

Title: Teaching with Technology: From Calculators to AI

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Teachers have always adapted to disruptive technologies, but often it is a gradual process. There have been many disruptive innovations that changed the fundamental way educators teach and the way students learn. Since the [release of ChatGPT in November of 2022](#), teachers have had to adjust very rapidly, perhaps the most rapid adjustment to the most disruptive technology. While many will equate the emergence of generative AI tools to the emergence of calculators in the 1970s and 80s, the parallels are less rigorous than we like to think (Table 1).

Table 1: Adoption Comparison of Calculators and Generative AI in Education

	Calculator	Generative AI (LLM)
Easy of use by student	High	High
Ease of faculty to control student use	High	Low
Student Access	First low, eventually ubiquitous	Instantly ubiquitous
Cost	First high, eventually low	Very Low (Free)
Subjects Affected	Subjects based on numbers and calculations: Math, Engineering, Science	All subjects -- even “creative” subjects like writing and reflections.
Likelihood of Errors	Only User Error	Hallucinations & Misrepresentations & Wrong Citations. Hard to tell when the GenAI has an Error.

Enables Student Learning	Yes, after the basics are taught.	To be determined: Yes, when faculty teach them how to use it best. No, if students <i>prompt and paste</i> .
Requires Pedagogical Adjustment	Low	High

Of course, calculators were not the first technological innovation to impact education: adding machines replaced the abacus, typewriters replaced calligraphy, computers replaced typewriters, the internet research replaced the library card catalog, just to name a few. Each of these innovations enabled teachers to expand student learning but also required new pedagogical approaches.

The use of relatively inexpensive hand-held calculators ubiquitous in education today evolved over a decade. Early calculators were for university and graduate students (i.e., higher ed) and required considerable investment from the school or the student. Years passed before the technology became inexpensive enough for calculators to become affordable and available in high schools and middle schools. Over the years it took to make the calculators affordable, teachers had time to learn and evolve their teaching methods, students who used calculators in colleges and universities became teachers comfortable teaching with calculators, and textbooks were eventually made to support student learning in the age of ubiquitous calculators.

This gradual adoption of technology over multiple years is not what occurred when ChatGPT was released on November 22, 2022. While the large language models that underlie ChatGPT were available prior to ChatGPT's release, the true innovation was the user interface that allowed anyone to start generating content . . . for FREE. The lack of any cost of ChatGPT's app and its availability for direct download also made its adoption instantaneous by anyone with a computer or smartphone and aware of its existence.

Educators' initial responses to ChatGPT's launch were varied. Some teachers and school administrations chose the *hear no evil, see no evil, speak no evil* approach, and chose to ignore the whole situation. Others wanted to address the issue but didn't have the tools or understanding to confront the new challenges. There are instances where some schools

made ChatGPT inaccessible from school computers or blocked the domain on the school's Wi-Fi, but this was only a small hurdle to digitally savvy students.

Notwithstanding the amazing capabilities of AI to create, generate content, and analyze great quantities of text, AI in education brings risks and challenges, just like every technology to precede it: **Hallucinations, Misinformation, Disinformation, Bias, Plagiarism, Critical Thinking Declines**. It is understandable that faculty would be skeptical to immediately adopt AI in the classroom.

The most Luddite response by some faculty was the *back-to-the-future approach* where all work was handwritten and completed during class time. This avoidance approach might be appropriate for teaching foundational skills (ex: basic math, compositional writing) but likely not the right approach when helping students learn how to integrate this powerful new technology into their academic lives. Like the use of calculators provides students in math and engineering student tools to learn advanced principles of these highly complex subjects, generative AI could elevate students' work in most subjects.

The calculator-GenAI comparison has merit for educators: both are powerful tools that transform how students learn. The fundamental truth is that, like the calculator, the Generative AI technology is not going away. We, the faculty responsible for teaching students how to thrive, need to learn how to teach with Generative AI for the betterment of our students, rather than avoiding it or hiding from it. Few educators would argue that learning is invalid unless outdated tools and methods are returned to the classroom. Instead, educators are starting to adapt to the latest transformation in their craft.

New technologies give birth to new pedagogies. It is incumbent on today's educators to teach students the skills of critical thinking, creative problem solving, and the appropriate techniques for using new technologies as tools to improve learning. Adapting and rebuilding our curriculum to teach with generative AI is perhaps one of the greatest pedagogical challenges facing K-12 and higher education faculty. Like always, we can't fail our students.

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Original Draft in Google Doc.