Strategies for Incorporating Engagement Methods in Large STEM Classes

Alan Ableson

Dept. of Mechanical and Materials Engineering

May 2, 2024

Queen's UNIVERSITY

Strategies for Incorporating Engagement Methods in Large STEM ~~Classes~~ Lectures in Core Subject Area

Alan Ableson

Dept. of Mechanical and Materials Engineering

May 2, 2024

Queen's UNIVERSITY

(Already today: so many great ideas to incorporate in active learning classes!)

First-year Calculus Environment:

Lecture theatres seating 200-250 students.

(Any rooms like that you know?)

Challenge:
Deciding during a class how well all students are able to apply what they have learned.

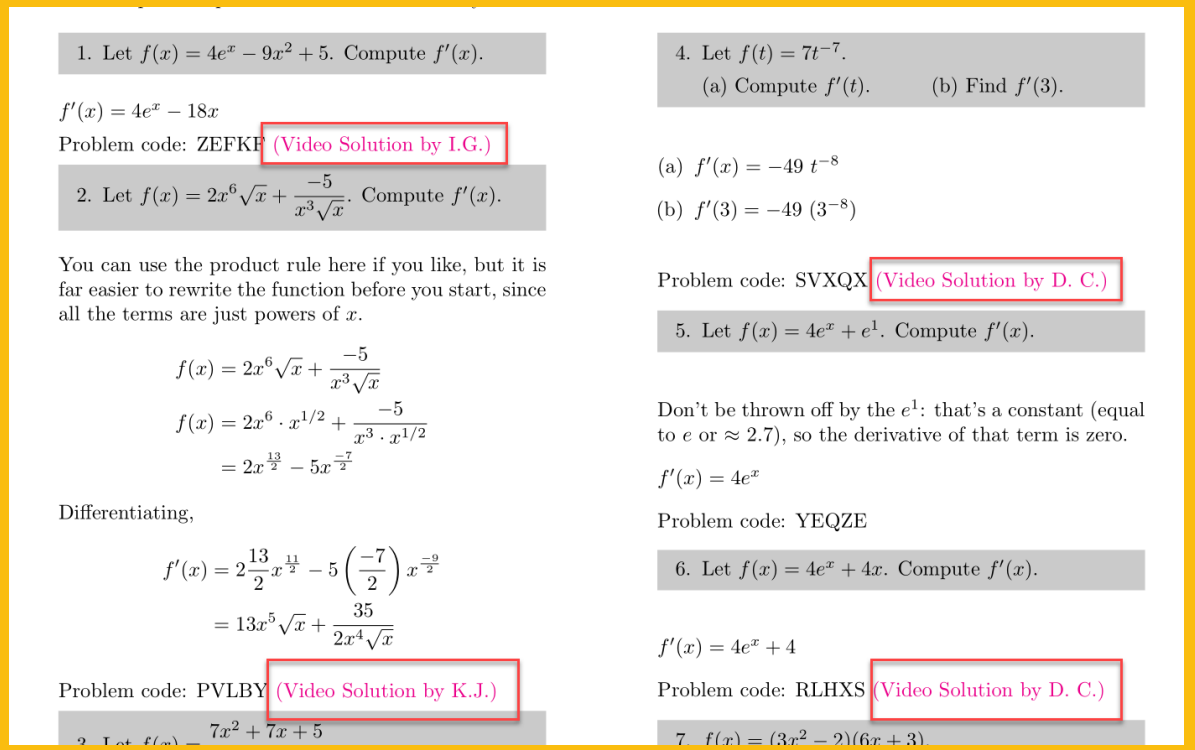
Success:
Qlicker/Clickers are great: instant class-wide feedback.

With difficult problems, pairing then re-asking is even more powerful.

Challenge:
Giving students who want something that goes beyond the course material.

(But isn't much extra work for the instructional team.)

Partial success:
Student videos of practice problem solutions.



1. Let $f(x) = 4e^x - 9x^2 + 5$. Compute $f'(x)$.

$f'(x) = 4e^x - 18x$

Problem code: ZEFKF (Video Solution by I.G.)

2. Let $f(x) = 2x^6\sqrt{x} + \frac{-5}{x^3\sqrt{x}}$. Compute $f'(x)$.

You can use the product rule here if you like, but it is far easier to rewrite the function before you start, since all the terms are just powers of x.

$$f(x) = 2x^6\sqrt{x} + \frac{-5}{x^3\sqrt{x}}$$
$$f(x) = 2x^6 \cdot x^{1/2} + \frac{-5}{x^3 \cdot x^{1/2}}$$
$$= 2x^{\frac{13}{2}} - 5x^{\frac{-7}{2}}$$

Differentiating,

$$f'(x) = 2\frac{13}{2}x^{\frac{11}{2}} - 5\left(\frac{-7}{2}\right)x^{\frac{-9}{2}}$$
$$= 13x^5\sqrt{x} + \frac{35}{2x^4\sqrt{x}}$$

Problem code: PVLBY (Video Solution by K.J.)

3. Let $f(x) = \frac{7x^2 + 7x + 5}{\sqrt{x}}$

4. Let $f(t) = 7t^{-7}$.
(a) Compute $f'(t)$. (b) Find $f'(3)$.

(a) $f'(x) = -49\ t^{-8}$

(b) $f'(3) = -49\ (3^{-8})$

Problem code: SVXQX (Video Solution by D. C.)

5. Let $f(x) = 4e^x + e^1$. Compute $f'(x)$.

Don't be thrown off by the e^1: that's a constant (equal to e or ≈ 2.7), so the derivative of that term is zero.

$f'(x) = 4e^x$

Problem code: YEQZE

6. Let $f(x) = 4e^x + 4x$. Compute $f'(x)$.

$f'(x) = 4e^x + 4$

Problem code: RLHXS (Video Solution by D. C.)

7. $f(x) = (3x^2 - 2)(6x + 3)$

Failure:
Weekly mathematics puzzle problems from a puzzle site.

Queen's UNIVERSITY

Challenge:
Reminding students (and me!) that even in a math class, we all bring in our multi-dimensional humanity into the class with us.

From Cynthia Pruss' talk:
"Make students feel like they are heard through different techniques."

Success: OnQ Pre-Class Quiz with open-ended questions

Brought you joy: saw my sister and went with my dad to Montreal to watch a Habs game
Hi everyone :0
Brought you joy: Midterm being over
Brought you joy: Felt like the 171 midterm went really well
Helpful strategies: The materials on Paul's Online notes actually help me a lot on self-pre-study of the Calculus 1
I find all this studying is making me very tired. I'm always napping lol.
Helpful strategies: The course videos are really helpful.
Helpful strategies: I like good tutorial sessions. And webwork is good too.
Brought you joy: Walking down by the water and enjoying a gelato by the harbour :)
Any anxieties? Im great!!!!!!!!!!!!!!!!!!!
Helpful strategies: I think that the qlicker questions are very helpful!
Brought you joy: Had a good midterm!
To be honest, I do not prefer the hybrid format. I wish the professor would cover and teach more complex problems in class.
Brought you joy: Ban had had really good muffins one morning
I am a bit confused with this weeks stuff
Helpful strategies: This week was pretty good! The first midterm went way better than expected but to be honest I did put in a lot of time to study.
Super excited to see what the year crest will be.
The practice problem (blank and solutions) format is the most helpful thing within the course.
Accomplishment: completing a 50 by 50 kakuro.
I wish our TAs would move a bit faster as we do not have time for more difficult problems.

Thanks to the many postdocs, teaching fellows and junior faculty who came along on this experimental ride!

Queen's UNIVERSITY

Open floor: any techniques in large lectures that have addressed these or other challenges?

Next up: Wrap-up and Closing!