# Enhancing faculty-student interactions in large enrollment science classes using inking, wireless and capture technology

## Strategic Initiative Grant

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Campus: Amherst

Disciplines: Biochemistry & Molecular Biology Dept., Office of Information Technology

Total amount of funds requested: $12,100 (Amherst Campus)

The goal of the initiative is to enhance student participation and instructional effectiveness in large-enrollment science classes. We propose to support faculty in their use of inking, wireless, and capture technology in the classroom to promote student-centered instruction and active learning. We will form a working group of early adopters, with four junior B&MB faculty working together with a panel of experts (a B&MB faculty mentor with experience in using instructional technology, OIT Academic computing staff, and a senior undergraduate student). In the summer, we will provide faculty with the technology and pedagogical insights from pioneers that have used the technology on campus, followed by a workshop that will give instructors practice in using the tools and provides feedback. During the academic year, teaching and learning outcomes in courses taught by participants will be followed by Midterm Assessments through the Center of Teaching and exchange of instructor's insights in regular meetings of the working group. The B&MB curriculum will benefit in several ways from this departmental initiative. 1) Junior faculty will be exposed to the teaching support infrastructure and good teaching practices early in their teaching careers 2) the junior faculty will apply their fresh perspective to an established curriculum, thereby invigorating it, and 3) the proposed technologies will improve learning outcomes in class and flexibility in course preparation. Best practices developed through the initiative will be communicated to other departments via the web and through presentations to improve large-enrollment science classes across the University.

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| Signature of Investigator's Department Chair: | Danny Schnell | ______________________ |
| Signature of Investigator's Dean: | Gordon Wyse<br>Associate Dean for Academic Affairs | ______________________ |
| Signature of Provost, Amherst Campus: | Richard Rogers<br>Faculty Advisor to the Provost | ______________________ |

## 1. PROJECT NARRATIVE

### Goal and Objectives

The goal of this initiative is to enhance faculty-student interactions in large enrollment science classes. We propose to use inking, wireless, and capture technology to create interactions in large classes that mimic faculty-student interactions encountered in small classes.
Our objectives are:

Learning outcomes

- Increase student's awareness of current questions in the discipline
- Increase student's quantitative skills by practicing more in class
- Train students in class to use web-based research tools

Teaching outcomes

- Incorporate more student input into the flow of lessons
- Capture the entire lecture for later study and assessment
- Increase efficiency in preparing up-to-date material

Choice and use of technology

- Leverage existing instructional technology and classroom infrastructure
- Provide tools that require minimal setup and are easy to use
- Develop best practices to focus on students, not technology

### Background and Need

In large enrollment classes, teaching can become impersonal, and student-teacher interactions can be compromised unless we adopt a teaching style that is effective in this setting. In small classes, instructors can easily address the needs and questions of individual students. However, many introductory science classes have 100-500 students (with an upward trend), and our upper-level core course have 50-100 students as well. The typical format of these classes is to show a presentation prepared in advance. These presentations might include biological images at high resolution, screen shots from web servers, and "canned" derivations of key quantitative relationships. Because the lecture is delivered electronically, it is easy to show complex images or data, and disseminate them before or after class on a class website. On the other hand, this format precludes the incorporation of student contributions. In a small group setting, one would pass around material, switch to the chalkboard to provide examples and explanations, or ask a student to demonstrate how to solve a quantitative problem. In the large class, however, these strategies are not possible or less efficient. There clearly is a need for a more flexible integrated approach that enhances student-teacher interactions in large classes.

The University of Massachusetts has a strong history of developing instructional technology (Online Web Learning, or OWL, is the prime example). It is also an early adapter of commercial teaching technology, enabling in-class polling of students (Personal Response System, PRS) and fostering student-teacher interactions outside of class through the internet (WebCT /SPARK). These tools are tightly integrated (PRS "talks to" OWL, SPARK "talks to" Spire). Lecture halls are technology-ready, with wireless access and projection hardware, and the Amherst campus has recently opened the Learning Commons, giving students around the clock access to computing resources. Individual instructors have used the available technology with great success, and pioneers have added these tools to their classes, learning from workshops and publications or training themselves by trial and error. B&MB has several such faculty members, and a cadre of 4 junior faculty who are eager to build on this technology-friendly environment. The initial participants are junior faculty who are in the process of developing their teaching skills and are enthusiastic about adopting instructional technologies into their courses. Also participating is a faculty member who has experience in incorporating instructional technology into courses, who will serve as a teaching mentor. We will avail ourselves of the expertise and support from both the Center for Teaching and Academic Computing. In consultation with Richard Rogers, a pioneer in using tablet and capturing technology in large classes on the Amherst campus, we have assembled a package of hardware and software that is "road tested" in supporting student-teacher interactions without distraction by technology.

**Improving the learning experience in large enrollment classes**

How can we give our students in large classes the kind of experience they would have in a small class setting? One proven method of engaging students in class, avoiding a passive and impersonal experience, is to work through relevant examples in class (e.g. analyzing experimental data, solving quantitative problems, etc). This fosters active learning and collaboration between students in class. Our department has substantial experience using PRS for asking questions and polling students for answers. After presenting a concept, we can pose questions, have students discuss strategies to answer them, and poll students on their mastery of the material. After students have entered their answer and seen the results of the poll, there is a ***window of opportunity for an engaged discussion*** about how to solve the problem and about the concepts used in tackling the question.

Neither the chalkboard nor the electronically projected presentation are particularly suitable for fostering these interactions. Students would like to see data relevant to a topic brought up in discussion right away, not after class or next week. Instructors would like to switch to the chalkboard to "jump out" of prepared lectures, summarize arguments given by individual students, and to address points that come up during the discussion. Because material on the chalkboard is difficult to read, is not recorded, and is not made available on the web site, opportunities for learning are lost. Discussion of problems solved on the chalkboard is not as rich as it should be, and afterwards instructors have no choice but to return to the "canned" lecture material. Preparing material on the computer in real time is also not practical with the tools we currently bring to class. In this proposal, we propose to use inking, wireless, and capture technology to allow instant creation of teaching material in response to student input.

**Instructional technology**

We propose to provide instructors with three types of technology.

*Inking:* Acting as an electronically enhanced chalkboard, inking allows writing on the projected slides with a stylus. Input is either directly at the computer connected to the projector, or on a mobile pad communicating with the computer via Bluetooth wireless protocols. The wireless pad allows instructors to hand the pad to an individual student, who then can share an idea with the entire class. (Ideally, the students would have tablets for inking, but this is outside the scope of our proposal since our focus is on large enrollment courses.) Inking enables annotation of prepared slides in response to student questions; summarizing student contributions in real time for later online access; showing quantitative relationships by drawing curves into pre-existing templates, and presenting mathematical derivations step-by-step in class. The content is free-form and overcomes the cumbersome keyboard/mouse entry of mathematical and chemical symbols, graphs, sketches, and cartoons into presentation software. Creative uses beyond those listed here will certainly emerge during the semester.

*Wireless networking:* This technology allows access to internet resources in class without precious time lost to setup. The connectivity enables interactive demonstration of research databases and visualization software, presentation of student contributions previously posted to the course web site, and presentation of current publications or news relevant to the course. In combination with the inking technology, the interactive web sites (such as bioinformatics servers) can be annotated to highlight the key inputs and outputs, so instructors can explain web-based research tools and databases in real time.

*Capturing:* Capture technology allows all information from a class (including both projected images and spoken words) to be archived. This enables students to review lessons after class. The synergy with inking and wireless technology is strong: without capturing, much of the material presented and developed in class would not be available for later review. Capture technology allows students to participate actively and jot down their ideas and questions during class without worrying about missing some information they cannot later retrieve. Capturing also helps to accumulate a portfolio of course material on the web site, available to the instructor as well as easy to share and discuss with fellow teachers. In conjunction with web access, instructors can demonstrate a sample task using a bioinformatics server in class, capture and post the demonstration, and ask students to perform a similar task on their own outside of class.

**Methodology**

Our approach is to form a group of early adopters within in our department, who will obtain the tools and training to enhance large-enrollment science classes, and then explore the instructional technology together. This group will apply the technology for courses taught in fall 2007, and will continue to meet during the academic year to share lessons learned, to assess learning outcomes, and to assemble a set of best practices that will be disseminated to faculty teaching similar courses. Because the technology is already robust, we will focus our efforts during the academic year on pedagogy rather than technology. The following outlines our approach.

*Provide technology and expertise.* Early in the summer, we will provide identical packages of hardware and installed software to each instructor. With the help of OIT staff Fred Zinn, the P.I. Theis will install the software, familiarize himself with the capabilities of the package, and demonstrate them to the group. Because participants come with a certain level of expertise (e.g., Heuck has used a Tablet PC in class, Garman has used an input pad, Normanly has used podcasting and WebCT), sharing technological tips and tricks among the group will start at this stage. In addition, we will ask local campus pioneers of the technology to give short presentations of their pedagogical insights. Presentations, demos and ideas will be collected on a web site. This web site will function as a repository for the participants and, after completion of the initiative, will form the basis for the final report and material for dissemination.

*Practice and feedback during the summer.* To practice use of the technology, every faculty participant will choose a previously given lesson that she/he feels could be more effective using inking/wireless technology. The instructor will rewrite this lesson, and teach it to all participants - plus a senior biochemistry student who has taken these classes previously - in a mock class during a one-day workshop in August. This initial investment of time to learn how to use the technology effectively during the summer will eventually be offset by time saved when preparing future lectures with the technology. The mock classes will be captured for later review and discussion and posted on our web site.

*Monthly meetings during the fall semester.* We will meet regularly while teaching to share lessons learned and establish best practices. Each month, we will focus on one topic, such as in class problem solving, science in the news, or integration of in class and web site interactions. We will collect tips and tricks on our website. Outside of our monthly meetings, participants will have the ability to post notes on a discussion forum on the website, maintained by an undergraduate assistant. Because all faculty participants are in the same department and work in the same building, sharing information and ideas in person will be facile as well.

*Assessment by students.* We will have midterm assessments conducted by the Center of Teaching for the three classes (Chem112, Bio285, Biochem523) taught in fall 2007. Questions will focus on our objectives concerning learning outcomes stated above, but will also poll how comfortable students are with the instructional technology that was introduced.

*Self-assessment and review.* We will prepare a questionnaire for faculty, asking about the effectiveness of the instructional technology towards our objectives. This will give us a record summarizing lessons learned in specific classes during the semester. We will review the individual assessments, and collect them into a set of best practices that emerged from the initiative.

*Report to Spring instructors.* During the 2007/2008 intersession, the group of early adopters will gather with other instructors from Chemistry, B&MB, and Biology who are teaching large enrollment courses in the spring of 2008. This will enable the lessons learned from the fall 2007 term to be propagated to the spring 2008 term.

## 2. DELIVERABLES AND DISSEMINATION

While there are a handful of examples of individual instructors using similar technologies on campus (*e.g.* Tilman Wolf, Engineering; Richard Rogers, Research Economics; Heath Hatch, Physics), this proposal is a strategic initiative for an entire department, making use of synergies and ideas emerging from exploring a new set of tools together. After completion of the summer workshop and the fall discussions, course material and feedback for courses taught using the capabilities of a tablet PC will be available on a public web site. The department will coordinate further use of the tablet PCs, which will contain software and course material ready for adoption of the technology by other faculty teaching similar courses. To distribute information on the technology more broadly, lessons learned during the initiative will be summarized in the interim and final report, with supporting material available on the web site. With completion of the strategic initiative, the department is in an excellent position to expand the technology throughout its curriculum, and to apply for external funding to purchase the additional hardware needed to equip all interested faculty with the technology. Our experience would function as a model for other departments, who could profit from best practices developed in this initiative. To alert faculty in other disciplines and other campuses about the project, model class sessions will be posted on the web. Furthermore, best practices developed through the initiative will be presented at the Spring 2008 symposium.

## 3. BUDGET

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| Technology: | | |
| 4 Tablet PCs | $6,600 | (Gateway M285-E or similar) |
| 4 Interwrite Schoolpads | $1,988 | (wireless pad for inking anywhere in class) |
| 4 Camtasia licenses: | $716 | (real-time audio and video capturing) |
| 4 Microsoft Office licenses: | $240 | (preparation and presentation of course material) |
| 4 Adobe Acrobat licenses: | $360 | (preparation of web postings, grading keys etc) |
| 4 Carrying cases: | $196 | (transport of equipment across campus) |
| Salary: | | |
| P.I. summer salary contrib. | $1,000 | (Preparing the teaching lab workshop) |
| Undergraduate assistant | $1,000 | (Compensation for work on web site) |
| | $12,100 | |

The four technology packages will enable faculty to teach using essentially all the tools available in a state-of-the-art wired classroom, but without the need to install additional hardware above the standard infrastructure already available. This package is designed to be flexible and extensible.

The undergraduate assistant will facilitate discussion forums on the web, and provide a student's perspective during the summer workshop. The effort will be 5 hours per week during the fall semester, plus 30 hours to build the web sites before the beginning of the semester. The P.I.'s summer salary contribution will compensate the work necessary to get the four technology packages ready for each instructor, the effort in organizing and running the summer workshop and the mock lectures, preparing written information to be disseminated via the initiative's web site, and setting up self-assessment questionnaires and student assessment tools to be used in all classes taught in fall.

## 4. TIMELINE

The following are the key milestones of the project:

07/01/2007: Tablet PCs with software installed available to instructors
09/01/2007: Feedback from August workshop disseminated to all participants
12/15/2007: Interim report (to include data from midterm assessments and instructor feedback)
01/15/2008: Workshop to disseminate best practices to Spring instructors
04/01/2008: Conference presentation ready (incl. initial feedback from Spring courses)
07/01/2008: Final report

## 5. PARTICIPANTS

**Karsten Theis, P.I.**: Has introduced PRS into Biochemistry core course (Biochem 523) together with Prof. Normanly and has taught the course three consecutive years. Is familiar with the midterm assessment program. Has more than 20 years experience in using computer technology, including system administration and web page development. Will teach Biochem 523 in the Fall 07.

**Jennifer Normanly**: Pioneer in adopting instructional technology for the B&MB department, including OWL, PRS, and most recently, audio podcasts (for Biochem 285). More than a decade of teaching experience at UMass Amherst. Will teach Biochem 285 in the Spring 08.

**Fred Zinn**: Senior Designer, Instructional Technology, OIT Academic Computing, University of Massachusetts Amherst. Has experience in teaching with a wireless pad, tablet PC and wireless mouse. Is part of the support staff helping instructors to use technology in the classroom.

**Scott Garman**: Taught 3 sections of Chem112 (enrollment: 101, 108 and 181 students) with extensive use of OWL, PRS, and web site technologies. Currently teaching Biochem/Chem 597a incorporating the use of a small USB plug-in inking tablet. Will teach Chem112 again in the Fall 07.

**Alejandro Heuck**: Taught Chem112 (enrollment: 181) using OWL and PRS. Has used inking technology in class. Will teach Chem112 in Fall 07.

**Dan Chase**: Has teaching experience from past position at Yale and has taught in BiochemH01. Will teach Biochem 285 in the Fall 07.

**6. LETTERS OF SUPPORT** appended to this document.