UNIVERSITY AT ALBANY
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Teaching at ALBANY

February 2012

Upcoming ITLAL Events

Faculty Spotlight:
Team-Based Learning
February 22, 2012
3:00 – 4:30pm
ITLAL Underground (LI B69)

80+ UAlbany faculty members can't all be crazy! Come and learn about the experiences of those instructors who have chosen to incorporate the Michaelsen method of Team-Based Learning (TBL) into their classrooms.

Break the Economy of Cheating
March 5, 2012 • 3:00 – 4:30pm
ITLAL Underground (LI-B69)
March 6, 2012 • 2:00 – 3:30pm
Husted 310 (Downtown)

Economists have known this for a long time: cheating is a behavior driven by incentives. This session does not promise simplistic techniques to inhibit cheating, but it does propose a realignment of priorities in course design: make your classroom a community of invested students.

Future Faculty Event:
Finding an Academic Job That Fits Your Needs
April 17, 2012 • 2:30pm – 4:00pm
ITLAL Underground (LI-B69)

You know you want to work in academe, but in what capacity and where? Join us for a panel discussion with faculty members from local four-year schools and community colleges to learn what their faculty life is like.

To register for events or request services, please visit:
http://albany.edu/teachingandlearning
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What's Really Possible in a Large Classroom?

It's hard not to be sympathetic with the perspective widely shared at public universities that there's a limit to what instructors can do to promote deep learning in a large class. There's no way, the reasoning goes, for one instructor, whether with or without TA's, to interact meaningfully with large numbers of students in a limited span of time. And if you did make it a goal to interact, the resources required would be prohibitive.

So, what do you think would happen if a Nobel Prize laureate in Physics decided to test this argument in a large undergraduate calculus-based physics course?

The Challenge

Enter Carl Wieman. Not wanting his prestigious name to be the target of criticism for sloppy research, he and his team conducted a carefully controlled study to determine what measurable improvement in learning, if any, could be achieved by students in a large (N=270) undergraduate, calculus-based physics class when taught using a set of specific, off-the-shelf, active learning teaching techniques.

Wieman's research team took many precautions to ensure the validity of the study. Rather than compare final exam scores of two courses taught over a full semester using different methods—which would introduce too many untrackable influences on student learning—this experiment was imbedded in a single week (the 12th) of a traditionally taught course. The intervention endured for just the 3 hours of class meeting time, after which the learning gains were measured and compared to those of the control group.

The Course

Both the control section and the experimental section of the course, except for the one experimental week of one of the sections, were taught by motivated, experienced, highly rated faculty members. In both sections these instructors lectured using PowerPoint and presented the content along with demonstrations. The students took notes, and clickers were used in both sections for summative evaluation of student understanding. ***The 1-week experimental unit, on the other hand, was taught by a guest post-doc who had never taught before, but who had been prepared for the experiment by studying several classroom teaching techniques.***

Instruction for the control group did not vary from traditional practices during the entire semester. Both the control group and the experimental group were taught in a large, theater-style lecture room with fixed seating. Both groups of students were assigned homework and had weekly labs, tutorials and problem-solving recitations. Every instructional aspect of the course was held constant between the two sections throughout the study, except during the single week of the intervention. Analyses were done to ensure that students in the experimental section, up until the beginning of the experiment, were not exceptional nor did they receive any special preparation.

Carl Weiman's Experiment

Held constant between the control and experimental groups:

- Class size (270) in theater-style room; fixed seating
- Same test
- 11 weeks of traditional teaching before experiment
- Lectures by highly rated instructors
- Labs
- Homework
- Clicker-based quizzes
- Tutorials and Recitations

Unique to the experimental group:

- 12th week of course: 3 hours of special instruction
- Taught by inexperienced, rookie post-doc
- No lecture
- Used an array of active learning techniques, including:
  - Pre-class online quiz
  - In-class tasks (predictions, arguments, critiques)
  - Clicker-driven discussion
  - Instructor feedback on student work

The instrument and process to measure learning for both the experimental and the control populations were identical, and were determined solely by the instructors of the traditionally taught sections. To reduce the stakes for students, and thereby remove yet another potential variable, students were told that the test did not count toward their final grade. All students, both those in the experimental group and the control group, were encouraged to take the test for practice. The test took place during the regularly scheduled class meeting.

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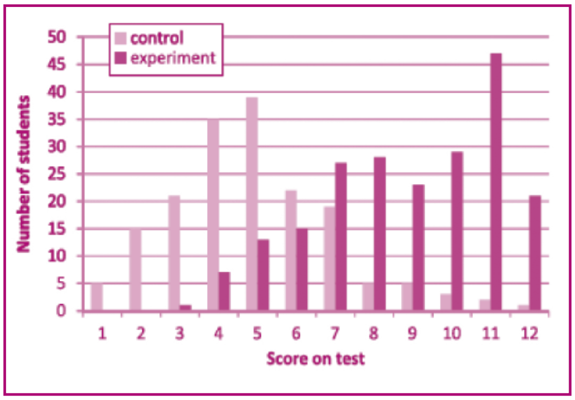
The Intervention

In the experimental section students were assigned four pages of focused reading. To ensure that they came to class prepared, they were required to take a short pre-class online quiz (with instant electronic feedback). Once in class, students spent the entire time engaging with other students in making predictions, testing predictions, making arguments, and critiquing reasoning—their own as well as that of others. The post-doc instructor managed these interactions by the use of clickers. There was no lecture except as provided in direct response to student work. The class time activities were intended to create multiple opportunities for practice thinking and feedback, both student-to-student and instructor to student.

So, What Happened?

It is worth noting that during the week of special instruction attendance in the experimental section grew significantly as the week progressed. Also, a greater number of students from the experimental section elected to take the test (211 over 171 in the control group). As for the scores, we'll let Wieman's team members explain for themselves the outcomes, as represented in the histogram at right: "The average scores were 41% in the control section and 74% in the experimental section. Random guessing would produce a score of 23%, so the students in the experimental section did more than twice as well on this test as those in the control section... The two distributions have little overlap, demonstrating that the differences in learning between the two sections exist for essentially the entire student population. The standard deviation calculated for both sections was about 13%, giving an effect size for the difference between the two sections of 2.5 standard deviations... An effect size of 2, obtained with trained personal tutors, is claimed to be the largest observed for any [previous] educational intervention. This work may obtain larger effect sizes than in this previous work because of the design and implementation that maximized productive engagement. The clicker questions and group tasks were designed not only to require explicit expert reasoning but also to be sufficiently interesting and personally relevant to motivate students to fully engage."



Why Did this Work?

Gregor Novak, author of Just-in-Time-Teaching, is famous for saying, "If what you're doing in the classroom is something you could do even if students were not there, then you should stop doing it." Novak's point is that the classroom is the opportunity for the professor's expertise to be applied as a direct response to something students have already done, thought or said—like the violin coach who listens to what the student plays and then offers expert feedback. For science instruction, the analog to playing the violin is "thinking like a scientist." This practice + feedback cycle is representative of the "deliberate practice" approach that Wieman's team used for designing instruction for the experimental unit of the course. If the goal is to support students in their development of physics expertise, Wieman says, then students have to practice physics thinking at every moment when they are in the presence of the expert. Deliberate practice is based on the notion that students learn more deeply and faster through immediate feedback on their thinking and understanding. This is possible only if class time is used to make feedback relevant.

A necessary consequence of using this approach when applied to a large class is this: anything that students can do on their own (such as getting basic facts and definitions through reading or watching a demonstration, etc.) is transferred outside of class.

Translating Deliberate Practice into a Classroom Strategy

Creating the framework and process of support for this learning environment may not seem easy or obvious. And doing so may require suspension of certain assumptions about what is possible—plus an open mind for playing with some of the tools and techniques that have become widely available for large class instruction. Some of these are:

- Online tools to provide students 24/7 access to content and to virtually eliminate the time-consuming shuffling of paper
- Online quizzing with auto-grading, to ensure student preparation
- Wireless instant feedback systems (e.g., clickers), to interact with a large audience
- Techniques for socializing students to work collaboratively (e.g. scratch-off test forms)
- Techniques for ensuring that student collaborative work is on-task and productive

Conclusion

Wieman and his colleagues became convinced by their research that large classes can be the place of deep learning and critical thinking—and the resources needed are already at hand. The one question they were not sure about was student receptiveness to the way class meetings were managed using the techniques. In a survey of students after the intervention, the picture become clear: 90% of respondents indicated that they "really enjoyed the interactive teaching" during the experimental week. Students responded positively to the statement, "I feel I would have learned more physics if the whole course had been taught" this way.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved Learning in a Large-Enrollment Physics Class. *Science, 332* (6031): 862-864.

Novak, Gregor M., Patterson, E. T., Gavrin, A. D., and Christian, W. (1999). *Just-In-Time-Teaching: Blending Active Learning with Web Technology,* Prentice Hall.

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