Mar 23rd, 9:30 AM - 9:50 AM

A flipped large Calculus 1 class; first observations and conclusions

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Interdisciplinary STEM Teaching & Learning Conference,
Savannah, GA, March 21-23, 2019

Some information about the class

- Enrollment: 230 students (all FTICs)
- The class was offered as part of our EXCEL program
- The class met for 80 minutes on Tuesdays and Thursdays in a large classroom
- On Fridays students met in 80-minute recitation sections taught by TAs (up to 50 students per section)
- Initially, all students had to spend three hours per week in the EXCEL lab.

Students are selected into the EXCEL program by the following criteria:

- Must meet the university criteria to be in Calculus 1.
- The 2nd and 3rd quartiles of the SAT/ACT math scores for incoming FTICs. 2019 Minimum: SAT Math 570, ACT Math 23; Maximum: SAT Math 690, ACT Math 28.
- Declared a calculus based STEM major (a major that requires at least Calculus 1).
- Minimally qualified to enter in College Algebra and the highest math placement they can have is Calculus 3.

Before coming to class:

- Read the assigned section in the textbook
- Read the summary in webcourses
- Complete the online pre-homework in WEBASSIGN

In class:

- Take a wake-up quiz (a problem from the pre-homework)
- Work on problems posted in class
- Discuss the posted problems and solutions with classmates, LAs, and TAs
- Listen carefully to the explanations by the instructor
- Take quizzes that check understanding of the discussed material

After class:

- Complete the online homework in WEBASSIGN
- Discuss problems with classmates in Piazza
- Study in the EXCEL LAB
- Participate in the recitations
  - Work on the assigned problems in small groups
  - Present and discuss solutions
  - Take the weekly quiz

Grading Policy

WebAssign Homework	5%
In-class iclicker questions	3%
Recitation participation	3%
EXCEL/COMPASS Lab participation	3%
Piazza activity	1%
Recitation Quizzes	10%
Mid-Term Exam Average (3 mid-term exams)	45%
Final Exam	30%

Resources

- Textbook
- Summaries
- Videos
- Online homework
- LAs
- TA
- Other students taking this class
- Recitations
- LAB
- Reviews
- Piazza
- My office hours

A typical class

Wake-up quiz

Find the derivative of $f(x) = (x^4 + 5x^2 - 3)^6$.

A $f'(x) = (24x^3 + 60x)(x^4 + 5x^2 - 3)^5$

B $f'(x) = 6(4x^3 + 10x)^5$

C $f'(x) = (4x^3 + 10x)^6$

D $f'(x) = 6(x^4 + 5x^2 - 3)^5$

E None of the above.

The Chain Rule:

$$(f(g(x)))' = f'(g(x))g'(x)$$

$$\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$$

$$(f(\square))' = f'(\square)(\square)'$$

Problem 1

Find the derivative of $f(x) = (2x + 7)^4$.

Problem 2

Derive a formula for the derivative of $f(g(h(x)))$.

Problem 3

Find the derivative of $f(x) = \sin\left(e^{\sqrt{x^2+1}}\right)$.

Quiz 2

If f and g are both differentiable and $h = f \circ g$, then $h'(2)$ equals

A $f'(2) \circ g'(2)$

B $f'(2)g'(2)$

C $f'(g(2))g'(2)$

D $f'(g(x))g'(2)$

E Not enough information.

Problem 4

Find the derivative of $f(x) = \sqrt{\frac{1+\cos^2 x}{1+e^{x^2}}}$.

Problem 5

Find $h'(3)$ if $h(x) = f(g(x))$ and

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	3	4	5	7
2	4	3	6	5
3	5	2	7	3
4	6	1	8	1

Quiz 3

The area of a circle $A = \pi r^2$ changes as its radius changes. If the radius changes with respect to time, the change in area with respect to time is

A $\dfrac{dA}{dr} = 2\pi r$

B $\dfrac{dA}{dt} = 2\pi r + \dfrac{dr}{dt}$

C $\dfrac{dA}{dt} = \pi r^2$

D $\dfrac{dA}{dt} = 2\pi r \dfrac{dr}{dt}$

E Not enough information.

Problem 6

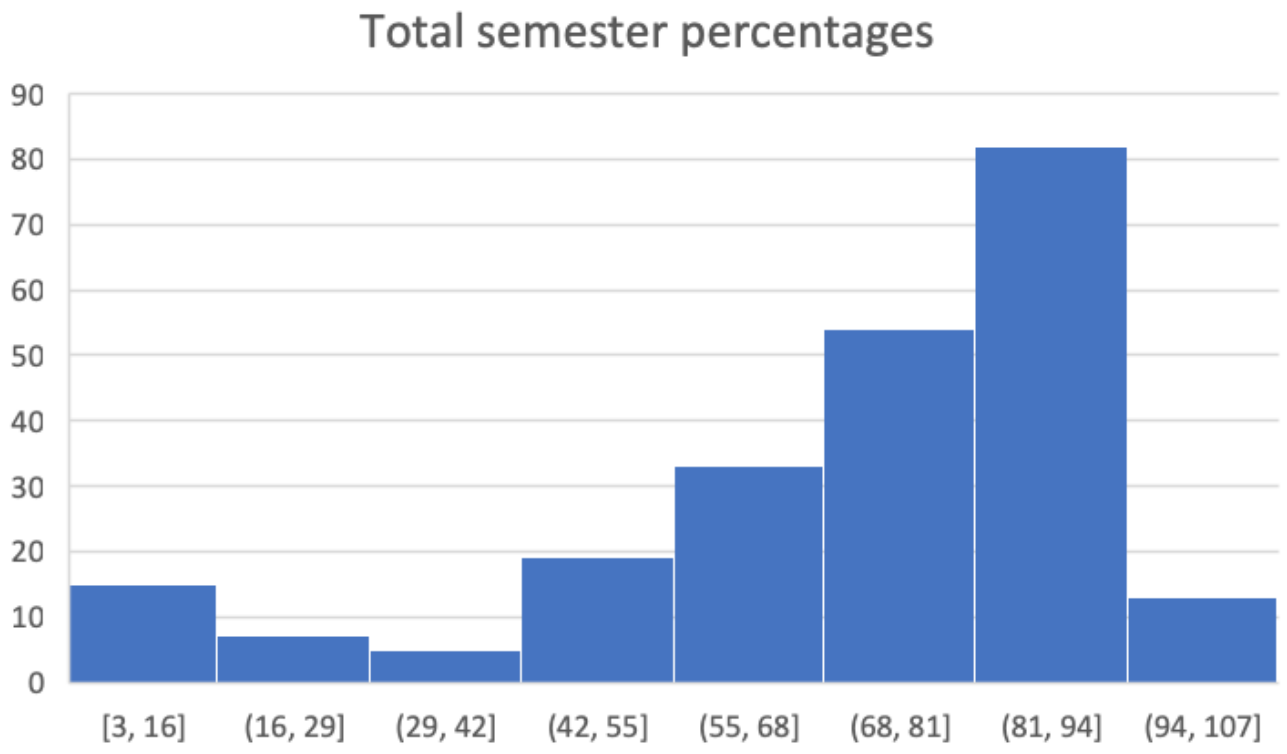
Find the derivative of $f(x) = \sqrt{x + \sqrt{x + \sqrt{x}}}$.

Problem 7

Find the derivative of $f(x) = \dfrac{2^{3x}}{3^{2x}}$.

- I Am done!
- I think I am done, But I am not sure.
- I am Confused. Please help me!
- I just started.

Students performance



Students comments: What did you like best about the course and/or how the instructor taught it?

- The professor kept the class interesting and pretty active.
- I really enjoyed how Professor Mikusinski incorporated a sense of community in this class.
- He always made the class enjoyable and we actually wanted to participate. It never felt forceful.
- I liked the utilization of of iclickers to encourage participation in the course. Professor Mikusinski made it so that the majority of the iclicker questions were used for participation and arriving at a correct solution would add points. I thought this was a great set up for the iclicker as it didn't punish students who were still learning concepts, but still encouraged them to participate and do well. I thought Professor Mikusinki's teaching style was very helpful as I learn concepts more easily by working problems.

Students comments: What did you like best about the course and/or how the instructor taught it?

- Allowing students to work together to solve problems and discuss concepts.
- I greatly enjoyed how interactive the course was with the iClicker questions. The reversed classroom style was greatly more interactive.
- I liked how we were able to collaborate with the people sitting next to us.
- Funny, and very engaging.
- I liked the course summaries provided the most because it helped give me a good idea of what the professor expected.
- What I liked best about this course was that we had our 6 LAs.
- I liked how he explained some topics in class and didn't leave instruction solely to the textbook.

Students comments: What suggestions do you have for improving the course and/or how the instructor taught it?

- Please, please, just actually teach.
- I did not enjoy having to learn the material before the class by myself.
- There needs to be more teaching. People often times don't understand the homework and then they're expected to know it all? No. Some things just need to be taught.
- Start by teaching the lesson.
- This class was awful for me personally. The professor was very unreliable and I've been relying on myself and prior knowledge to learn. The class is not engaging and does not stimulate learning for me at all.

Students comments: What suggestions do you have for improving the course and/or how the instructor taught it?

- Reverse classroom is ineffective as the material is never clearly explained.
- Not teaching it reverse classroom but having an actual lecture, myself personally is able to retain knowledge and understand it significantly better if it is taught the traditional way.
- We didn't learn much during the class, just did practice problems.
- Actually teaching the concepts instead of trying to teach us through problem based learning.
- I don't feel like "active learning" style courses are beneficial to students, especially with a challenging math course such as calculus.

Student Perception of Instruction

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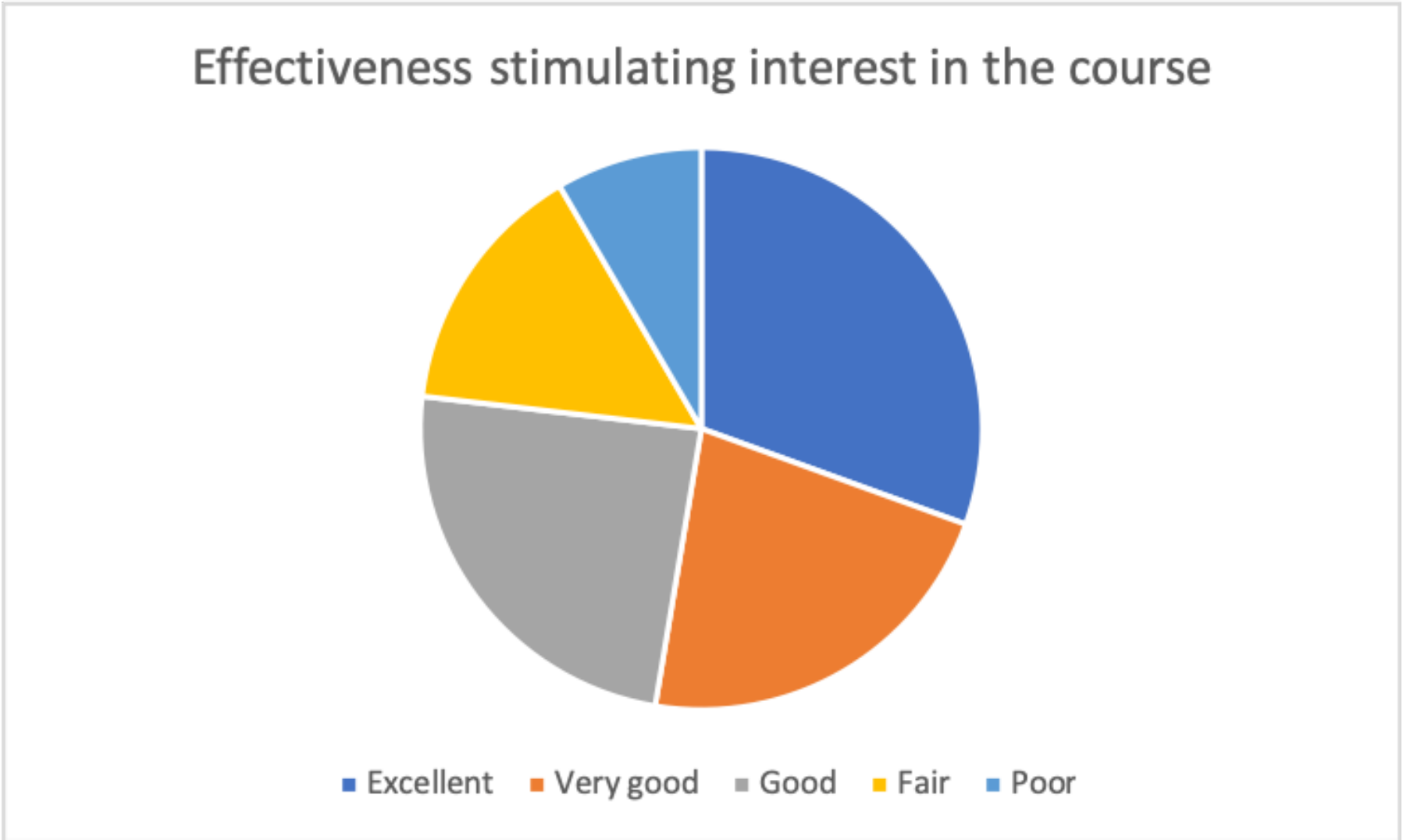

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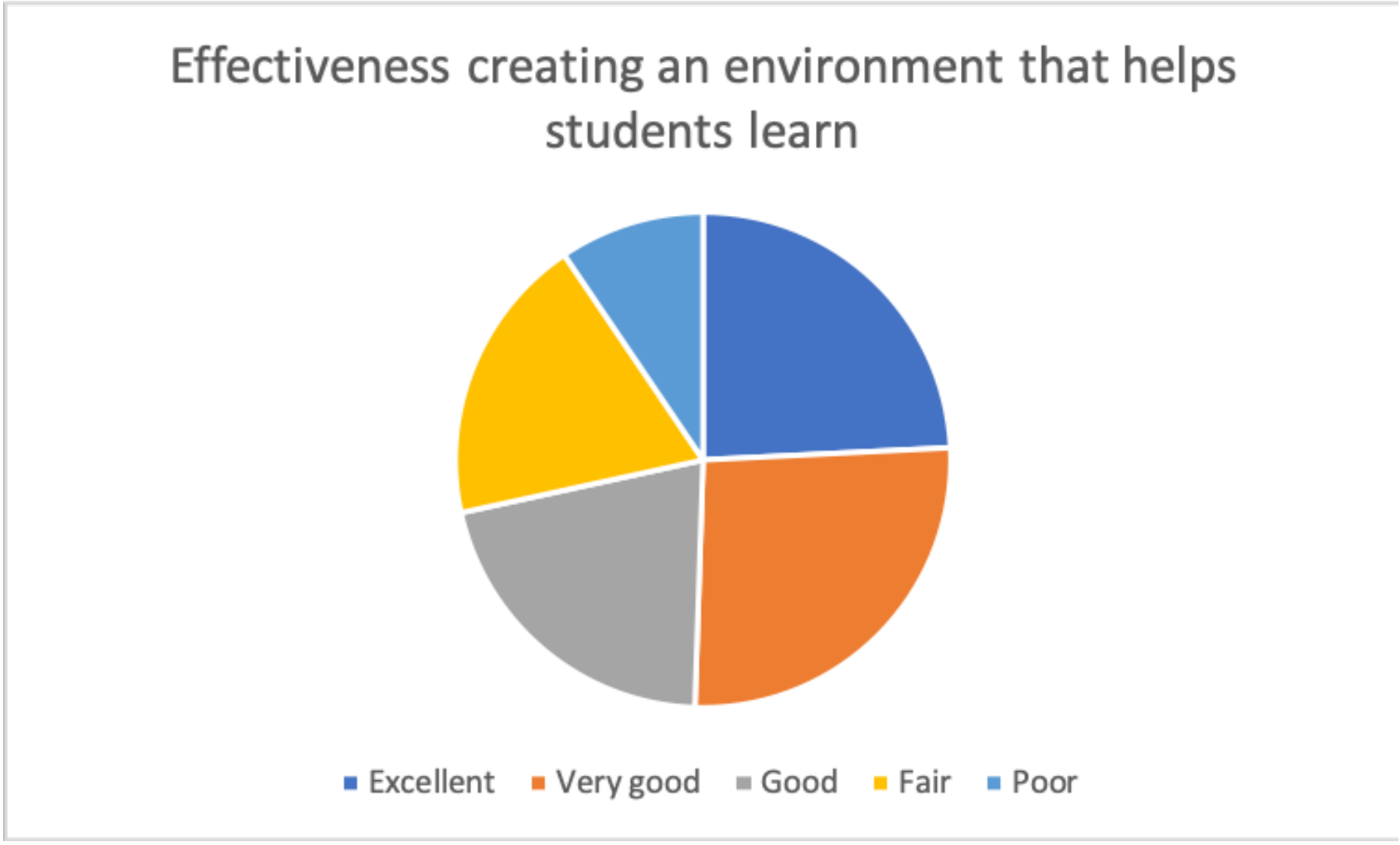

Student Perception of Instruction

- An active learning class can be an effective way to teach calculus in large classes.
- LAs are essential.

What would I like to change or improve?

- Include a short review at the beginning of every class.
- Better "marketing" of the class format to students.
- Expand the online component.
- Provide an adaptive tool to help students with their deficiencies.

Thank you!