A Tale of How Oral Reviews Morphed into Active Learning Classes

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Formative Oral Assessments: Engaging Students in Articulating their Thinking

- Ungraded, voluntary
- Often cited by students as most important aid to learning
- Small groups of 5-6 students for an hour
- All students at white boards

- Emphasis on conceptual questions
  - Why would you use linearization?
  - What does it look like on a graph?
  - From the graph, what kind of functions will give the best results?
  - Does it matter where you center the linearization?

How Do Orals Work?

Voluntary and ungraded
Outside of regular class time
5-6 students is ideal
Students write their names on the boards
Emphasis is on conceptual understanding
Not how many radians is 180 degrees, but why?
Not find a derivative, but if the derivative is -6 at x=4, what does that tell you about the graph at x=4

Benefits of Oral Assessments

- Students negotiate meaning and make mathematical connections
- Students learn to be far more metacognitive about their own learning
- Students feel more confident in their mathematical ability
- Students display more expert views on the nature of mathematics. (CLASS survey)

Problems to be Addressed

- Orals popular with students
- We would start with about 30% for Test 1
- sometimes more than 70% by test 3
- BUT the logistics are very time consuming

- PROBLEMS:
- RETENTION in STEM majors/college
- Students who are not fully prepared for the one semester Calculus I course
- Students who earn 3 on the AP

Supporting STEM Students

- summer camps,
-a two-semester Calculus I course,
-revised active learning recitations
-a pathway for students who earned an AP3
- drop down course
-supported by Learning Assistants (LAs).

Summer "Prep" camps
Math Readiness and Bootcamp

- **Math Readiness**
- – 5 days / residential
- –intensive prep for math placement test
- –students divided into groups of 10–12 with
- instructor/two LAs (use Noyce scholars)
- **Boot Camp**
- –week long residential
- –bio/chem or math/physics/engineering
- –common meals + meal cards
- –study habits/ yoga / time management /
  research project with presentation
  (carbon footprint of Mason (trees/cars/etc)

Two-semester Course

- Smaller: 36-44 students versus 72-90
- Advantages over pre-calculus
- -students are less resistive
- -students see reasons e.g. “factoring”
- Students at white boards 50-75% of time
- Students have concepts broken down into smaller chunks – 8 tests versus 4
- Mason is phasing out Pre-calculus

Students who earn 3 on AP

- Given three credits for 1st semester of the two-semester course
- Enroll in 2nd semester (review entire course)
- At conclusion: 4 credits for regular Calculus 1 class/ 2 elective math credits
- Almost all earn a B or better
- Some went on to honors Calculus 2, again earning an A or B

What about Students in Regular Calculus classes?

- Experimented with sharing an Active Learning Classroom
- drop-down class provided for students failing the first test in Calculus I

Revised Recitations

- 45 students instead of 30
- One TA and 2 LAs
- Students at white boards/working in groups
- Asked to work problems
- Must explain their reasoning
- Run like oral assessments

Learning Assistants Critical

- Undergraduates
- Take Teaching and Learning Seminar
- Facilitate authentic group learning
- Meet weekly with their “instructor”
- LAs are often students from previous classes that we observe helping fellow students
- In 72 person ALC and recitations, 2 LAs
- In 36 person ALC, 1 LA
- *LAs build a strong foundation in their major

QUESTIONS?

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DATA?

CLASS Results: 7 items had significant pre/post differences

Students agreement increased significantly on:

- Item 8 – I am not satisfied until I understand why something works the way it does. (p=.042)
- Item 11 – I study math to learn things that will be useful in my life outside of school. (p=.012)
- Item 16 – To understand math I talk about it with friends and other students. (p=.002)
- Item 23 – Mathematical formulas express meaningful relationships among measurable things or amounts. (p=.001)
- Item 36 – When studying something new in math, I compare it to what I already know rather than just memorizing the way it was presented. (p=.028)

Students disagreed more strongly

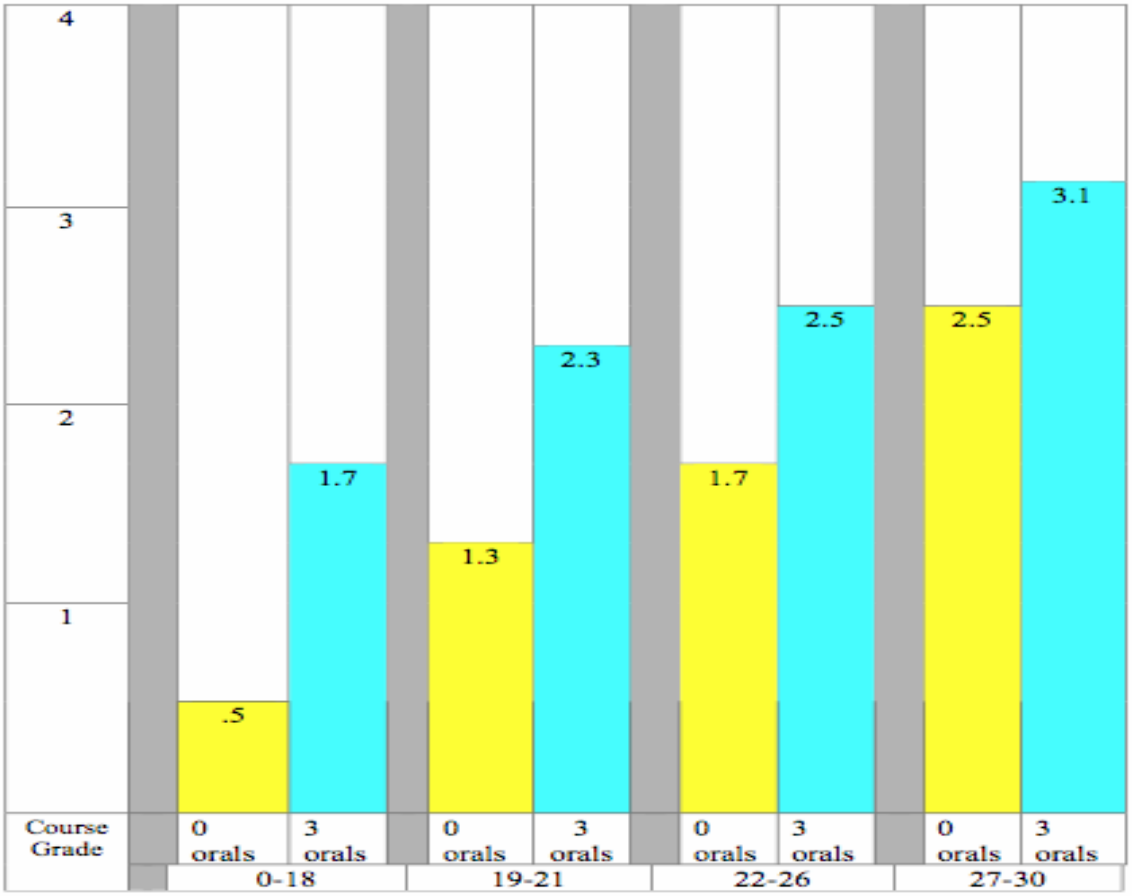
- Item 7 – There is usually only one correct way to solve a math problem. (p=.037)
- Item 18 – If I don't remember a mathematical method needed to solve a problem on a test, there's nothing else I can do. (p=.007)

*Students answers to all other questions were not significantly different pre/post

Looking at control vs. treatment in Calculus I for each exam unit exam

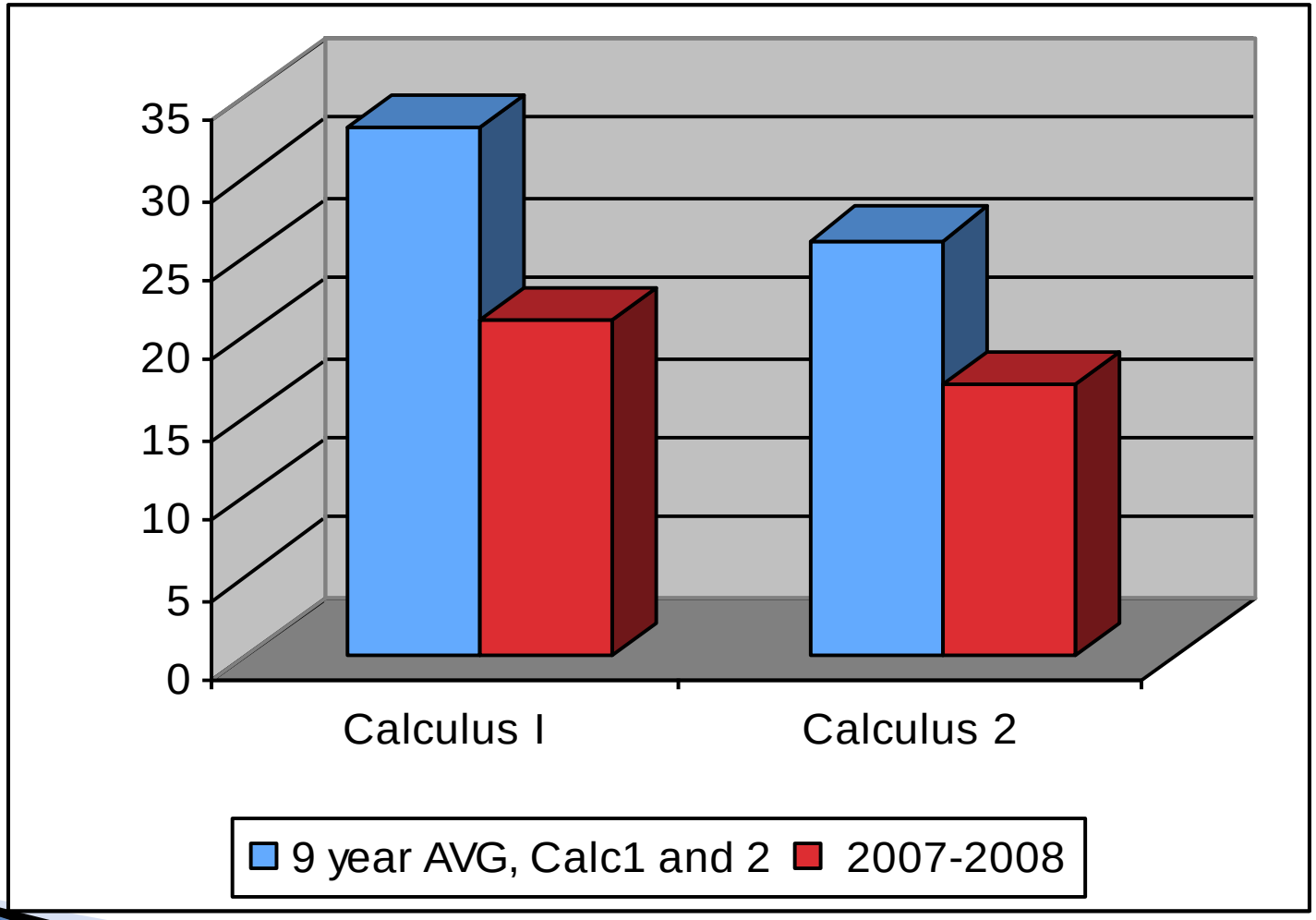
Compare Exam Scores	N	Average	St. Dev
No Orals Exam 1	333	75.1	15.0
Orals Exam 1	134	81.6	10.4
No Orals Exam 2	298	74.5	15.4
Orals Exam 2	162	79.8	12.6
No Orals Exam 3	318	64.4	19.1
Orals Exam 3	138	73.9	15.7

Average Grades by placement score and number of orals



Course Grades in APPM 1350
for students participating in 0 vs 3orals in Fall 2008

Decline in Failure Rates



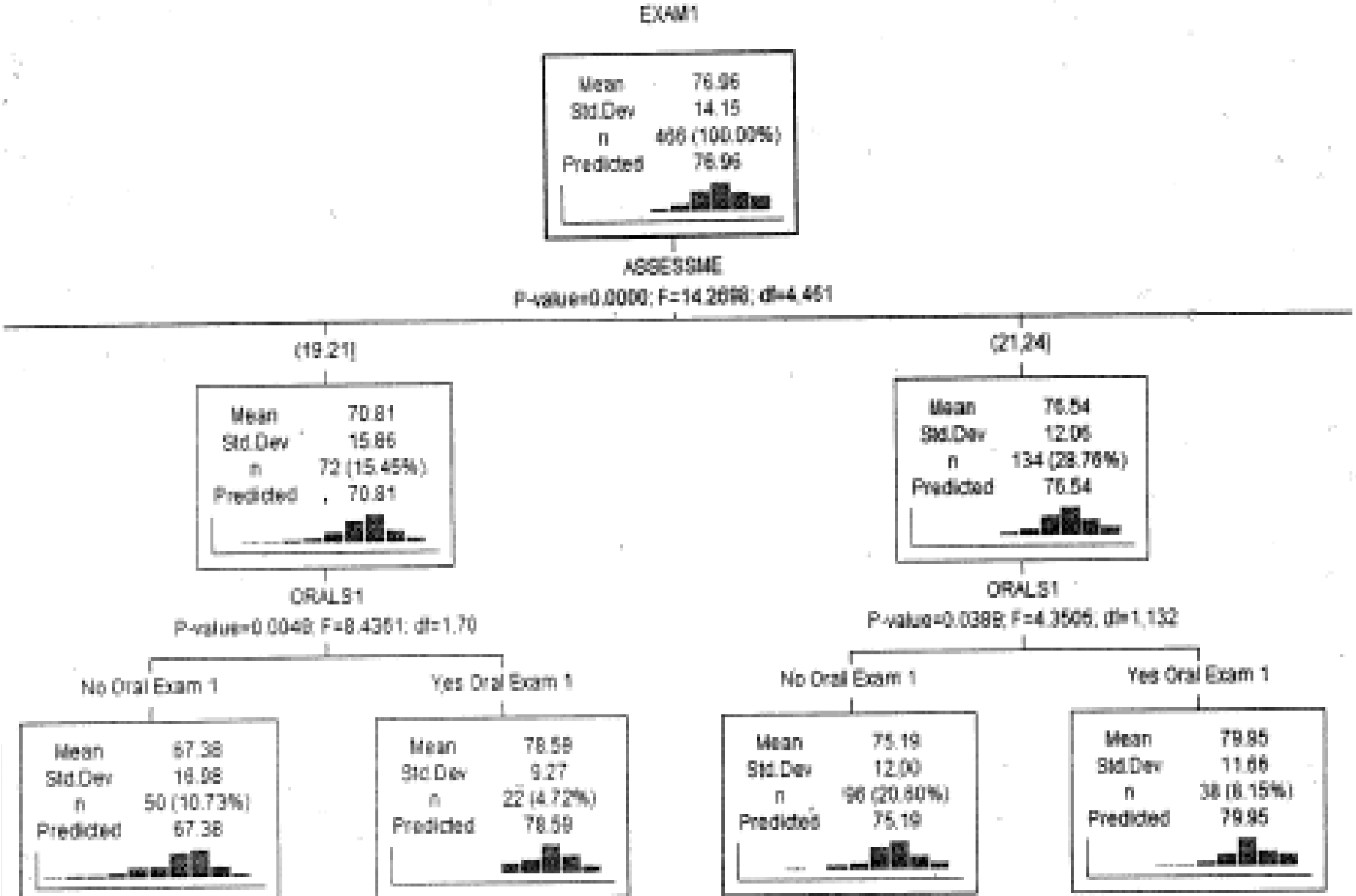
Effects of Orals

- Students learn the importance of understanding the basic concepts in order to be able to apply those concepts to novel situations
- Students become more metacognitive about their learning
- Students learn better ways of studying
- *Students work harder because they believe their instructors are invested in their success.
- Students attend class and office hours more and do more homework
- All of the above improvements increase with the number of orals in which students participate

Students' Reactions

- Helps me understand the hard concepts
- Helps me determine what I know and don't know for the upcoming test
- It clarifies things I was unclear about
- It gives me confidence before the written test
- It helps to hear how other students think about some of the important ideas

Research Results



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Great Calculus Experiment –Fall 07

TEST	ORALS Failure Rate	NO ORALS Failure Rate
1	10%	12.5%
2	9%	13%
3	8.5%	13.1%