ITLAL Special Event  
Friday, November 2, 2007

Tara Gray, Ph.D.  
Author of Publish and Flourish

One of the most sought-after presenters in the US on academic productivity, Dr. Gray is our guest for a day of interactive, hands-on workshops. As a member of Criminal Justice and Director of the New Mexico State University Teaching Academy, she has presented workshops in twenty states, Guatemala, Mexico, Canada, and Thailand.

Workshop #1  
Time Management for Busy Faculty  
10:00 - 11:30 AM  
Assembly Hall  

Lunch  
(Please RSVP)  
11:45 AM - 12:45 PM  
Assembly Hall

Workshop #2:  
Publish and Flourish  
12:45 - 4:45 PM  
Assembly Hall

RSVP is required for these events. Please specify which workshop you will attend, and if you will be joining us for lunch. Feel free to call 1-442-5521 or email at teachingandlearning@albany.edu.

Publish and Flourish (afternoon session) is by reservation only. Participants need to bring writing samples from current projects, and be prepared to engage in peer review and discussion.

Helping Students Learn to Think Conceptually:  
Are we making it happen?

I used to get in front of my students and do all the science for them. I should have been showing them how to do it themselves. If they were studying the piano, I wouldn’t have gone, “sit down, I’ll play the piano for you.” (Eric Mazur)

One recurring challenge we face as professors is how to support beginning students as they struggle toward disciplinary thinking. We often find that students are highly effective at memorizing information, mimicking procedures or applying received concepts algorithmically within a narrow context, but they are unprepared to wrestle with complex conceptual problems in ways that lead to deeper learning.

How do we change the way students respond to conceptual challenges and apply disciplinary knowledge? One way is to address directly the need to distinguish early in the learning process between the key concepts and perspectives needed for effective disciplinary thinking and the huge bulk of information used to explain, illustrate, or support those concepts.

We can take our cue from Eric Mazur, professor of Physics at Harvard. Earlier in his career he was a successful practitioner of the lecture in introductory courses. A good presenter, he received positive evaluations, and his students could solve difficult problems of the kind usually found on tests: narrowly defined, procedural and calculational. But he noticed that these same students, when given open-ended, speculative challenges, were unable to think like scientists. They had trouble working conceptually, posing questions, constructing mental experiments, and imagining solutions in the abstract. He therefore decided that students needed less experience “plugging and chugging” their way through formulas and calculations, and more experience solving messy, less procedural problems that allowed them to muck around with the concepts of the discipline.

Changing the paradigm

When Mazur began to change his thinking about teaching, he had to reconsider how a course functions. Several principles guided the new paradigm, all of them placing more responsibility on the students.

1) Let students be responsible for preparation. In order to free up more class time for conceptual thinking and speculation, students had to cover a considerable amount of content outside of class. Mazur discovered after a short time that his students at all levels were capable of understanding the bulk of the material on their own. He began requiring students to read from the textbook before class and quizzes them regularly to ensure that they were prepared.

2) Test more conceptual understanding, and less linear problem solving. Mazur began designing a series of ConceptTests, asking students to apply basic physics concepts to either real-world or purely hypothetical situations. For example, a question might take this form: if a karate expert strikes a brick with his bare hand and the brick breaks, where and how does the brick come apart? This approach, free of formula and calculation, allows students to explore the various effects of compressive, tensile, and shear stress on materials. Mazur advocates...
combining inquiries for conceptual understanding with traditional problem-solving practice.

3) Have students engage in instruction of their peers. Mazur discovered that students who are just learning a concept can better explain it to other novices than can a real expert. This marks a dramatic shift away from a culture of competition to one of cooperation, requiring students to interact with each other during class.

4) Grade students on their mastery of the course material, not in relation to their peers. As part of his belief in a cooperative rather than a competitive model, Mazur eliminated the curved grade and moved to a grading scheme based on specific criteria.

A learning sequence within the learning paradigm

A class based on this learning paradigm looks dramatically different from a typical lecture, but structurally it is rather simple. Since students are required to read the textbook and lecture notes before class, the class begins with a quiz to ensure that they have completed this assignment. If you are teaching a large class, this quiz can also be administered before class begins, using a course management system such as Blackboard. Another alternative that works in some contexts is to have students respond to a quiz in groups at the beginning of class. The readiness quiz is followed by a short (7-10 minute) lecture and/or demonstration on key points. Then comes a ConcepTest question, which asks students to solve a problem or respond to a situation in the abstract.

Students' answers determine the next step. If fewer than 90% of students don't come close to a reasonable answer, they are asked to discuss their answers with each other and attempt to convince their peers that their answer is correct. After students have completed this discussion, they are asked to answer the same question again. Mazur has found that students who initially answer ConcepTest questions incorrectly frequently change their answers to the correct one after a discussion with their peers. This process takes 5-8 minutes. Sometimes the correct answer is followed by a demonstration. The same process is repeated, with four key points covered in each lecture. Each point requires about 15 minutes.

Variation

A step can be added at any of several points to help students stretch their intellectual understanding in this process. Students may do a better job of processing readings or lectures if they have been presented with a ConcepTest question as a speculative exercise as the first step in the study of a unit: for example, in class before a reading is assigned, or just before a lecture on a key concept.

Sources:

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