

## **Assessing the Effectiveness of Large Lectures with Discussions**

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In Fall 2006, Don Pfaff and I taught pilot 150-student math courses, with TA recitation sessions. At the same time, numerous other faculty taught “traditional [for us]” 35-student classes of the same courses. Today I will describe an assessment project to compare these two dramatically different modes of instruction for mathematics courses. This project, designed by Judy, Don and me, includes a pre- and post-test, a comprehensive web based survey (a modification of the CLASSE), as well as other data.

### **Goals:**

- Identify specific strengths and weaknesses of the large lecture format.
- Optimize organizational structure.  
Large classes require time and energy for “teaching” and for coordination. Identify specific activities for which faculty and TA power can be best used.
- Measure how well different groups of students are served by the format overall, or by different components of the format.

Students fall into vastly different groupings in terms of preparedness, study habits, maturity, etc. For example, the relative merits of

- (a) a more intimate class size, or
- (b) learning calculus from a world class expert in the field of mathematics,

are bound to be different for

- (A) well-prepared freshman starting calculus, or
- (B) students struggling to make the adjustment to university level coursework, perhaps who has taken several attempts to master the prerequisite material.

## Background on Large/Small Formats

[The question IS NOT whether I can do as good of a job teaching 150 students as 4 of me can do teaching 40 students each.]

### Typical UNR Math Enrollment (Fall 06)

Course	# 35-40 Student Sections
096 Intermediate Algebra	19
120 Fund. College Math	20
124 College Algebra	20
127 Precalculus	4
128 Precalc and Trig	8
176 Business Calculus	5
181 Calculus I	12
182 Calculus II	6
	94 Total

(plus higher level service courses, courses for majors and graduate courses)

### Compare this with Current Faculty Size

Type	# Faculty	Teaching Load	# Sections/Semester
Tenure lines	20	2	40
Lecturers	3	3	9
			49 Total

## Meeting Enrollment Demand

We have traditionally covered the bulk of these courses with temporary lecturers, graduate students, and letter of appointment faculty.

Concerns:

- (1) Consistency across sections (see Danelle Clarke's talk on coordination of Core Math Classes, 1pm).
- (2) Inexperienced TAs in charge of their own classes. (This concern was highlighted by the Spring 06 External Review of the Department of Mathematics and Statistics.)
- (3) Quantity and quality of candidates for LOA positions (low pay, 1 semester commitment, often holding other jobs).
- (4) A potential disconnect between regular faculty with curriculum expertise and lower level instruction.
- (5) Many students don't ever take a math class from a mathematician; others don't during their first 2 years. Permanent faculty can provide a university level perspective on mathematical thinking and the role of mathematics in the world.

These pressures, and a suggestion from Core Director Paul Neill, prompted us to explore the use of the large lecture format in the pre-Core and Core courses, Math 124 and Math 181, in Fall 2006.

### **Large Lecture Format**

Large lectures (~150 students, 1 professor)

Recitation sections (~25 students, 1 TA)

#### Fall 06 Pilot Projects:

~150 student Calc I class (taught by me)

3 lectures + 1 recitation section (instead of 4 lectures)

~150 student College Algebra (taught by Don Pfaff)

2 lectures + 1 recitation section (instead of 3 lectures)

The large lecture courses running parallel to our traditional small format sections of the same course offered a special opportunity for assessment. This project is a collaboration with Judy Ouimet, UNR Office of Assessment, and Don Pfaff, UNR Math & Stat Dept.

#### **Benefits of Large Lecture:**

Regular faculty can offer much broader perspective on university curriculum, subject matter, applications; enthusiasm may better inspire students.

Smaller recitations can focus on problem solving and discussion with students (25 instead of 35-40).

#### **Obvious Drawbacks of Large Lecture:**

Perceived distance, impersonal feeling, intimidating for students to interact with faculty

Logistics of exams/grading

1 week of “new material/theory,” between recitations

New TA is not as efficient as experienced instructor (effective loss of class time)

#### **Size of assessment study (in students)**

	Large	Small	Total
181 Calc I	150	180	330
124 College Algebra	150	300	450
Total	300	480	780

#### **Assessment Methods**

##### **Direct methods:**

Pre-test, post-test, and cumulative final exam scores

##### **Indirect methods:**

Started with CLASSE\* survey, but revised it to focus on most important issues in large vs small comparison. Administered over the web using Ultimate Survey software.

##### **Link direct and indirect:**

Gather student names in survey so that all 3 can be combined into large data set.

\*CLASSE was developed by Judy Ouimet, Assessment Coordinator at UNR, and Bob Smallwood, Associate Provost for Assessment, University of North Florida. For more info, see (all one link):  
<http://www.sacscoc.org/annmtg/2006%20Annual%20Meeting/2006%20AM%20Handouts/PDF%20files/CS-29%20CLASSE-Student%20Engagement%201.pdf>

Differences in students:

Frequent responders VS Shy freshmen

or

Students w/ strong note-taking skills and weekly planners

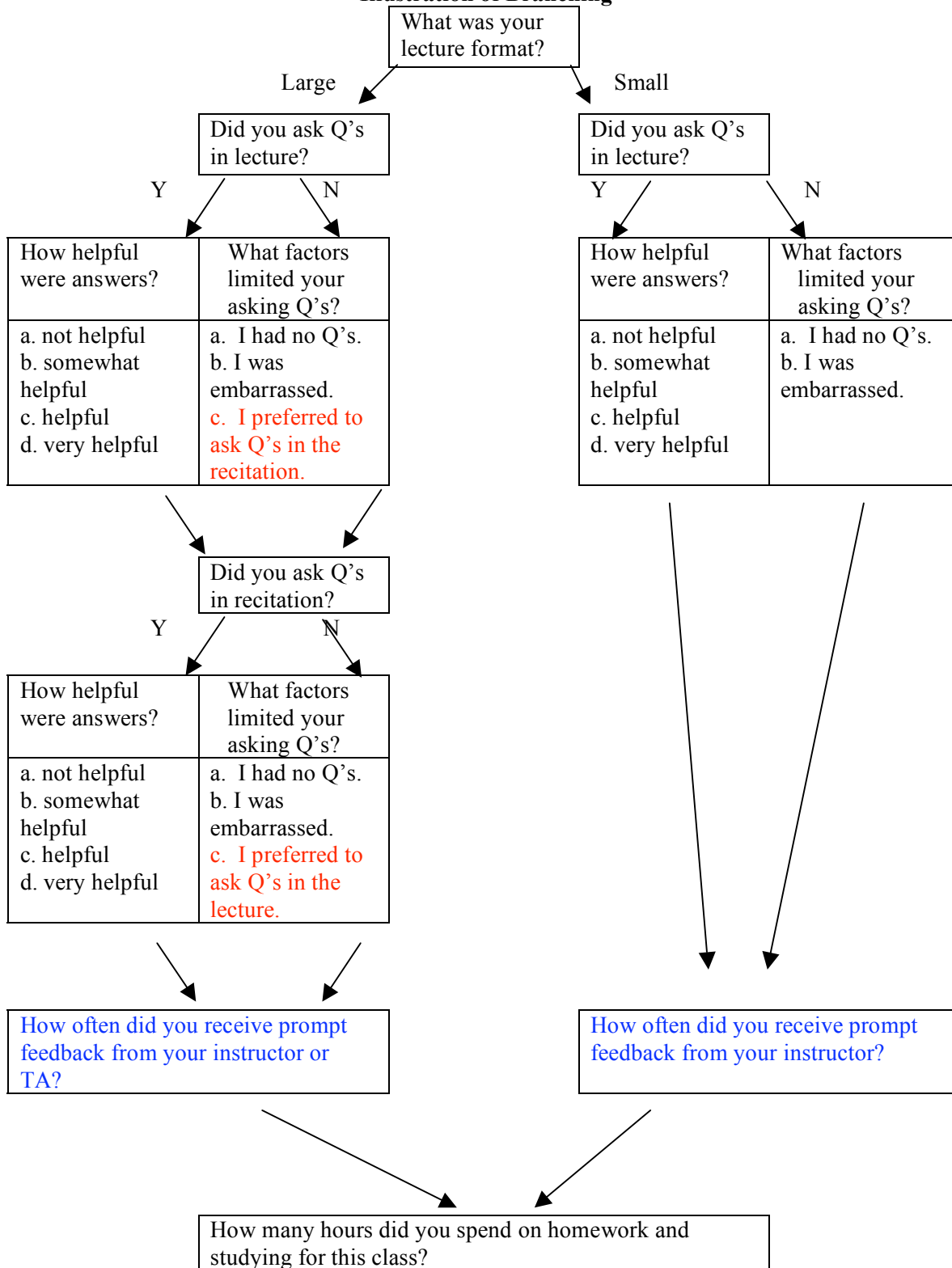
VS

Students who don't yet own alarm clocks

Thus we created branching questions.

Answers to these determine follow-up questions.

### Illustration of Branching

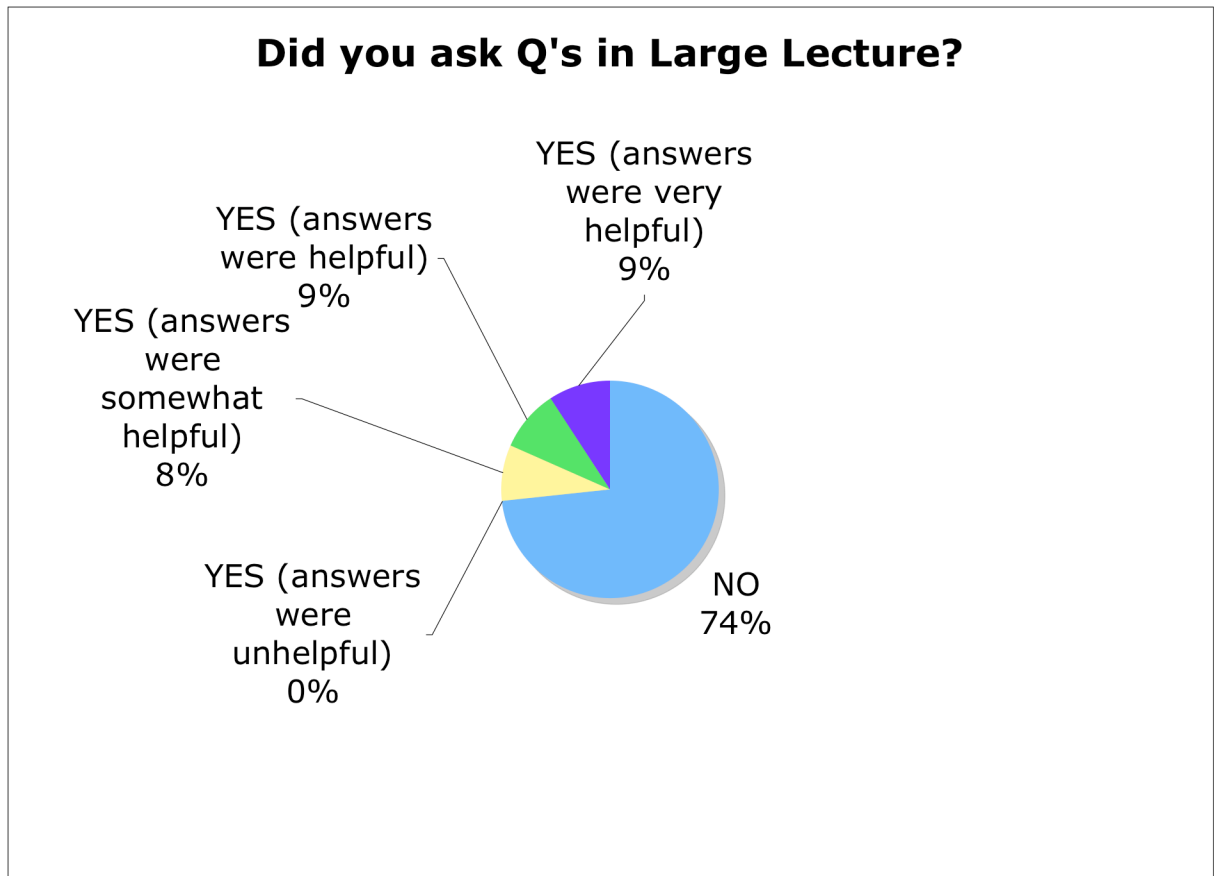


**Current status of data analysis:**

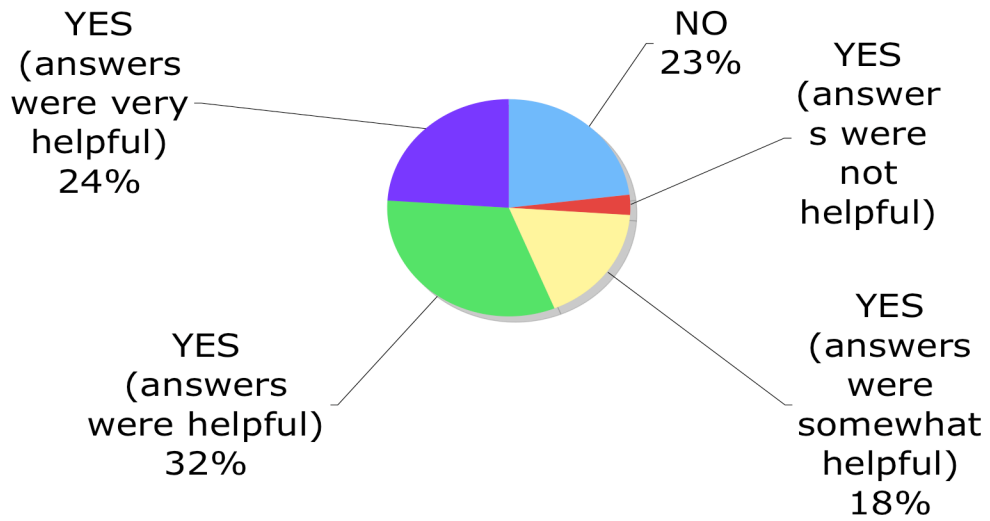
All survey, pre/post-test, and final exam score data have been collected and (just recently) entered into spreadsheets. CAIS information, such as student demographics and previous academic history, can also be merged with the this data set.

**Preliminary conclusions:**

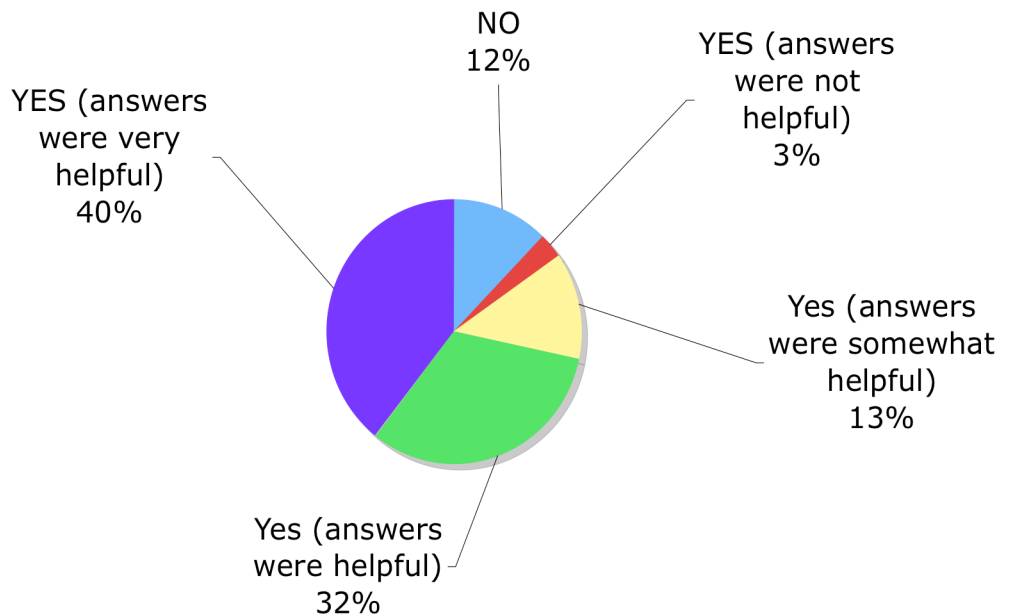
At present, all I can report on are answers to survey questions comparing large/small format student participation. Already there are some interesting results comparing Large vs Small.



### Did you ask Q's in Small Lecture?



### Did you ask Q's in Recitation Section?



**Average “effectiveness of answers”**

(0=not helpful, 3=very helpful)

Large Class Instructors	1.9
Small Class Instructors	2.0
Recitation TAs	2.2

Of those who didn’t ask questions in the lecture, over 90% either “didn’t have any questions” or “preferred to ask their questions in the recitation section.”

**Other forms of interaction with instructor/TA**

There were similar results with office hours and other communication with the instructor/TA outside the class. There was less communication with the large lecture instructor than the small class instructors, but more with the recitation TA.

**How often did you work harder than you thought you could to meet instructor’s expectations? (Some measure of motivation/inspiration)**

	Large	Small
Sometimes/never	68%	62%
Almost always or always	32%	38%

This is a concern but, with more experience and fine tuning of the large lectures, this gap may become less significant.

**Still to be analyzed:**

We have data available to study the following correlations, but have not had time to merge the files and analyze the data.

<b>Pre/post-test and final score</b>		
Effectiveness of online components (EDUCO)		
Hours spent on course		
Use of different study techniques		
Interest in material	versus	Class format

**Preliminary conclusions:**

(1) Attendance tends to be lower in the large lecture. We’ll analyse the current data to see whether the students missing more classes are doing more poorly. We may want to consider ways to encourage attendance and participation more in this format, such as quizzes or clickers.

(2) From the students’ perspective, the recitation sections are a very valuable experience. We need to make sure that the recitation activity led by the TAs is as effective as possible, and well-coordinated with the goals of the course. The students seem fairly satisfied with this form of student/instructor interaction.

(3) Given the importance of the recitations, we need to find better ways to take advantage of them throughout the course. It is difficult to time exams so that the recitations work for reviewing, since they are not generally scheduled on the same day. For example, in fall, recitation sections met only three of the last five weeks due to holidays.

(4) It would be better to spread the discussion activity in the recitation component throughout the week. (It is important for the students not to go a week between working on and discussing problems.)

(5) Overall effectiveness needs to be measured with direct assessment methods (i.e. analysis of pre/post-test performance and exams). Whatever the outcome of this analysis, the recitation sections will be a crucial component of future large lecture formats.

**Changes after first pilot and preliminary analysis:**

- Significant changes in TA mentoring. See Spring 07 Core Math Orientation handout, entitled “Tips for Graduate Students assisting large lecture courses,” which discusses:
  - (a) prioritizing what to cover,
  - (b) PREPARING for class,
  - (c) means of getting written solutions out when time is short in class, or recovering from a botched explanation,
  - (d) advising students on difficulties/resources,
- Discussions among faculty teaching these courses; sharing their experiences and ideas, web resources. (See “Tips for Large Lecture Math Instructors” for some resources.)

Both notes mentioned above are available at <http://wolfweb.unr.edu/homepage/naik/coremath/index.html>

**Longer term changes**

Having a single recitation per week presents various logistical problems for students keeping up with the material, instructors scheduling exams, etc. The intense discussion that the students engage in during the recitation section, which they appear to value highly, needs to be spread out during the week. This will also allow more flexible use of the recitation sections for practice problems, group work, and exam preparation. For this reason, we are moving to modify the courses that will be taught in large lectures to include two recitations per week.

New catalog designations:

Math 181 3+2 (4 credits)

Math 124 2+2 (3 credits)

For example, Math 181 will go from 4 small lectures per week (4 credits) to 3 large lectures + 2 discussions (for the same 4 credits). By viewing the discussion as a problem solving lab, this is in line with credits earned for science courses with lab components.

**Issues postponed until later**

It is our preliminary impression that Math 124 does not work as well as Math 181 in the large lecture. It is still rather early to reach a firm conclusion. We certainly want to wait until we examine the pre/post data and final exam performance versus large/small format, and probably also try another pilot large lecture. In any case, the 2+2 (3 credit) designation on Math 124 would certainly help make the large class format more tractable.

**Points to ponder if you are considering such a project:**

- Inclusion of pre-test (with same questions as post-test) allows you to factor out “coasters,” who take your class after having most of it in high school.
- Marginal extra credit for survey helps motivate participation. (In my view, critical evaluation of their activity in the course is worthwhile, but shouldn’t be weighted too heavily.)
- Iron out the bugs first (our web address was very long and didn’t e-mail well).
- Students provide their name (not R-number) in survey so that responses can be correlated with other CAIS data and so that extra credit can be given (they don’t know their R-numbers). Unfortunately, asking their names makes it feel less anonymous. It helped to be able to say “The Assessment Office will gather the data and give us a list of those that participated, so we can award extra credit.”
- Secure login keeps people from voting often.
- Marginal credit for (completion of) the pretest. They can’t be graded on it since it consists of “final exam problems.”
- Factor out instructor popularity by using at least two of each format; use only cumulative data.
- How to handle the logistics of pre/post-tests? Give pretest on first day as a quiz and incorporate post-test into final. (Note: check that all sections have cumulative final, comparable calculator policies, allow multiple choice questions, etc. This requires discussion with all instructors before syllabi are finalized.)
- Ultimate Survey software allows branching questions, but requires some practice. It doesn’t have all the features one might hope for to create, edit, and proofread surveys with branches.