Investigating the Effects of Classroom Voting and Peer Instruction on Teaching and Learning in an Introductory Differential Equations Course

Ron Buckmire
buckmire@oxy.edu
Occidental College
Los Angeles, CA
Outline

- Definitions
  - Classroom Voting
  - Peer Instruction
- Investigational Context
- Research Questions
- Summary of Results
- Preliminary Conclusions
- Future Work
- Questions
Definition of Terms

Classroom Voting

Classroom voting is a pedagogical technique where the instructor poses a multiple-choice question to the class and the students individually vote on their preferred answer, usually after working together in pairs or in small groups. Oftentimes a summary of the distribution of students’ votes can be viewed by the entire class.

Peer Instruction

Peer Instruction is a particular implementation of classroom voting where after the students have indicated their answers to a multiple-choice question they are given an opportunity to discuss their responses with other students in the class and after this “peer instruction” time interval another classroom vote occurs.
Investigational Context

- Introductory *Differential Equations* course at a small liberal arts college in the Western United States (~2000 students).
- Class size: 2008(13), 2009(15), 2010(21), 2013(18)
- Course textbook: *Differential Equations*, 3rd Edition by Blanchard, Devaney & Hall.
- Course material: solution techniques, bifurcation, Laplace transforms, systems of linear ODEs, qualitative analysis
- Taught the class using same text book in Fall 2008, Fall 2009, Fall 2010, Fall 2013 (revised edition)
- Used Interwrite PRS clickers to implement classroom voting and peer instruction in 2009, 2010 and 2013.
- Evaluated student learning outcomes using same final exam
Research Questions

- (RQ1) What is the impact of using classroom voting/peer instruction on student learning outcomes?
- (RQ2) What is the impact of using classroom voting/peer instruction on student satisfaction with the course?
- (RQ3) What is the impact of using classroom voting/peer instruction on instructor satisfaction with the course?
Source Data

- Scores on every question on all final exams for every student
- Distribution of student grades for every time course was taught
- Semester GPA for students in the semester they took the course
- Anonymous student evaluations for every time course was taught
Summary of Results: RQ1

Final Exam Score

2008  2009  2010  2013
Summary of Results: RQ1

Course Grades

<table>
<thead>
<tr>
<th>Year</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>3.1</td>
</tr>
<tr>
<td>2009</td>
<td>3.7</td>
</tr>
<tr>
<td>2010</td>
<td>3.5</td>
</tr>
<tr>
<td>2013</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Summary of Results: RQ1
Average Student GPA versus Course GPA

<table>
<thead>
<tr>
<th>Year</th>
<th>Student GPA</th>
<th>Course GPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>3.1</td>
<td>3.2</td>
</tr>
<tr>
<td>2009</td>
<td>3.3</td>
<td>3.6</td>
</tr>
<tr>
<td>2010</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>2013</td>
<td>3.8</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Summary of Results: RQ2

STUDENT EVALUATION: Overall Course Outcomes

Course Outcomes

- 2008: 5.4
- 2009: 6.2
- 2010: 5.8

Joint Mathematics Meetings in Baltimore, MD (January 15, 2014)
Summary of Results: RQ2

STUDENT EVALUATION: This course improved my basic knowledge and comprehension of the subject (7.0 scale)
Summary of Results: RQ2

STUDENT EVALUATION: This course improved my ability to analyze, synthesize and/or apply information regarding the subject.
Summary of Results: RQ3

What is the impact of using classroom voting/peer instruction (CV/PI) on instructor satisfaction with the course?

• No Data Available To Answer This Question
(Preliminary) Conclusions

- On average, performance on the course content measure (final exam) appears to have increased over time.
- Students who did not experience CV/PI (Fall 2008) did worse on course content measure (final exam) than students who did.
- No apparent correlation between student satisfaction and the use of CV/PI.
- Need a means by which to measure the impact of the implementation of CV/PI on instructor.
Future Work

- What kinds of instrument can be deployed to measure the impact of classroom voting/peer instruction on the instructor?

- What kinds of instrument can be deployed to measure other (more affective) aspects of student outcomes?

- Conduct a statistical analysis of the data to discern correlations between treatment and non-treatment groups.