

# Problem-solving Workshops in Calculus

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# Abstract

The first-year Calculus Workshop Program offered at UBC provides an activity where students meet once a week outside of lecture time to work on math problems in small groups. This may sound simple enough, but in fact the design and delivery of the program is a complex process.

To make sure the program was delivered effectively across all course sections, we undertook a two-year study whose goal was to identify possible pitfalls, implement changes, and measure their effects on students' attitudes and learning.

# The setting

MATH 180 and MATH 184: 4-credit courses for students with no prior knowledge of Calculus.

- **MATH 180** – Differential Calculus with Applications to Physical Sciences and Engineering (~450 students)
- **MATH 184** – Differential Calculus with Applications to Commerce and Social Sciences (~500 students)

# Workshops are ....

- problem-solving sessions
- a mandatory, weekly activity
- multi-sections with common lectures
- designed to facilitate student learning using a Socratic method

# Workshop format

- Room with many blackboards:  
~25 students + 2 TAs
- Groups of 3-4 students
- Problem sheet for the week provided
- Work is done on blackboard
- Quiz (marked) or worksheet (marked for participation) at the end of most session

# What students actually do...

**They** do the work:

- Write solutions on blackboard
- Discuss with peers
- Ask for help from the TAs (who are trained not to be too helpful)
- Write individual quiz on paper

Group dynamics are a factor!

## 2008: Issues and concerns

- Topics presented late in lecture left students with insufficient background for the workshops
- Students dissatisfied with relation of course content to workshop content
- No individual accountability
- Too much time spent off-task by students
- Problem set production too rushed
- Limited reusability of problem sets from year to year.

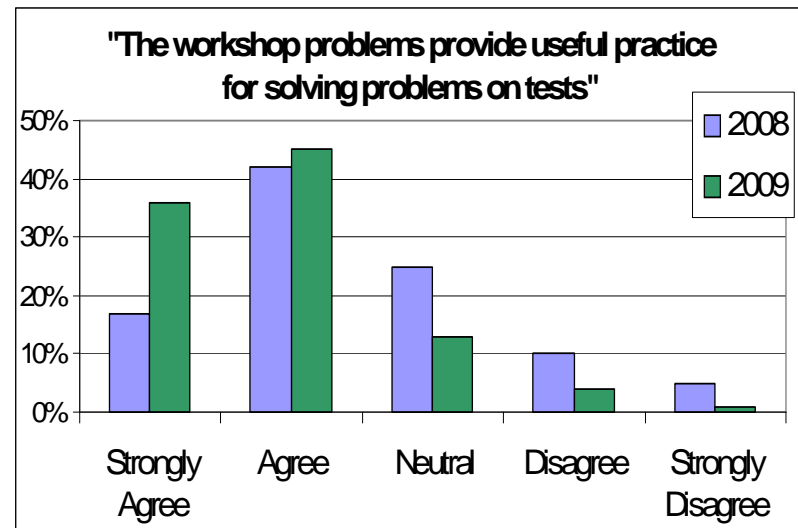
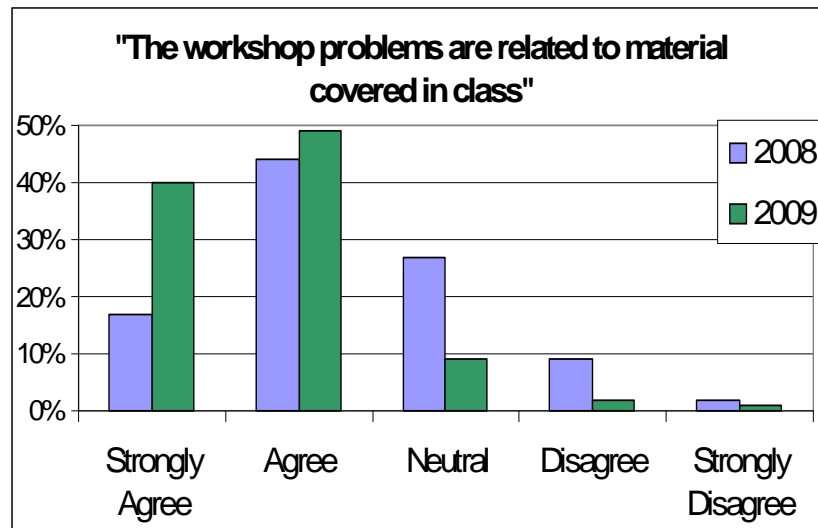
# 2009: Changes

- Clear learning goals stated on problem sheets
- Quiz at end of session to keep students on task and provide further feedback on learning
- Tight coordination of schedule and order of material between lectures and workshops
- Regular instructor meetings
- Regular TA meetings
- One Head TA for each course to keep TAs coordinated, run training sessions and feedback for other TAs, collect comments to assess problem quality



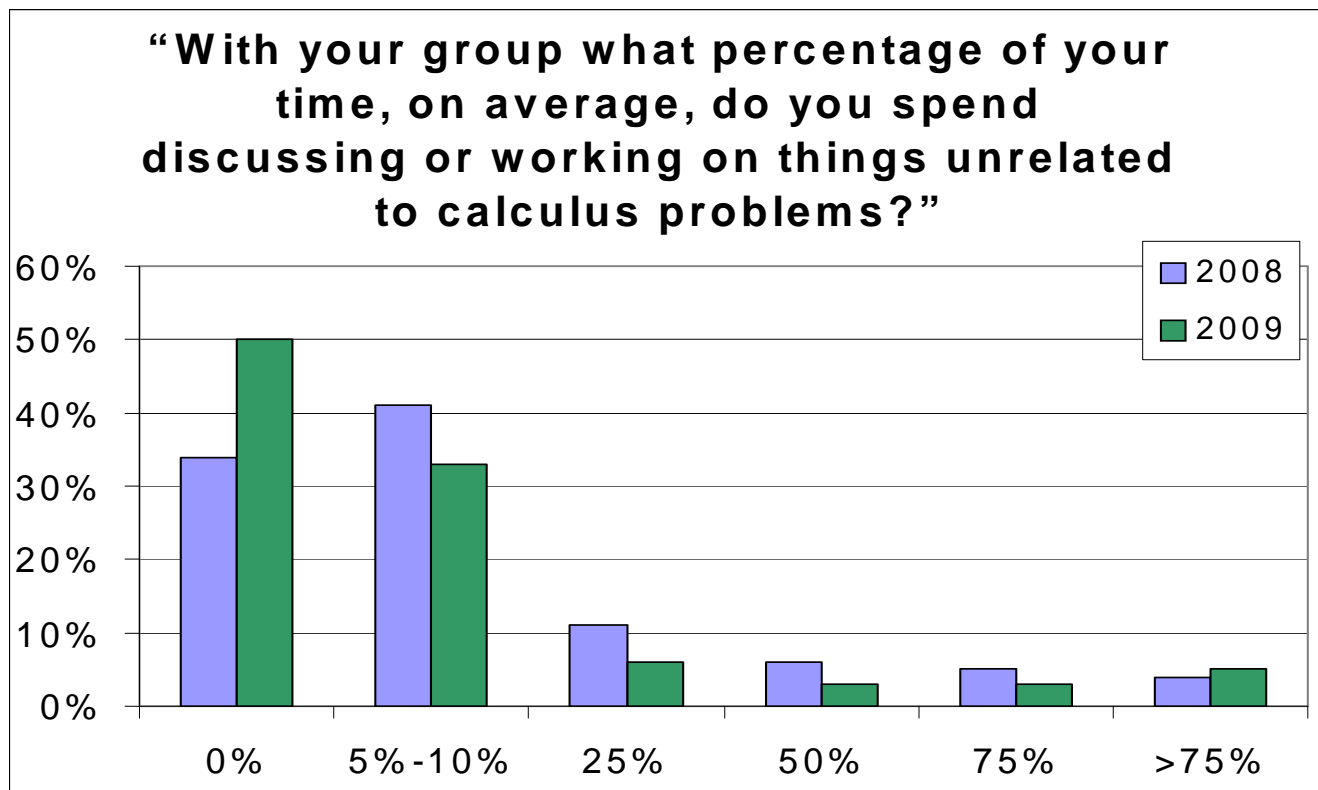
# Results: Students' Attitudes

End-of-term survey (2008: 54% of class, 2009: 75% of class)



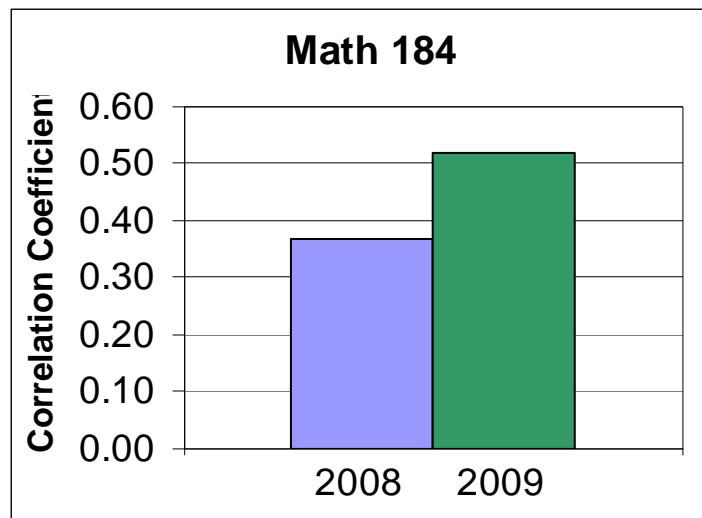
# Results: Students' Engagement

Self reported, midterm evaluation

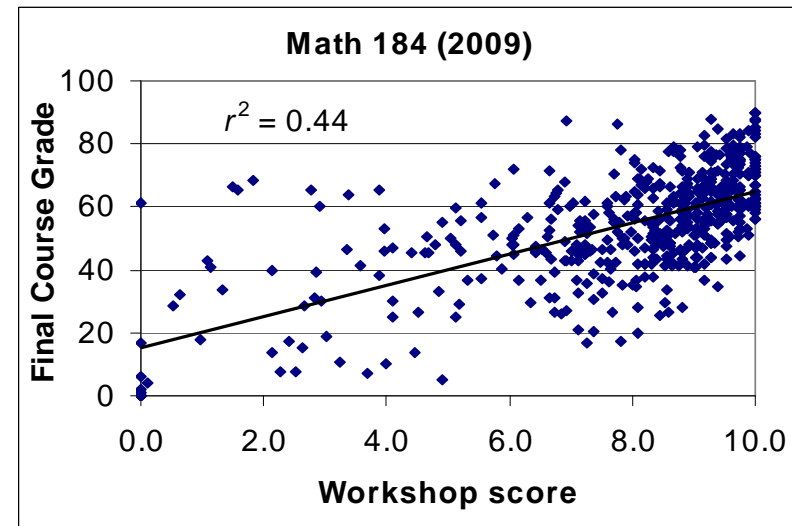


# Results: Correlation to course grades

Correlation between workshop attendance and course grades



Correlation between workshop score (attendance + quiz) and course grades



# Conclusions

In 2009 we implemented changes to address issues observed in previous years, transforming the workshop program into a team effort. Meetings with the workshop coordinator, course instructors, and workshop TAs were scheduled on a regular basis; students received individual feedback on their learning in the form of weekly quizzes. These changes resulted in improved student attitudes towards the workshop program, and a higher correlation was measured between students' performance in the workshops and their grades in the other components of the course.