Teaching Methods Comparison in a Large Introductory Calculus Class

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Motivation


• Can we do this for Calculus?
Setting

• Math 104: Differential Calculus for Business and the Social Sciences
• 1\textsuperscript{st} Term, 1\textsuperscript{st} Year Course
• 95% of students in this course have taken a calculus course prior to university.
• Two sections, 150 and 200 students, good instructors.
The plan

1. Establish two comparable sections.
2. Junior instructor trained in research-based methods takes over for one topic (100-150 minutes of in-class time) in each section.
3. Compare student responses on quizzes, midterm and final exam questions for both topics.
# Experimental Design

**Course weeks**

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**Assessments in common**

| att | D | Q<sub>RR</sub> | M<sub>RR</sub> | Q<sub>LA</sub> | att | FE |
Instructional Methods

Standard week: **Lecture with questions**
• Chalkboard lecture
• Clicker questions
• Whole-class discussions led by instructor

“Intervention week”: **Higher engagement**
• Pre-class assignment
• In class:
  ▪ Structured handout
  ▪ More clicker questions
  ▪ Small group tasks

Captured by *Teaching Dimensions Observation Protocol*
Research Questions

1. Will students demonstrate more sophisticated reasoning on an immediate test of learning?

2. Will any effects persist to later, more standard tests of learning in the course?
Measurement

Series of assessments:
• Quizzes in class at end of each topic.
• Common midterm problem (one topic).
• Common final exam problems.

Goals for the assessment:
• Problems typical in the course.
• Expose student thinking: concepts and computation.
Related Rates

Concepts
• constant vs. changing quantities
• 3D shapes

Computation
• Implicit differentiation technique
• Derivative rules
Cones and Cylinders

Filling inverted cone and cylindrical tanks of equal volume, adding water at same rate.
Linear Approximation

Concepts

• Goal of the process
• Interpreting error
• Relate graph/picture to the formula

Computation

• Use of the formula
• Derivative rules
Results for experimental section:

On immediate assessment of learning:
• Higher performance on *conceptual* items.
• Similar performance on *computational* items (which depend more on earlier course components).

On later assessment:
• Effect present on second, standard assessment.
• On third assessment of Related Rates topic (final exam), effect not significant.
  (See poster for numbers and details!)
Work in progress

• Comparison with other topics on final and with other sections.
• Validation interviews for assessment items.
• Track student learning through term, incorporate attitude data.