AI Friction Labs

CASE STUDY · CALCULUS · CHESHIRE ACADEMY · CONNECTICUT

“I’ve never had to explain anything to anyone until now.”

Twenty-one students were handed a single task: teach the derivative to a confused AI classmate who kept almost understanding — and discovered how much they didn’t know.

21	29	26	82/100
STUDENTS	SIMULATION SESSIONS	SURVEY RESPONSES	AVERAGE SCORE

THE SETUP

One task, no formulas, unlimited attempts.

Explain the derivative to Devon, a confused AI classmate who kept almost understanding.

No calculations. Just the concept itself — what it means for a curve to have a slope at a single point — communicated clearly enough that Devon could follow. Devon resisted jargon, pushed back on incomplete explanations, and stayed stuck when a student repeated themselves.

Attempts were unlimited. Five students came back for a second round. Twenty-six completed a reflection survey afterward.

WHAT THEY EXPERIENCED

The moment the explanation got hard.

For many students, the exercise produced a genuine shift — the realization, mid-conversation, that their understanding was shallower than they’d assumed. Students who worked through that realization tended to find something on the other side of it.

> It did make me wonder if I fully knew the topic, since I had to simplify what I was talking about.
>
> STUDENT REFLECTION

> Devon asked questions that I wouldn’t have thought of and gave me a new perspective on how someone else may have thought.
>
> STUDENT REFLECTION

> This made me think less mathematically and use real-life applications to explain. But in helping the person, this made me further understand what I was teaching.
>
> STUDENT REFLECTION

Not every student broke through. Some ran out of approaches and stayed stuck — and that frustration turned out to be its own kind of signal.

> I was really confused on how else to approach the AI.
>
> STUDENT REFLECTION

> It was fun until Devon began asking the same question over and over again.
>
> STUDENT REFLECTION

Engagement was universal. Response to difficulty was not. That gap is something a transcript captures in a way a test score cannot.

WHAT THE INSTRUCTOR SAW

Frustration as the lesson.

Bill Fallon Calculus Teacher · Cheshire Academy

> *They were all very active. They were really working at it. Some of them really didn't like it. Some of them really loved it.*

The range of reactions is itself worth noting. The frustration was something Fallon saw as instructive on its own terms.

> *Things are going to frustrate you in life. People are going to frustrate you. This bot is frustrating you. How do you work around that and make it so that you are productive and helping the person as best you can? That is a whole other level of thought and learning.*

The simulation put students in a genuinely uncomfortable position. For many, it was the first time persistence and adaptability mattered more than knowing the right answer.

> *In class, you want to have things that are meaningful in terms of what the kids are learning and how they're expressing that. Teachers who are less enthusiastic about it — they're going to miss out on the payoff.*
>
> BILL FALLON

WHAT IT REVEALED

Knowing a procedure and understanding what it describes are not the same thing.

There's a reason tutors often learn more than their students. Explaining something forces you to locate the gaps in your own understanding. The simulation put every student in that position by design — not as the one being helped, but as the one doing the helping. For most of them, it was the first time.

A student can differentiate x^2 correctly without having a working model of what a derivative actually represents. Most written assessments cannot tell the difference. The simulation could, usually within the first few exchanges.

BROKE THROUGH

Students who hit Devon's confusion and found a new image — a physical analogy, a different way in — were students whose understanding went deeper than vocabulary.

STAYED STUCK

Students who cycled through definitions without finding another angle were students who had memorized a phrase.

The transcript showed both, clearly and without ambiguity. That is what it made available to a teacher that a problem set cannot.

SURVEY & COHORT DATA

What the data showed.

26 student survey responses · 29 simulation sessions (21 unique students) · Cheshire Academy, Spring 2026

26	3.3/5	3.5/5	46%
SURVEY RESPONSES	AVG. USEFULNESS RATING	AVG. CHALLENGE RATING	WOULD RECOMMEND TO A FRIEND

82 average score (of 100) **23–96** score range **+33.6** avg. gain on second attempt

5 / 5 retakers improved

01

Knowing the material was not enough on its own.

Multiple students described realizing mid-conversation that their understanding was shallower than they had assumed. The gap between procedural fluency and the ability to explain was visible within the first few exchanges of most transcripts.

02

Frustration was the most common reported experience.

It was also the most instructive. Students who described getting stuck were among those who reported the clearest shift in their thinking about the material afterward.

03

Adaptation separated the high scorers from the rest.

Students who moved from formal definition toward concrete analogy broke through Devon's confusion. Those who repeated the same explanation with minor variation did not — a difference the transcript made visible.

04

Second attempts improved across the board.

All five students who retook the simulation scored higher, with an average gain of 33.6 points. Instant feedback was cited repeatedly as a reason students went back.

Scoring note. Simulation performance evaluations were conducted using an AI grading tool and reviewed by the assigning educator. Survey data reflects 26 voluntary student responses. Performance metrics involve inherent subjectivity and should be read alongside the qualitative observations in this report.

Simulations that surface student thinking.

AI Friction Labs

Cheshire Academy · Calculus · Spring 2026