Enhancing Student Learning Experiences in the Presence of AI Part I:

Course and assignment designs that deter low-effort AI use while preserving formative struggle

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Introduction

Who am I?

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What problem are we addressing?

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Why am I worth listening to?

My Classroom Evidence

Spring 2026 Calculus III course Exam comparison

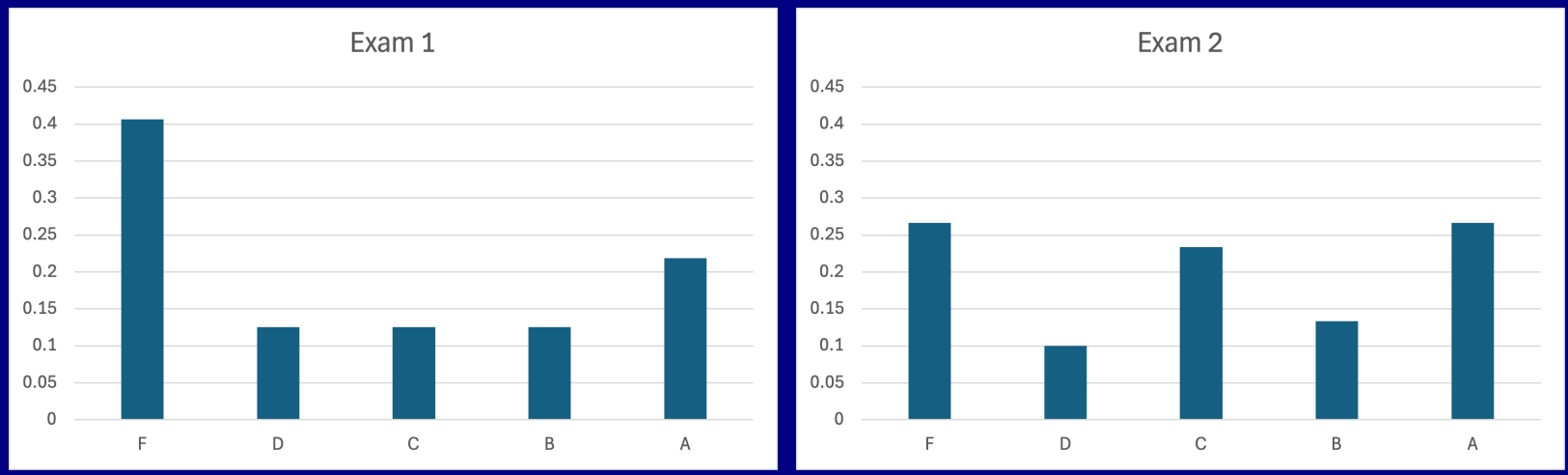

Figure: Grade distributions from Exam 1 (n = 31) to Exam 2 (n = 30).

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Outline

- Goals for the day
  - Introspect about learning
  - Build perspective to connect to students
  - Create a few materials to take home
  - Reflect on learning and the ideas presented
  - Choose actionable changes for your courses

Instructional Categories

- Rapport
- Class environment
- Assignments
- Assessments

Why?

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These will be your foundation for a soapbox talk.

Rapport: The Soapbox Talk

The “Soapbox” talk is a mechanism to set expectations and connect with students on day 1.

Brainstorming for a Soapbox Talk: You

For an effective soapbox talk, it is important to have a personal connection to the message you are sharing.
Consider:

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What you care about is likely the driving motivation for you to engage them in your specific learning environment.

Brainstorming for a Soapbox Talk: Them

Additionally, it is important to make it personally connect to your students: why should *they* care?
Support your message with what motivates *them*.
Consider:

- Who is in your class?
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What they care about is the driving motivation for their buy-in to learning in your course.

My Soapbox Talk

About me: I'm an applied mathematician. That means I use mathematical tools in application problems from other fields (physics, biology, chemistry, etc.) I work on a bridge between the disciplines of math and science, and I teach that way too. Most of my research has been in biomedical optics and photonics, but I have worked in a variety of fields.

About my teaching: I have lofty goals as your instructor. I want to empower you and show you that you are capable of more than just computations. A computer can replace you if all you understand about math is the computations. (If I can program a computer to do it, then a human doing the same operations is not adding value to the work.) Humans are capable of *more*. I want to help you become the most successful human you can be - and I do that by asking you about the work you are doing. Sure, you need to be able to compute integrals effectively - but there are bigger questions, like "What did you calculate?" "What does that tell you about this problem?" or "Why did you do it that way?" These questions draw on your reasoning. Your reasoning will be with you for decades to come, and it will give you the instinct and confidence to solve problems that haven't been solved. Why is this important? Every job you get in your field is going to ask you to solve problems that haven't been solved (if they had been solved, they wouldn't need you.) You will draw on your toolbox and your reasoning to solve those problems. I want you to do more than "plug and chug", I want you to be able to succeed and impress your future employers because you have that extra piece: you have that reasoning. I don't expect it to come naturally, and I don't expect perfection. My goal is to improve your reasoning this semester, even if it's just a little bit. That little bit is more than you came in with, and that progress will make you more successful in everything you do. I will push you academically, but I am also your safety net. When you are struggling, I am here to help you. **If you are struggling: you are learning**. Ask those questions, dig deeper to understand. Working through that struggle gives you growth. Without struggle, understanding doesn't stick. Learning something new involves some level of struggle. I've said that if you aren't struggling, you aren't learning. You can succeed, and with enough work and time, I believe all of you will.

Class Environment

There are some (weird) things I do in my classroom

- Decentralizing calculator usage
- Emphasizing reasoning
- Focusing on the work, not the answer (unsimplified forms)
- Seeking meaning through connections to tangible things
- “Yes, and...”

Result: a classroom full of questions and *learning*

Assignments

This is the place where most students turn to AI
How do we shift that?
I use:

- low-stakes assignments tied to effort rather than correctness
- groupwork/hands-on activities
- low-stakes modeling: conceptual understanding and connections to tangible meaning

Additional options:

- Flipped classroom
- Tailored homework, like ALEKS

Low-Stakes Assignments

Points are defined by *thoughtful effort*, not correctness
I see three levels of questions we ask mathematically:

1. Conceptual understanding: JiTT-type questions
2. Computational work: homework
3. Interpretation of meaning: modeling/everywhere, connects back to the conceptual understanding

JiTT-Type Questions

JiTT questions: Conceptual questions based off the reading or videos

- First question always asks for what they found most confusing
- Additional questions focus on reinterpreting the content in their own words

JiTT-Type Questions

Why this works: Either

1. They think about it themselves, or
2. If they use AI, they have explanations with instructor feedback to study for exams.

Note: Assessments must include similar questions in order to ensure student buy-in

Example JiTT-Type Questions

Calculus:

1. If $\lim_{x \to \infty} \dfrac{f(x)}{g(x)} = 0$, what does that tell you about the relationship between $f(x)$ and $g(x)$?
2. When will an absolute maximum exist? How is an absolute maximum different from a local maximum?
3. Given a water tank in the shape of a cylinder, will it take the same amount of work to pump water out of the bottom half as it does the top half? Explain your answer.
4. What is required by the alternating series test to determine if an alternating series is convergent? How does this compare to a non-alternating series?
5. Why is the center of the sphere given by $(x-a)^2 + (y-b)^2 + (z-c)^2 = 1$ at (a, b, c) instead of $(-a, -b, -c)$?
6. Why is it so much more frequent for lines to cross in 2D, compared with 3D?
7. How is a surface integral different from a standard double integral?

Numerical Analysis:

1. Describe the type of error, where it comes from, and how it is exhibited for
   a) discretization error and
   b) roundoff error.
2. Compare the fixed point iteration to our iterative methods for solving linear systems. What is required for them to converge? How are their structures similar? How are they different? Note the speed of convergence for each and their rates of convergence - how is this generally defined?

Low-Stakes Assignments: Homework

Written homework graded on thoughtful effort, not correctness.

- The emphasis is on *trying*
- Requires written solutions
- Great opportunity to give the students “mini exams” in homework form

An alternative way to do this is homework notebooks: They write solutions to online homework problems in a notebook.

- Grade the notebooks on a completion basis
- Use the notebooks for in-class quizzes

In online classes, I have also used homework notebooks as a place for sentences explaining their work: metacognition.

An alternative to written work is tailored homework (ALEKS).

Groupwork Assignments

Groupwork engages peers with each other!
Options:

- Worksheets: practice problems
- Hands-on activities: materials they physically manipulate in class (Raising Calculus to the Surface)
- Modeling projects: open-ended problems connected to reality
- Desmos (or similar) activities
- Programming projects (less useful with AI capabilities)

Groupwork couples well with a flipped classroom environment

Assessments

Assessments have to be in person to eliminate AI usage...

Online proctoring and lockdown browsers are hurdles that don't (in my experience) prevent cheating.

Cheating

I believe that all cheating stems from four things:

1. Opportunity (How easy is it to cheat?)
2. Pressure (How important is the grade?)
3. Difficulty (How difficult is it to learn?)
4. Buy-in (Why do I want to know this?)

AI has changed the landscape for Opportunity and Difficulty.

A student who has Buy-in will still learn, even if they use AI.

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We can reduce pressure by using low-stakes assignments. We can increase student buy-in through the classroom environment, assignments, and assessments we choose.

Assessment Tools

In general:

- Weight in-class work significantly higher than online assessments.
- Modify the questions asked:
  - I write my own questions (don't use canon textbook problems)
  - ask interpretation questions: what does (blank) mean?
  - ask them to explain how to do the work
  - ask them why the problem is solved that way

Assessment Tools

If assessments/tests need to be online, then we have to shift the way we assess students.

- AI “tricks”: using white/transparent text to add something to the problem
- Verbal testing: verbal exams when AI use is suspected to confirm student knowledge
- Video solution to a specific problem where they explain their work.
- Open-ended problems / Modeling
- Metacognition questions
- Constrained formatting that a human can follow, but AI will mess up

Conclusions

How do we create student buy-in to learn through productive struggle in the face of AI?

- Soapbox talk: Build rapport and set expectations
- Class environment: Reinforce expectations
- Assignments: Emphasize learning and productive struggle - not correctness
- Assessments: Use in-person assessments as much as possible, change how you assess (especially) if it's online

The primary component that we have the ability to shift is student buy-in for learning; it's more important than ever.

Wrap-up

- Look back at your first answers on the worksheet, would you change any of them?
- Write down two things you can reasonably change about your upcoming courses to deter inappropriate AI usage.
- Please complete the Exit Survey!
- Recall our goals for the day:
  - Introspect about learning
  - Build perspective to connect to students
  - Create a few materials to take home
  - Reflect on learning and the ideas presented
  - Choose actionable changes for your courses

Thank you!

Please contact me if you are interested in discussing and/or sharing ideas, or if you have any questions!

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