Interactive Lecture Demonstrations

Resources:

http://serc.carleton.edu/introgeo/demonstrations/index.html

Physics:

http://www.physics.umd.edu/perg/ILD.htm

Research:

Classroom demonstrations: Learning tools or entertainment? Catherine Crouch¹, Adam P. Fagen², J. Paul Callan¹, and Eric Mazur¹
¹Department of Physics and Division of Engineering and Applied Sciences, Harvard University, 9 Oxford Street, Cambridge, Massachusetts 02138
²Program in Molecular Biology and Education, Harvard University, 9 Oxford Street, Cambridge, Massachusetts 02138

We compared student learning from different modes of presenting classroom demonstrations to determine how much students learn from traditionally presented demonstrations, and whether learning can be enhanced by simply changing the mode of presentation to increase student engagement. We find that students who passively observe demonstrations understand the underlying concepts no better than students who do not see the demonstration at all, in agreement with previous studies. Learning is enhanced, however, by increasing student engagement; students who predict the demonstration outcome before seeing it, however, display significantly greater understanding. © 2004 American Association of Physics Teachers.

Use of interactive lecture demonstrations: A ten year study
Manjula D. Sharma, Ian D. Johnston, Helen Johnston, Kevin Varvell, Gordon Robertson, Andrew Hopkins, Chris Stewart, Ian Cooper, and Ronald Thornton*
School of Physics, University of Sydney, New South Wales 2006, Australia

The widely held constructivist view of learning advocates student engagement via interactivity. Within the physics education research community, several specific interactive strategies have been developed to enhance conceptual understanding. One such strategy, the Interactive Lecture Demonstration (ILD) is designed for large lecture classes and, if measured using specific conceptual surveys, is purported to provide learning gains of up to 80%. This paper reports on learning gains for two different Projects over ten years. In Project 1, the ILDs were implemented from 1999 to 2001 with students who had successfully completed senior high school physics. The learning gains for students not exposed to the ILDs were in the range 13% to 16% while those for students exposed to the ILDs was 31% to 50%. In Project 2, the ILDs were implemented from 2007 to 2009 with students who had not studied senior high school physics. Since the use of ILDs in Project 1 had produced positive results, ethical considerations dictated that all students be exposed to ILDs. The learning gains were from 28% to 42%. On the one hand it is pleasing to note that there is an increase in learning gains, yet on the other, we note that the gains are nowhere near the claimed 80%. This paper also reports on teacher experiences of using the ILDs, in Project 2.
Interactive lecture demonstrations: a tool for exploring and enhancing conceptual change
Rachel Zimrot and Guy Ashkenazi*

Department of Science Teaching, The Hebrew University of Jerusalem, Israel

Abstract: Interactive Lecture Demonstrations (ILD) are a student centered teaching method, in which students are asked to predict the outcome of an experiment, observe the outcome, and discuss it with respect to their former expectations. The demonstrations are designed to contradict students’ known misconceptions, generate cognitive conflict and dissatisfaction with the existing conception, and promote a process of conceptual change. An ILD based course was used to explore the effect of cognitive conflict on the conceptual change process, and the role of student interactivity in this process. Three major levels of conceptual change were identified: high – students who remember the outcome of the demonstration, and explain it using the consensus model; medium – students who can recall the outcome, are dissatisfied with their alternative model, but do not switch to the consensus model; and low – no meaningful recollection of the outcome, and no change in the alternative model. A multiple-choice test based on the lecture demonstration was given to two groups, one of which only observed the demonstrations, without predicting and discussing. We found a significant difference between the groups, with an obvious drop in students’ ability to recall the outcome of the demonstrations in the non-interactive group.

Background on Normalized learning gains and Interactive Engagement:

Interactive-engagement vs traditional methods: A six-thousand student survey of mechanics test data for introductory physics courses*
Richard R. Hake
Department of Physics, Indiana University, Bloomington, Indiana 47405

A survey of pre/post test data using the Halloun-Hestenes Mechanics Diagnostic test or more recent Force Concept Inventory is reported for 62 introductory physics courses enrolling a total number of students N = 6542. A consistent analysis over diverse student populations in high schools, colleges, and universities is obtained if a rough measure of the average effectiveness of a course in promoting conceptual understanding is taken to be the average normalized gain \(<g>\). The latter is defined as the ratio of the actual average gain (%<post> – %<pre>) to the maximum possible average gain (100 – %<pre>). Fourteen “traditional” (T) courses (N = 2084) which made little or no use of interactive-engagement (IE) methods achieved an average gain \(<g>T\text{-ave} = 0.23 \pm 0.04\) (std dev). In sharp contrast, forty-eight courses (N = 4458) which made substantial use of IE methods achieved an average gain \(<g>IE\text{-ave} = 0.48 \pm 0.14\) (std dev), almost two standard deviations of \(<g>IE\text{-ave}\) above that of the traditional courses. Results for 30 (N = 3259) of the above 62 courses on the problem-solving Mechanics Baseline test of Hestenes-Wells imply that IE strategies enhance problem-solving ability. The conceptual and problem-solving test results strongly suggest that the classroom use of IE methods can increase mechanics-course effectiveness well beyond that obtained in traditional practice.

Normalized gain: \(<g> = (\text{post} – \text{pre}) / (100-\text{pre})\)
III. CONCEPTUAL TEST RESULTS
A. Gain vs Pretest Graph - All Data

Fig. 1. %<Gain> vs %<Pretest> score on the conceptual Mechanics Diagnostic (MD) or Force Concept Inventory (FCI) tests for 62 courses enrolling a total N = 6542 students: 14 traditional (T) courses (N = 2084) which made little or no use of interactive engagement (IE) methods; and 48 IE courses (N = 4458) which made considerable use of IE methods. Slope lines for the average of the 14 T courses <g>T and 48 IE courses <g>IE are shown, as explained in the text.