USING AN AUDIENCE RESPONSE SYSTEM (A.K.A. ELECTRONIC CLICKERS) TO IMPROVE STUDENT LEARNING EXPERIENCES IN LARGE FINANCE AND STATISTICS CLASSES

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ABSTRACT

Core finance and statistics courses in many research universities are taught in a mega-section format of several hundred students. Reasons for such a format include: very high student to faculty ratios, rapid business school growth without commensurate increases in faculty lines, and reduced teaching loads for faculty to conduct research. At the same time, there is a need to improve teaching quality and student learning/performance (and satisfaction). We examine whether the use of an electronic classroom response system using "clickers" improves student learning. We find that attendance in mega-section basic finance and introductory business statistics courses increases and average exam score performance improves in the basic finance course.

BACKGROUND

Educators across disciplines have had a continued interest in improving student engagement and learning. Light [5], based on interviews of 1,600 undergraduate students at Harvard University, concluded that undergraduate students "don't want to be admitted and then just be left alone." Hake [3] using pre/post in an introductory physics course found that an interactive teaching style was superior to a lecture teaching style in terms of student performance. Handelsman, Briggs, Sullivan, and Towler [4] conducted an analysis of student responses to a 27 question questionnaire designed to measure student engagement in the classroom. Four factors were identified: skills engagement; emotional engagement; participation/interaction engagement; and performance engagement. The "bottom line" seems to be that students want to be "engaged." That is, they want to be involved in the classroom as well as outside the classroom where a large portion of academic learning apparently takes place. With this said, how do we "engage" students during class in a 400-seat classroom?

In a traditional mega-section lecture environment, only a few students pose a question or respond to an instructor's question. Other students often feel as though they are part of the "masses," feel anonymous, and consequently do not contribute to the class discussion. In particular, finance and statistics courses generally have important quantitative components that require extensive hands-on work for students to learn the material. The perceived value of a mega-section course for delivering quantitative material is often viewed as being low by students. Classroom attendance typically is low and performance on quizzes and exams often is on the low side for these mega-section courses. Furthermore, student satisfaction surveys also tend to be lower for mega-section courses relative to much smaller size courses.

CLASSROOM RESPONSE SYSTEMS

One electronic tool, an audience or classroom response system (CRS), seems to have had some success in improving student engagement and learning in hard science (e.g., see: Duncan [2] and Beatty, Gerace, Leonard, and Dufresne [1]) large-course sections involving several hundred students. This paper reports findings on the impact of using of a CRS using "clickers" in mega-section section (approximately 400 students per section) core finance and statistics courses results in improved student "engagement," academic performance, and possibly course satisfaction.

A typical classroom response system allows students to respond to multiple-choice or yes/no questions during class using a small, handheld device called a "clicker." The instructor displays a question and possible answers via an overhead projector or computer screen. The student chooses their response by "clicking" the appropriate button on their clicker. The system software tracks all student responses, stores the responses in a file for grading purposes, and allows the instructor to instantly display a distribution of responses.

Students actively participate in the course by discussing the questions with peers, individually responding to questions, and then receive immediate feedback. Clicker results benefit the whole class (aggregate scores show the overall class understanding) as well as the individual student (who can compare his/her answer against the results for the remainder of the class. The use of clickers keeps students paying attention to classroom content and serve as attendance checks. The use of clickers also can provide feedback to the instructor who can assess the level of class understanding, and if necessary, adjust further discussion to resolve confusion.

METHODOLOGY

This study is based on the analysis of data gathered at a major research university (University of Colorado at Boulder). The first finance course, called Basic Finance, is offered in sections of approximately 400 students each. One mega-section is offered during the fall semester and two mega-sections are offered during the spring semester. The data base consists of data gathered for the academic years 2002-05. We began using electronic clickers in our basic finance course in 2004 and thus have comparative data on student performance before and after the introduction of electronic clickers.

We also offer our Introductory Business Statistics course in a mega-section format. Data have been gathered for the statistics course to see whether the findings for the mega-section basic finance course are supported by the findings for the mega-section introductory statistics course. The following hypotheses are being examined:

Hypothesis 1: Class attendance is higher for the finance and statistics core course sections involving the use of electronic clickers.

To the extent that class attendance is a factor in a student's course grade, attendance should be higher in sections using the clicker. This assumes that any other method of recording class attendance before the use of clickers did not exist or was less effective. A second attendance factor might exist if clicker (quiz) results are factored in a student's course grade.

Hypothesis 2: Student performance scores are higher for the finance and statistics core course sections involving the use of electronic clickers.

We are comparing average exam scores for course sections using clickers to those scores for course sections prior to the use of clickers. Of course, when making such comparisons it is important control for exams covering the same topics and being of consistent difficulty.

Teaching the core finance and statistics course in a mega-section format seems to be the ongoing reality at most major research universities. Given this assumption, it is important to find ways to "engage" students in such a classroom setting. This study explores whether the use of electronic clickers leads to higher student course satisfaction and improved learning experiences.

STUDY RESULTS

Table 1 and Graph 1 show the combined results for two instructors who taught the basic finance course during the 2002-05 time period. Instructor 1 teaches two mega-sections each spring semester. Thus, prior to the use of clickers, he taught two mega-sections in spring, 2002 and spring, 2003. Instructor 2 teaches one basic finance mega-section during the fall semesters. His pre-clicker course was offered in fall, 2003 with his clicker-used course being taught in fall, 2004.

The average exam score increased from 75.3 (1700 exams) to 77.9 (1738 exams) and was statistically different at the .001 level. FCQs returned increased from 45% of those enrolled to 55% for course sections using electronic clickers. Class attendance based on clicker-recorded data averaged 85% compared to an "estimated" pre-clicker attendance in the 50%-60% range. Exam scores in the 80%-100% range increased from 36% of enrolled students prior to the use of clickers to 46% for course sections that used electronic clickers. At the same time, exam scores in the 50%-70% range declined from 29% to 20%. Results are also available separately for each of the finance instructors, as well for the basic statistics course.

SUMMARY

The use of electronic clickers in the basic finance mega-section course resulted in a statistically significant increase in the average exam score. However, the average exam score result for the business statistics course was not as robust for the two mega-sections for which data were available. Class attendance as measured by clicker response rates exceeded 80% compared to an "estimated" 60% class attendance during pre-clicker courses for both the basic finance and business statistics courses. The use of electronic clickers clearly resulted in higher student attendance in both the basic finance and introductory business statistics courses and the average exam grade showed a statistically significant increase in the basic finance mega-section course.

It is possible that the percentage increase in faculty course questionnaire (FCQ) response rates between the pre-clicker and clicker-used time periods might reflect an increase in student "engagement" or "satisfaction." However, such an interpretation is only conjecture at this time. Future research will be directed towards determining whether possible changes in student responses to specific questions on the FCQs reflect changes (improvements) in student engagement and satisfaction between the pre-clicker and clicker-used course sections.

TABLE 1: **BASIC FINANCE COURSE RESULTS COMBINED: BEFORE AND AFTER USE OF CLICKERS**

Clicker Impact on Course Scores

BCOR 2100 Scores
Combined Sections 2002-2005

Scores	2002-2003 Mean	SD		2004-2005 Mean	SD
Exam 1	80.3	11.6		80.0	12.2
Exam 2	76.8	12.3		76.7	12.8
Exam 3	68.8	13.8		77.0	14.4
Ave Exams*	**75.3**	**9.9**		**77.9**	**10.1**
n =	1700			1738	
Distribution	%			%	
90-100	6			10	
80-90	30			36	
70-80	35			34	
60-70	23			16	
50-60	6			4	
Attendance					
FCQs returned	670 in 1700	45%		950 in 1741	55%
Clicker based				1254 in 1476	85%

* T-test of difference of means, p < .001

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