were less than 5% while the failure rate in the traditional control group was 13%.

The pre- and post-tests were given in two TEAL groups: Fall 2001 and Spring 2003. These two groups were compared to the control group. Both TEAL groups improved their conceptual understanding significantly more than the control group. Figure 1 compares learning gains (Hake, 1998) for the TEAL Spring 2003 group with the control Spring 2002 group, after dividing each class into a “high,” “medium,” and “low” group based on the student’s pre-test score.

Figure 1: Learning Gains for TEAL Students in Comparison to Control Group

![Learning Gains Graph]

Learning gains <g> = \frac{\% \text{Correct post-test} - \% \text{Correct pre-test}}{100\% - \% \text{Correct pre-test}}

Finally, in the small-scale implementation of TEAL, a majority of the students said they would recommend the TEAL course to fellow students, indicating the benefits of interactivity, visualizations, and hands-on experiments. In the large-scale implementation, students expressed both positive and negative attitudes in the course survey.