Teaching Interests, and Interested Teaching

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Before discussing any teaching philosophies, here is a short summary of my experience. I was a teaching assistant for 11 quarters at the University of California, Davis (UC Davis) and designed and taught an entirely new course for the UC system. While a graduate student, I taught the lecture and lab sections for one summer at San Francisco State University (SFSU) and was asked to return the following summer (my own research precluded the time commitment required). I was nominated and reached finalist status for the UC Davis Outstanding Graduate Student Teaching Award (2001). I led supervision (explained below) at the University of Cambridge. Recently at the University of Maryland, I have taught in both the Physics and Astronomy deparments and was given the chance to direct a living-and-learning honors program.

The truest way to measure a professor's success at teaching has to be reflected in the way non-major students succeed in courses. For physics and astronomy, this can be seen not just by the students' learning outcomes (exams, etc.), but also in the degree to which they are no longer nervous or overawed about these so-called hard sciences. My approaches to achieve these goals are partly a result of my own experiences as a student. My undergraduate physics education was a product of the old "Passive Learning Model". The students arrived to the lecture hall as "empty vessels" waiting to be filled with information from the lecturer's mouth and blackboard. I recall how puzzled I was that only a very few of us sailed along with little difficulty to good grades, while others struggled and gradually dropped out of physics altogether. I was further confused when, in my Junior year, my own grades began to slip and I realized how little information I had retained.

When I was taught as a graduate student TA at the UC Davis how to teach in an active learning classroom, my past experience began to make sense. The "Active Learning Model" goes well beyond the lecture-homework-exam style by directly engaging the students in the learning process, encouraging them to individually create models via dialogue with TAs and peers and hands-on testing of ideas. Physics education research has shown that active learning produces a marked improvement in comprehension and retention, *e.g.*, in pre-medical and biology majors who are required to take physics (specifically, a marked improvement in the physics MCAT scores; the MCAT is often taken well after the physics classes).

At SFSU, I found that a major stumbling block for students was the apparent disconnect between the lectures and the way the labs progressed. In the labs, emphasis was placed on error analysis and writeup procedure[1]. Good laboratory methods are important and can be taught at any time, but the first hurdle for physics students (majors or otherwise) is usually comprehension of the basic principles which defy intuition so easily. Adopting methods used at UC Davis, I had students work in groups of three or four using equipment to argue over and answer questions which I set. The more tedious aspects of the lab were downplayed, though data was taken, error analysis was discussed, and individuals' contributions were monitored to establish a grade. Still, they focused on using labs to connect the equations from lecture with a physical model in their own minds. While this class was too small a

[1]Naturally, I am unaware of any subsequent changes in those laboratory sections. My experience with SFSU dates from the Summer of 1999.

sample to test this approach in an unbiased way, most students reacted positively.

Noting the success of the active learning model, I applied the same ideas to a new course for non-physics majors in Cosmology at UC Davis. Working with the lecturer (who would lecture two hours a week to introduce topics and simple equations), I designed, wrote, and taught ten two-hour discussion sections which pressured students to challenge their understanding of the material using word problems and experiments, rather than encouraging rote memorization. Physics majors were prohibited from taking the course (for fear of "curve-breaking"), yet two physics majors audited the class and two other students switched their majors to physics after taking it. I was subsequently drafted to assist in analyzing, testing and editing new laboratory and discussion section manuals for the Honors introductory Physics sequence.

While at the University of Cambridge, I took the opportunity to "supervise" Applied Mathematics (Theoretical Physics) students. That experience was an example of how "new" pedagogical methods are often simply rediscovered ones. Cambridge does not require attendance at lectures, but does require weekly "supervision" for a handful of students to discuss problem sets with faculty in an intimate, intense session. While this particular model is unfeasible for most universities due to cost considerations, it was nonetheless an acknowledgement that learning and comprehension is ultimately self-directed.

Now at Maryland, I lecture courses of 50 to 150 students for the Physics and Astronomy departments. Most of Maryland's large lecture halls include response technology (i.e., "clickers"), and I have readily adopted them to engage the students during lecture. In addition to "think, pair and share" sessions during lecture to encourage peer-teaching and review, they are also polled periodically in every lecture to anonymously answer questions which challenge them to apply what they have just heard. This has allowed me to make formative assessments of their progress without increasing the number of tests or exams to a burdensome level for either the students or myself.

Last year, in recognition of my teaching ability and interests, Maryland appointed me co-director for a living and learning program, "Science, Discovery and the Universe." One of twelve "College Park Scholars" programs, SDU is comprised of 120 freshmen and sophomores of exceptional academic and leadership skills, who have a strong interest in science. My duties include:

- organizing and leading colloquia on pseudoscience to illustrate what science actually is;
- administrating co-curricular activities (*e.g.*, trips to museums) relevant to our program;
- numerous office hours in their residence hall to encourage critical thinking and discussion;
- assisting students in securing internships, mentorships or service-learning projects required for their sophomore year "capstone."

In May 2008, I attended the Wakonse Teaching Conference, held in Michigan (sponsored by the University of Missouri). It was a thrill to share teaching strategies with professors from many Universities, and, frankly, it was reassuring that not all "Research One" universities discount undergraduate education. I still receive emails from past students remarking how they now see physics in every-day experiences even though some of them are not even science majors. For instance, an ex-student of mine emailed to tell me that she noticed interference patterns in the waves caused by dangling her legs at the edge of a swimming pool. How does one explain to a non-teacher the thrill that email caused, especially when it arrived over a year after the student was in my class? It is all too easy for me to be committed to the value of good teaching because I find the rewards so fulfilling.

For teaching references, please contact Prof. Wendell Potter, Prof. Andreas Albrecht and Dr. Randall Harris of UC Davis; Prof. Susan Lea (current Chair) and Emeritus Prof. Robert Rogers of San Francisco State University; and Dr. John Trasco and Dr. Greig Stewart at the University of Maryland.