

## Adventures in Educational Technology

Let's call it the Darwinian theory of education. The case can be made that the conventional form of instruction – a professor lecturing to a classroom of students, supplemented with office hours for individual mentoring – has evolved over the centuries as the most efficient method of teaching. One-on-one tutoring may be the best pedagogically, but is not cost effective for a large class. Individual students all studying on their own is cheap but not very effective educationally. Given the constraints found at universities the standard practice of lecturing plus office hours plus individual homework and study is a compromise which has evolved as the best way to teach a large class. .

However Darwin would predict yet further change in response to new environmental influences, such as those caused by the rapid introduction of new technology. It is clear that technology is already causing teaching methods to evolve. In fact, technology is developing fast enough that we continue to change yearly. This article looks at some of the recent experiments within the Department.

Led by the early work of our Physics Education Research Group; many members in the Department were early adopters of the personal response devices, “clickers”, which allow each individual student in the class to immediately respond to problems posed by the instructor. The increased student involvement makes the lecture setting less one-sided. Online homework services allow the students to get instant feedback on their work and have eliminated the need for hand grading. Powerpoint (or equivalent presentation software) has become the University-wide standard for large undergraduate lecture classes. However, the static nature of Powerpoint presentations is a severe drawback in the physics classroom. To circumvent this drawback, there has been increasing use of tablet computers, which allow a user to write on the tablet screen during a presentation. This technology allows derivations and practice problems to be worked out and questions to be responded to during a Powerpoint presentation. This leads to more dynamic interactions in the class between the instructor and the students. In the Physics Department, this development has been led primarily by Prof. **Heath Hatch**, and has caught on with many other faculty members.

Lately Heath Hatch has pioneered the practice of recording classroom lectures as videos for student use. This results in a product combining the tablet screen (used as the “blackboard”) with the instructor's voice in a way that can be indexed and placed on the course web page. The videos allow students to return to the lectures and review individual segments on a given topic. Checks on web page usage show that the students do take advantage of this method of study and other faculty members are starting to adopt the practice. Initially some fear existed that a lecture with video would decrease student attendance, but it has not turned out to be so.



Fig. 1 Professor Heath Hatch using a Tablet PC in a class.

Pursuing these ideas further, Prof. Hatch has also used new technology to take a new step in distance education. He has taught our gen-ed course “Weather and our Atmosphere” both in the regular curriculum and through the University Without Walls (UWW). UWW is a part of UMass Amherst which deals with non-traditional students, usually not resident in campus. At UWW he took the recorded lectures from a previously offered regular class, broke them into 5-15 minute units on individual topics and constructed the distance education course around them. The pattern of preview, recorded lecture, review and problem assignments proved to be effective. The recorded classroom segments gave the feel of a regular classroom to the distance learning format. Prof. Gary Bernhard of UWW says “The course was a resounding success.” Moreover, Prof. Bernhard continues, “Early in the fall 2008 semester, Heath came to a UWW faculty meeting to talk with us about his course and what he had learned from working with adult students. He inspired us to experiment with Camtasia and other screencasting software set up online courses...Heath is regarded throughout the University as the UMass screencasting and tablet PC guru”

At the other end of the spectrum, Prof. **John Donoghue** is also using a tablet in distance education at the graduate level. In the Fall of 2007, he taught an advanced grad course on the Standard Model of particle physics to a classroom of 8 students at UMass, 3 at the University of New Hampshire and one UMass student who was doing research at Duke. This was part of a deal with UNH in which one of their professors taught Quantum Field Theory to UMass students, freeing up the faculty resources to teach the Standard Model course at a time when we would not have been able to offer it. Here the tablet was combined with a conferencing program that allowed all parties to see each other at all times, to hear and speak to each other and to see the tablet screen projected as a blackboard. The tablet was written on just as a blackboard would be (no fancy Powerpoint presentations in graduate courses!). Questions were asked and answered in normal fashion. All accounts of the students involved indicate that this ended up feeling

pretty similar to a normal classroom with very little change in the classroom routine. This is then a novel way to offer courses that otherwise might not be given.



Prof. Donoghue is also using the recording technology in the graduate curriculum, providing a recorded version of Quantum Field Theory, presently being offered as a two semester sequence in the spring and fall of 2009. Here the motivation is different, with the focus being on archiving the course for future uses. The department has offered QFT as a one-semester course every other year. Many other graduate programs offer it as a two-semester sequence, often every year. Since theory students need QFT in order to start research, ones that are otherwise ready to start research at a time when it is not being offered are at a disadvantage. The archived course, combined with faculty guidance, could allow the students to learn enough to start their research projects. Moreover, if we return to a one-semester offering, the archive of the two-semester course could provide enrichment units to supplement the course.

It is clear that technology should not be adopted just for its novelty. However, as one thinks of the full experience of teaching and learning, there are often interesting ways to improve learning through the use of technology. Some paths will prove to be evolutionary dead-ends. However, others will prove to be effective additions to our teaching tools. It will be interesting to follow the course of these and future technology experiments in enhancing learning.