Three chapters of homework in 11 minutes?

I've been teaching an algebra-based college physics course each summer for nearly 20 years. At my institution, a summer course is a little extra salary for 5 weeks' work, and it feels like Santa comes to visit in July when the session ends. Meeting for 5 weeks means I meet with 20 or so students for 2 hours each day, 5 days per week, with another 6 hours of lab work each week. Nobody can listen to (or give) a lecture for 2 hours a day, and for the first 15 or so years of running the course, it was like a physics summer camp! Two to four hours of problem solving, video analysis, whiteboarding, eating the Saskatoon berries when they ripened outside my office window, and doing problems in sidewalk chalk on the path to the library. Thanks to an early exposure to Modeling Instruction,[1] this felt like some of the most exciting, exhausting, and best teaching I've ever done.

Then COVID arrived, everything went online, and suddenly the thought of taking a class in person, at school, over the summer, was unthinkable. Nobody would sign up for an in-person summer course, particularly when the online option was available at our sister institutions, and if I wanted Santa to visit in July, I'd need to switch the class's delivery method to "online asynchronous" in April to meet registration floors.

Once again, nobody can listen to an online lecture or sit in a synchronous Zoom session with camera on for more than a few minutes, and I figured out a teaching approach that seemed to work. Lecture notes, short videos of worked problems, Pivot Interactives labs,[2] a home cooking activity measuring kcal/dollar for food items on a grocery list, and of course online homework problems via LON-CAPA[3] or WebAssign for mass practice. Teaching wasn't the fun social experience from my pre-COVID in-person summer classes, but the approach seemed viable.

I'd never paid much attention to online "AI" services before they became the default search option in Google in spring 2025. I figured AI was mostly just irrelevant marketing speak for an $n + 1$ technological improvement—along the lines of e-Learning from the early aughts, Big Data, Standards-Based Grading, the Internet of Things, and most recently the Blockchain. Then in May, per the submission logs, five of my students finished three chapters of WebAssign homework in roughly 11 minutes. What in the world was I going to do with problem solving if my online students could get the answers to nearly any physics question in seconds to minutes?

I decided during COVID that I wasn't going to go the route of invasive online proctoring with webcam monitoring of students. The invasion of privacy was too much for a student who has Internet access only at McDonald's, and I had no desire to join an arms race of monitoring technology that would favor the devious cheater who could outfox monitoring attempts—I didn't want to punish the students who were "bad" at cheating while reinforcing the behavior of students who figured out the best way to beat the system by dabbing Vaseline on their webcam. I also didn't want my students to be put in the position of wetting their pants[4] to avoid looking like a cheater. So Respondus LockDown browser, Pearson Test Centers, etc., were out.

One of the people I admire hates it when I ask, "What opportunities does this problem provide?"[5] Over the past 20 years, "this problem" has been the 2008 recession and related budget cuts, COVID, program reviews, the demographic cliff, new administrators, and now, I suppose, that AI systems seem to know what the answer to a physics problem looks like, and will give it to the students for free (for now …).

I don't know how to solve this problem, but there are probably some related opportunities that a person could take advantage of.

How do I know that students are doing the work? I don't. However, in my classes, everything must now be handwritten and submitted on paper or as a PDF. There are plenty of solutions for this, including tablet pens and photo-to-PDF software.[6] While poetic, I think handwriting and hand-drawn diagrams are more intimate and meaningful than typed text. Could a student transcribe an answer from an AI and present it as their own? Sure, but at least the words and pictures would be moving through their brains,[7] and in the past it has seemed normal for students to look for the answer to problems in books the professor isn't using. Handwriting is at least a speedbump for the student who would otherwise simply copy and paste typed work, and perhaps handwriting, for me, is an indication that there's a person who cares about students on the other end of a submitted assignment.

During COVID, a friend shared a "solution guide" activity with me that I now use regularly. In my summer class, each week students are assigned a problem to write up in the style of a textbook solution. Every student writes for a different problem, and their work is shared in an online forum. I model this activity for the students, using a rubric adapted from UMN.[8] Students draft solutions, which I give written feedback on, and after a few cycles of revision, the students are given the OK to post their work. The rubric, feedback, and grading are structured to value the storytelling parts of a physics problem that an answer box containing "72.5 newtons" can't get at. When I think about physics, there's always a picture with knowns and unknowns, there are graphs and conservation laws, and when an answer arrives, there's productive self-doubt and evaluation of whether the answer is plausible. I can praise all these things with written feedback, and for this reason I'm not sad to see online homework leave my class.

There must be other opportunities for student interaction and student growth in the coming semesters. I look forward to learning about them.

References

1. https://www.modelinginstruction.org/.
2. https://www.pivotinteractives.com/.
3. https://www.lon-capa.org/.
4. https://abovethelaw.com/2020/08/law-students-forced-to-urinate-while-being-watched-by-proctors-during-remote-ethics-exam/.
5. This is certainly not my original idea—nor is it Rahm Emanuel's slytherian comment on "never letting a crisis go to waste." I might have heard this sentiment first in Liker's *The Toyota Way.*
6. e.g., HP Pen, Apple Pencil, Remarkable Tablet, and Microsoft Lens.
7. https://www.scientificamerican.com/article/why-writing-by-hand-is-better-for-memory-and-learning/, https://www.npr.org/sections/health-shots/2024/05/11/1250529661/handwriting-cursive-typing-schools-learning-brain.
8. https://groups.physics.umn.edu/physed/rubric.html, https://groups.physics.umn.edu/physed/People/Docktor/talks_papers/PS_RUBRIC_v4.4.pdf.

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Resistance is fuzzy

In the beginning of the fall semester of 2025, Lily Gehres of Tulsa arrived at her electronics class at Kenyon College with a crocheted "resistor" for every member of the class,

Fig. 1. Crocheted resistor. The brown and black bands stand for 1 and 0, and the green is a multiplier that means 10^5. The silver band indicates the "tolerance" or the uncertainty in the resistance value, ±10%.

plus one for the instructor, Tim Sullivan. She was a declared physics major and was starting her senior year at the college. Tim lent his to me so that I could photograph it (Fig. 1). It is 5 cm long, and the tag attached to it said 1 MΩ ± 10%. When I was an undergraduate physics major in the fifties, we all knew that the first two color bands gave the first two values of the resistance and the third one was the multiplier. We never got to see resistors with 5% tolerance, with their gold band. After black and brown, which stand for 0 and 1, the rest of the numbers use the familiar ROY G BIV of the spectral colors, starting with 2 for red and going on to 3 and 4 for orange and yellow, etc. (but note that indigo is omitted, and gray and white complete the sequence as 8 and 9).

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If your car were the only thing left in the universe …

This short classroom idea uses a playful "what if" scenario to help students grasp the meaning of instantaneous velocity. By imagining a moving car as the last object in the universe, students can connect Newton's first law to a vivid mental image, making an abstract definition easier to remember.

What if your car was suddenly the only thing left in the universe? No Earth, no Moon, no Sun—just your car and empty space. That's the question I sometimes ask my students.

I tell them, "Imagine your car is moving along a straight road. Now, in an instant, the engine stops working, the road becomes perfectly smooth, all friction disappears, and there is no air at all. Then—just for fun—imagine everything else in the universe vanishes."

Now it's just you, your car, and nothing else.

What happens next? The answer, of course, is Newton's first law: your car will keep moving in a straight line at the same speed forever. That speed—in this "magic moment" when all the forces vanish—is what we call the instantaneous velocity at that moment.

Students usually smile when they picture this scene. They also remember it. For the rest of the year, when I ask "What's instantaneous velocity?" they don't recite the textbook definition. They just say, "It's the speed your car would keep if the whole universe suddenly disappeared."

I've found that little imagination games like this make abstract concepts stick. Students realize that physics isn't just about formulas—it's also about stripping away reality until only the essential idea is left.

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