

TEACHING **AT ISU**

Using Active-Engagement Teaching Methods in Large-Enrollment Classes to Improve Student Learning

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I have always enjoyed learning about scientific concepts and explaining them to other people, and I used to spend a great deal of time and effort preparing extremely clear and detailed lectures. After a while, though, I could not avoid the realization that most of my students were not learning physics very well, despite my painstaking efforts to present concepts clearly, completely, and methodically. Although physics is a difficult subject, I felt that I should be doing a better job of communicating its ideas.

I became aware that university faculty engaged in physics education research were having success with instructional methods that employed "active engagement." In these methods, most often applied in instructional laboratories or small classes, instructors avoid giving students a fully worked-out set of answers and explana-

tions right at the beginning. Instead, they guide students to figure out concepts on their own – as much as possible – through hands-on laboratory investigations or closely guided theoretical reasoning. Instructors guide students to follow productive lines of reasoning through a form of Socratic dialogue, asking many leading questions.

But can these instructional methods be employed in a lecture hall with 80 or more students? The answer is yes. Two effective techniques are: (1) guide students through a sequence of multiple-choice questions that force them to think deeply about the targeted concept, and use a classroom communication system to obtain instantaneous responses from all students simultaneously; (2) allow students to work in small groups on problems requiring non-multiple-choice responses such as diagrams or short answers. Responses to properly designed questions can be very quickly checked by the instructor who circulates around the lecture hall, examining the work of students near the aisles and front row.

The communication system I use is flash cards: each student is given six 5 x 8 cards on which the letters A, B, C, D, E, or F are printed. I write questions on the board along with several possible answers or provide pre-printed questions, and I'll usually give students 15-30 seconds to consider their answer. If they

have trouble responding, or if there is much disagreement on the answers (for instance, half with "A" and half with "C") I'll give them another minute (or more) so they can discuss it with each other. This method allows a virtually continuous exchange of questions and answers between instructor and students. ,



Professor David Meltzer

I have done careful assessment of my students' learning over the years, using several standard conceptual tests as well as questions borrowed from other instructors' exams. I measure students' learning gains, that is, improvement from a pretest given on the first day of instruction to a post-test given the very last day. My students' gains are consistently above those reported in classes using more traditional forms of lecture instruction.

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They are exposed to fewer topics than in a traditional class, but seem to learn the concepts they study in much greater depth. They also learn to analyze problems qualitatively, and not simply by relying on equations. Course evaluations suggest that most students enjoy this method of instruction. Many more details about the assessments and the instructional methods can be found on the website of the ISU Physics Education Research Group, <http://www.physics.iastate.edu/per/>.

References:

1. David E. Meltzer and Kandiah Manivannan, "Transforming the lecture-hall environment: The fully interactive physics lecture," *American Journal of Physics* **70**, 639-654 (2002).
2. Eric Mazur, *Peer Instruction: A User's Manual* (Upper Saddle River, NJ, Prentice Hall, 1997).

Resources Available in Teaching Science

These books on science education are available in the Parks Library:

- George E. DeBoer, *A History of Ideas in Science Education: Implications for Practice* (Teachers College, 1991). Q183.3.A1 D4
- Dorothy L. Gabel, ed., *Handbook of Research on Science Teaching and Learning* (Macmillan, 1994). Q181.A1 H35
- Marjorie Gardner, et al., eds., *Toward a Scientific Practice of Science Education* (Erlbaum, 1990). Q181.3 .T68
- Shawn M. Glynn, et al., eds., *The Psychology of Learning Science* (Erlbaum, 1991). LB1585 .P78
- Diane F. Halpern, ed., *Enhancing Thinking Skills in the Sciences and Mathematics* (Erlbaum, 1992). Q181 .E633
- Anton E. Lawson, *Science Teaching and the Development of Thinking* (Wadsworth, 1995). NIL

Eric Mazur, *Peer Instruction: A User's Manual* (Prentice Hall, 1997). QC30 .M345

Committee on Undergraduate Science Education, *Science Teaching Reconsidered: A Handbook* (Nat'l Academy, 1997). Q181 .S3822

Ann P. McNeal and Charlene D'Avanzo, editors, *Student-Active Science, Models of Innovation in College Science Teaching* (Saunders, 1997). NIL

Sheila Tobias, *They're Not Dumb, They're Different: Stalking the Second Tier* (Research Corporation, 1990). Q181 .T58

Learning Spanish through Experience

by Kathy S. Leonard
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Early this semester, I was among a group of five faculty members named as IAS Master Teachers, specifically for our work in creating off-campus learning opportunities for students. These are some thoughts and experiences on experiential learning as used to help students learn Spanish.

Foreign language educators are constantly striving to broaden students' horizons and to instill in them respect and understanding towards others who are linguistically and culturally different from themselves. One of the ways we do this is to encourage our students not only to learn foreign languages, but also to live and work in close contact with ethnically diverse groups, whether in the United States or in other countries. I actively encourage, and often require, my students to be involved in activities outside the classroom that help them learn Spanish. These activities have included: a collaborative project with a university in California where students exchanged

letters (before email) with native-speaking Spanish students; interviews with foreign students and immigrants in the Ames area to learn about the various dialects of Spanish; and life in a residential learning community, Casa Hispánica, where students lived together and participated in extra-curricular activities related to Hispanic culture.

Last summer, Nancy Guthrie of the International Education Services staff and I took the idea of off-campus learning quite literally. We traveled to Arica, Chile, where

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students enrolled in a program for Spanish language and service-learning. In service-learning, participation in a project is meant to be a mutually beneficial educational experience for the students and also for the persons being served. It is an opportunity to use a new pedagogical tool that links the classroom with real-life experiences where students can use their Spanish skills in a natural setting.

What all of the above-mentioned activities have in common is the element of experiential learning. There is no better way to understand peoples of other cultures or to learn their language than to be placed in real-life situations where communication must be negotiated face-to-face with native speakers of the language under study. In such situations, students are not only actively involved in their own learning, but in many cases are solely responsible for this learning. Research has shown that when cultural exchanges take place between diverse groups, increased interest and motivation figure prominently not only in the learning

of a second language, but also in participants' continued interest in experiencing other cultures first hand, something foreign language educators continually strive to promote. As a Chinese proverb has it, "Tell me and I forget. Show me and I will remember. Involve me and I will understand."

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For further information on service-learning and experiential learning, see:

<http://www.fiu.edu/~time4chg/Library/bigdummy.html>

<http://www.ipls.org/whatiservice.html>.

<http://csf.colorado.edu/sl/>

What Did You Tell Us ? *Survey of Faculty Development Needs*

Last year at this time, you may have responded to a three-page survey about teaching and learning at Iowa State. This survey was designed to help the Center for Teaching Excellence assess the needs of ISU faculty and learn how best to direct its efforts in enhancing teaching and learning on campus. The CTE has already implemented several changes in response to that survey, and we would like to tell you what we learned.

Among other things, we learned that if you attend CTE events fairly regularly, you are likely to be an assistant or associate professor. We learned that you would like to find out about CTE events through email as well as by

reading this newsletter. In addition, you probably prefer face-to-face interactions to Web-based faculty development, since you find that social interactions and opportunities to learn from peers make CTE events valuable.

"...about 4 out of 5 tenured or tenure-track respondents are familiar with CTE's services."

Because of the value of personal interactions, you are likely to prefer workshops as a CTE activity, though informal discussions with colleagues and hearing about teaching techniques over coffee or lunch may also be attractive. CTE will continue to use, and continually strive to improve, its workshops, and will continue to offer programming in less formal settings such as teaching and learning circles.

Respondents to the survey indicated that helping students develop critical thinking or problem-solving skills is their greatest area of interest. Also of high interest are facilitating effective classroom discussions; incorporating active learning strategies; using technology to enhance learning; and designing effective lectures.

In terms of faculty development, respondents said that they were interested in integrating communications skills across the curriculum; principles of student outcomes assessment; scholarship of teaching and learning; large class instruction; and developing teaching portfolios.

More than 40% of faculty responded to the survey, and we were pleased to learn that the overall perception of the CTE's effectiveness is very positive. An overwhelming majority (92%) of those who expressed an opinion told us that they find the CTE somewhat or highly effective. In all, about four out of five tenured or tenure-track respondents are familiar with CTE's services, and assistant and associate professors tend to participate in CTE events most regularly.



Seeds of Knowledge: How is class like a pumpkin? Steve Jungst, Professor of Natural Resource Ecology and Management, ponders this question at a workshop on developing expected outcomes and assessing student progress. Jungst and Jan Thompson, Assistant Professor of Natural Resource Ecology and Management, presented their workshop - and pumpkin - on October 22.

We found, however, that fewer non-tenure track faculty are familiar with or participate in CTE events. The CTE recognizes that, since our goal is to enhance student learning, we need to direct resources and programming to benefit of non-tenure-track faculty

The CTE staff thanks everyone who responded to the survey as well as those who participated in our follow-up focus groups. Thanks also to the staff of the Research Institute for Studies in Education (RISE), which helped us to create the survey and tabulate its results. We will continue to seek ways to meet the needs of ISU faculty in improving teaching and learning on campus, and welcome your comments, ideas and suggestions.

Gardner to Speak on Campus

Howard Gardner, a well-known educator and developmental psychologist, will appear on campus in January. Gardner, who holds the John H. and Elisabeth A. Hobbs Professorship in Cognition and Education at Harvard, developed the theory of multiple intelligences in the 1980s. He has received many honors and awards, including a MacArthur Fellowship.

Gardner will speak on "Art, Science and Interdisciplinary Thought" on Tuesday, January 28, at 8:00 PM in C.Y. Stephens Auditorium. The CTE is pleased to be a co-sponsor of this important event with the College of Design.

Enhancing Learning in Large Classes

A workshop series on effective practices for teaching large classes will be presented again in the Spring semester.

The workshops, facilitated by CTE Director Corly Brooke, will address such issues as classroom management, syllabus design, active learning strategies, creating community, gathering student feedback, and engaging students more fully in the large classroom.

The workshops will be held from 3-5 PM on five Thursdays: February 6 and 20, March 6 and 27, and April 10 and participants must be willing to attend all five sessions. To register, email cte@iastate.edu or call 294-2906.

Spring Forums Planned

The CTE Faculty Forums will be held on Wednesdays from noon-1:30 PM during the Spring semester. Tentative dates and topics are: February 12 "Teaching with Case Studies"; March 12 "Experiential Learning"; and April 16 "Critical Thinking through Inquiry". Watch for further details.

"Quick Start" Workshop

The CTE will conduct a workshop in January for faculty wishing to get a "quick start" to the semester. Susan Yager, CTE Associate Director, will lead a discussion-oriented session on Robert Boice's suggestions for effective and efficient teaching and research.

Boice, a retired professor of psychology, has published several books describing a set of basic principles for faculty to consider in all aspects of their professional lives.

The workshop, which will provide an overview and discussion of Boice's "first-order principles," will be held from noon-1:30 PM on Wednesday, January 22. To register, email cte@iastate.edu or call 294-2906.

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