Blended Learning in a Large Introductory Physics Class

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Introduction

We transformed Physics 207, 'General Physics,' into a 'blended' classroom in the 2012-2013 school year. Other institutions have found significant learning gains in courses with increased student engagement in lectures [1]. We assess the impact of this style on student learning at UW.

The course:
•1st semester of a 2-sem intro to physics, w/ calculus, 5 credits
•req'd for many science majors: AOS, Genetics, Zoology, etc.
•250 students in the fall, 130 students in the spring

Learning goals:
•develop critical thinking & problem solving skills
•learn basic physical principles
•make quantitative measurements & understand uncertainties

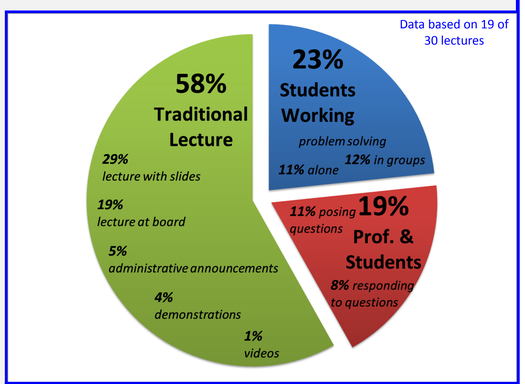
Assessment:
•Force Concept Inventory (FCI) pre/post test of concepts
•Colorado Learning Attitudes about Science Survey (CLASS)
•End-of-semester course evaluation & survey

Blended Course Set-up

Traditionally, P207 includes two 50-minute lectures from the professor per week, two 50-minute discussion sections led by a TA, and one 3-hr lab. Readings and problems come from a traditional, encyclopedic physics textbook, and homework exercises are done online.

With the blended format, students complete an online pre-lecture (~20 minutes) and reading quiz before each class. Lecture hours are a mix of teaching on the board and clicker questions/peer instruction. During lecture, students solve problems alone and in groups, with help from TAs and the professor. The large textbook is replaced by a shorter booklet that matches the online pre-lectures.

Figure 1: Use of class time in the blended-format lecture periods. On average, 42% of class-time is spent with the students actively engaged with the material or the professor.



On average, 3.8 students contributions and 3.0 student questions per lecture

Student Use of Technology

Nearly every click a student makes using the course technology is recorded. This includes time spent watching online pre-lectures, answers to in-class clicker questions, and performance on online homework. We use this data to evaluate how students use each course component.

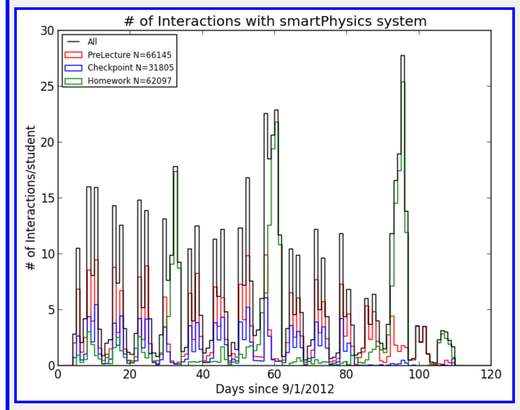


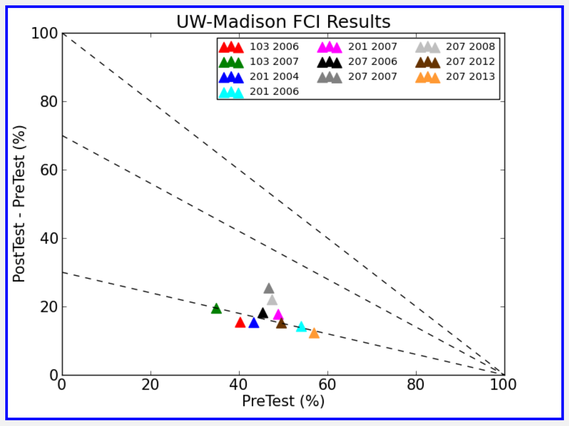
Figure 2: Student interactions with the online system over the semester. They complete pre-lectures and quizzes 2x/week. Optional homework questions were most used before exams. 150,000 interactions were collected over the semester.

Assessing Learning Gains

We assess student learning using standardized tests and surveys (FCI, CLASS). These are given at the beginning and the end of the semester, and the change in performance is compared to other classes.

The FCI is a mechanics concept test. The average FCI score showed a 30% increase over the semester for the fall 2012 class. This is consistent with learning gains measured by similar, traditional format physics courses at UW.

Figure 3



The CLASS survey measures "expert-like" thinking by measuring attitudes about physics and comparing students' responses to responses from professional physicists. Students in the P207 (Fall '12) showed a 6% shift away from expert-like responses over the semester. This is consistent with results from traditional lecture classes at other universities.

Student Opinions on Course

68% agreed or strongly agreed that the online pre-lectures helped them to learn.

"I loved the online lectures. I could go at my own pace and take notes the way that works best for me."

59% agreed or strongly agreed that the in-class clicker questions helped them to learn.

"kept me on track" *"made me think"*

77% agreed or strongly agreed that group problem solving in discussion helped them to learn

Discussion section rated as most helpful aspect of the course (8.46/10)

"Explaining things to others is a good way of solidifying that learning."

"I liked working together because everyone had different ideas how to solve the problems"

However only…

43% were glad there was time for problem solving in lecture

"it felt like a lot… was skimmed over"

Lecture rated as least helpful aspect of the course

31% agreed or strongly agreed that they would choose to enroll in another physics course taught in this format

Outlook

After introducing a blended classroom format to P207, we have found mixed results. Students generally use the online materials, but as measured by the FCI, we do not see increased learning gains compared to more traditional classes. Student opinions on the new teaching techniques are mixed.

Future Goals
-Incorporate TAs more in lecture
-Encourage more student participation
-Analyze online data for correlations between use and performance
-Continue analysis of qualitative and quantitative questionnaire data
-Explore other assessment techniques focused on problem solving skills
-In light of results, continue to improve course for Fall 2013

References
[1] Chen, Z., Stelzer, T., Gladding, G. (2010). "Using multimedia modules to better prepare students for introductory physics lectures" Physics Review Special Topics – Physics Education Research, 6, 010108.