Contrasting Styles of Distance Education at the Graduate and Undergraduate Levels

We present lessons learned and pedagogical strategies developed while teaching and designing two very different web-based distance learning courses.

One course is designed to prepare highly motivated graduate students to use modern computational research tools. The other course presents a standard one-semester astronomy course to first year college students.

In many ways, the courses have educational goals at opposite ends of Bloom's hierarchy of learning – the undergraduates are being introduced the objects and processes in a new field while the graduate students are continuing study within their field of expertise.

Because of the different motivations, maturity, and desired educational outcomes for the two groups, the pedagogical approaches to these courses are different.

In the graduate course, material is presented as an electronic textbook with examples and independent exercises. Feedback for these exercises is automatic, since students can immediately see the outcome of their efforts by the response of the computer. The course relies explicitly on the independence and background of the students taking the course.

In the undergraduate course, the on-line materials are designed to augment a textbook, and in some classes, a lecture. A great deal of emphasis in this course design was place in providing immediate feedback through an automated quizzing system.

Both courses accomplish their educational objectives. Students in the graduate course learn the computer skills taught, and students in the undergraduate course improve their performance on in-class multiple choice exams. We feel this case study illustrates how diverse classes and student populations can be enhanced with web-based tools, if the technological elements used in the course are tied to pedagogical goals and the characteristics of the students.
Contrasting Styles of Distance Education at the Graduate and Undergraduate Levels

Stanley M. Zoltek
George Mason University
School of Computational Sciences
Department of Mathematics

John F. Wallin
George Mason University
School of Computational Sciences
Department of Physics and Astronomy
Traditional Classroom

- Teacher
- Lectures, exam results
- Student
- Exams

Web-Enhanced Classroom

- Teacher
- Lectures, exam results
- Student

Interactive website
- Immediate feedback
- On-line quizzes
- Exams
Abstract

We present lessons learned and pedagogical strategies developed while teaching and designing two very different web-based courses. One course presents a first year undergraduate curriculum in astronomy, and the other prepares graduate students to use computational research tools in a multi-user environment.
The Graduate Course
Computational Tools I

UNIX (Computer operating system)
- Managing files and directories
- Searching using regular expressions
- Moving, backing up files using the tar command

Emacs (Programmer's text editor)
- Search/replace using regular expressions
- Version control

LaTeX (Scientific Word Processing)
- Formatting text,
- Creating tables
- Typesetting formulas

Web Publishing: HTML, Simple scripting
The Graduate Course
Student Demographics
(Course sections offered each semester since 1997)

- English is a 2nd language: 30%-55%
- Non US citizen: 30%-55%
- Percentage female: 40%-60%
- Possess undergraduate degree: 100%
- Undergraduate Degrees
  - Biology
  - Mathematics
  - Physics
  - Engineering
  - Economics
  - Geography
  - French
The Graduate Course
Pedagogy and Goals

- Small class size: 22 or less
- Instruction delivered on-line in form of a web-based, self-paced, “electronic textbook”
- For each new concept taught, students work through one, or at most two, examples with provided solutions
- Assigned Projects require synthesis of concepts covered in the “electronic textbook” (No exams or quizzes)
- Support provided via email, on-line chat, office hours and telephone
- On-line, self-paced instruction and support allows students with widely differing backgrounds to attain similar levels of subject mastery
The Graduate Course Outcomes

- 95% of the students completed the course with a grade of B or better (C is a failing grade for this course)
- 90% of the students successfully completed the next course in the sequence

Comments on student/course evaluation forms and informal feedback include:
- Course being self-paced gave me the edge to compete with the more technically prepared student
- Basing the course grade on quality of completed projects made me synthesize and expand on what was covered in the on-line “textbook”
The Undergraduate Course

*Introduction to Astronomy*

**Stellar evolution**
- formation, life cycle, and death of stars
- supernova, nova, black holes

**Structure of Galaxies**
- galaxy formation and evolution
- active galaxies, quasars
- Cosmology
- formation, evolution, and end of the universe

Formal evaluation is completed using in-class multiple choice exams. Laboratory sections support the lecture material.

Large lecture courses are probably the worst format for learning, but are the economic basis of the modern university.
The Undergraduate Course
Student Demographics
(Course sections offered each semester since 1997)

- Class size: 250-320 students
- Percentage female: 40%-60%
- Possess undergraduate degree: 0%
- First year students: 40-60%
- Undergraduate Majors--90% are nonscience/nontechnical
The Undergraduate Course
Pedagogy and Goals

- Extremely large class size: 300+
- Instruction delivered with in-class lectures and on-line
- Emphasis of on-line system is to provide students with immediate feedback and remediation of misconceptions
- Each week students took a 20-35 question extra credit electronic quiz with automatic retesting of incorrect answers. To received credit, students needed to answer all questions correctly with infinite retries.
- Support provided via email, office hours and telephone
The Undergraduate Course Outcomes

- 70% of the students took the extra credit quizzes regularly
- 90% of the students used the quiz system at least once
- no correlation was found between student demographics and usage
- in-class test performance was correlated more strongly with use of the quiz system than with attendance in the lecture
- course evaluations and informal feedback strongly support a hybrid web/lecture approach works more effectively than lecture alone