

# Action Research Project \*

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# The problem

## Problem Statement

Many students in my Advanced Placement Calculus classes were not adequately prepared for the AP Calculus exam due to lack of understanding of the unstructured open response questions.

## Purpose Statement

To describe how implementing a change in classroom instruction will influence student achievement scores on AP Calculus questions.

## Research Question

How will implementing a problem-based lab that requires students to examine, explore, collaborate, and write about their solutions influence the students' comprehension of the AP Calculus questions?

# Challenges

## Challenge 1

### **Poor Test Performance**

The underlying cause of poor student performance on standardized tests is that students have not been taught how to think and solve unstructured problems on their own.

## Challenge 2

### **“Teaching to the Test”**

Test bias is a concern among those involved in educational research. The challenge is to find the right balance between good instruction and test preparedness.

## Challenge 3

### **Writing In Mathematics**

Research supports that writing about math helps with students’ understanding of math. Significant gains can be made in students’ problem-solving ability by writing about the process.

# Solution

## LAB-BASED PROBLEM SOLVING

A weekly lab will be conducted which will require students to examine an unstructured problem, explore ways to solve it, collaborate with their classmates, and write about the mathematics behind their solutions.



# Implementation & Results

**Pre-Test**

**Post-Test**

**Pre-Survey**

**Post-Survey**

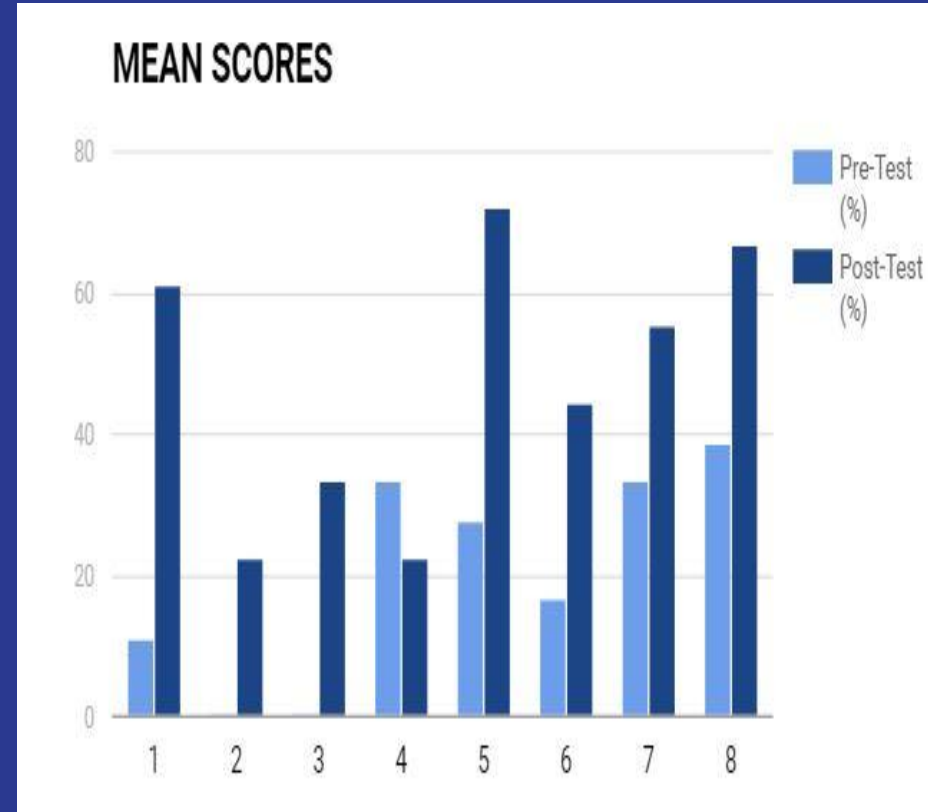


**Students take part in six problem-based labs.**

# Results

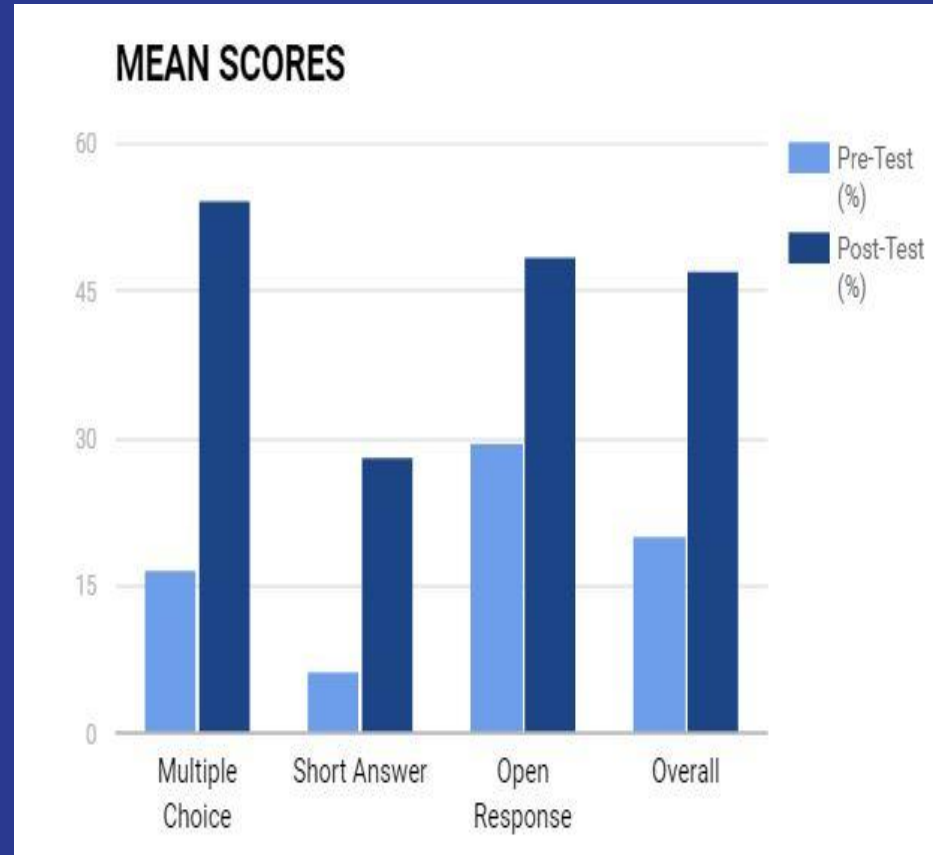
A Paired Samples Test (T-Test) showed that there was sufficient evidence to conclude there was significant growth in overall mean scores from the pre-test to the post-test.

The graph shows pre- and post-test scores for each of the eight students.



# Results

Paired Samples Tests (T-Test) showed there was sufficient evidence to conclude there was significant growth in multiple choice and short answer mean scores from the pre-test to the post-test, but an outlier in the open response data resulted in insufficient evidence to be able to conclude any *significant* growth in open response scores.





# Discoveries

# The Intervention Made a Difference!

Although one student showed a decrease in overall mean score from pre- to post-test, the various T-Tests provided sufficient evidence to conclude that the intervention did accomplish what it was intended to do, that is, increase students' comprehension on the questions on the Advanced Placement calculus exam.

# Pleasant Surprise!

After breaking down the data into smaller subgroups and analyzing it further, the students showed the greatest increase on the multiple choice questions, followed by the short answer questions, with the free-response questions ranking third in mean score increase. I was pleased to learn that the intervention had positive results on all modes of questioning.

# Male vs Female

Although the data set was very small (eight students), a Chi Square Test determined that there did not appear to be a relationship between gender and growth on the post-test overall mean scores.

# Who Knew?

Another Chi Square Test determined that there did not appear to be a relationship between students' attitude ( like vs. dislike) towards the labs and growth on the post-test overall mean scores.



There is sufficient evidence to conclude...

# ...students should be given more time to collaborate!

## Sage on the Stage

Thirty-three years ago the “methods” classes that I took in college as part of my preparation for student teaching and licensure taught me to plan my lessons so that I was teaching “bell to bell” so students did not have any “free time.”

## Plan - Plan - Plan

Research shows that activities should be well thought out to support instruction, foster learning, and gather evidence of progress. “Waiting until the quiz on Friday to find out whether students are making adequate progress is too late” (NCTM, 2014).

## Guide on the Side

The lab-based approach to problem solving has shown me that students can learn math through discovery and collaboration. It is crucial that I spend less time on the stage and more time on the side!

**“The initial results of this intervention are promising and have caused me to examine the way in which I instruct students. Because of this research project, I have informed my instruction accordingly. Prior to this action research project, I always made sure that I offered specific instruction to the students, as I have always believed that students were not capable of “teaching themselves.” Through this research and through this intervention I have come to learn that once students have been taught the skills necessary to think and solve unstructured problems and support their thinking and problem-solving process through writing about mathematics, they are fully capable and willing to work and collaborate in groups to succeed as problem-solvers.” ~M.H.**



# The Action Research Team

