

# Generative AI could solve a problem that's long plagued classrooms

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Most of us have vivid (and sometimes painful) memories of struggling to learn something new at some point in our lives. Maybe it was fourth grade math homework at your kitchen table, or a new app that suddenly made you feel like you'd joined your grandparents' generation. Perhaps it's a more recent memory of new workplace technology that was more difficult to pick up.

It's not your fault. Learning is a challenge, especially with the way that we currently educate people.

The first forms of organized learning were based on mastery and apprenticeship. Once someone was highly experienced and skilled at a subject or trade, they were paired with an apprentice. The master worked one-on-one with their apprentice to teach them everything and the process was highly tailored to the apprentice's needs. Fully understand gravity? Let's move on to the next topic. Struggling to get a good angle on the horseshoe? Let's practice that. Done with "wax on, wax off"? Now it's time to paint the fence.

Public education is a social triumph, but as it turns out, it's not the best way to learn. In 1984 educational psychologist Benjamin Bloom observed that students who learned through one-on-one tutoring outperformed their peers by two standard deviations, with their educational performance above 98% of those who learned in traditional classroom environments. There was something to that one-on-one approach, that master-apprentice relationship, that was missing.

Obviously, private one-on-one education for every student is something that no educational system can bear—even those in the most affluent of countries. And so, the challenge, dubbed Bloom's 2 Sigma Problem, abandoned the idea of a one-on-one approach and instead tried to find ways to achieve the benefits of one-on-one education in group settings.

Until now, this challenge has frustrated the best teachers and educational psychologists, but with the emergence of generative AI systems, a solution finally feels within reach.

## A closer look at Bloom's 2 Sigma problem

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Before we look at how AI can play a role in solving the 2 Sigma Problem, we need to take a closer look at Bloom's observations and the circumstances upon which they were made.

Perhaps the biggest nuance to note is that the private tutors used "mastery learning"—a method that requires students to achieve a certain level of competence in order to progress further throughout the curriculum. For example, if you get a C— in Algebra 1, why on earth would we send you on struggling even more in Algebra 2? Mastery-based learning says, you've got to really understand the topic before we move you on to more challenging things.

Mastery learning is demonstrably effective—although its efficacy depends on a number of variables. Ability is one, with a [1990 paper showing](#) that the benefits of mastery learning are more pronounced with less-able students.

While it's possible to implement mastery learning in a classroom environment, it's an incredible logistical challenge. More specifically, it's incredibly time-consuming and requires the commitment of resources—particularly staffing—that often don't exist in the stretched public school system.

Fortunately, there's a growing body of research that suggests that mastery learning can be performed just as well with software-based approaches—and, in some circumstances, better. One [2014 study from DARPA](#) looked at a course delivered to US Navy students, with one cohort receiving human education and the other learning [through a custom-built application](#). Remarkably, the latter group outperformed the instructors by a significant margin.

## The rise of the large language models

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You're likely already aware of cutting-edge AI tools such as OpenAI's [ChatGPT](#), Google's [PaLM](#), Meta's [LLaMa](#), and Anthropic's [Claude](#). These systems go far beyond simple text prediction or language understanding; they are multitalented platforms that can accomplish an astonishing array of tasks. From generating entire essays and writing software code, to creating poems, jokes, and even assisting in scientific research, their capabilities are both broad and deeply impactful.

Beyond their awe-inspiring talents, these AI tools are equipped with the ability to analyze complex data patterns, optimize workflows, and offer personalized educational content. They can break down intricate topics into digestible information,

making learning and decision-making easier for humans.

It's for this reason that you can ask ChatGPT to explain an ostensibly abstract concept, like, for example, the theory of relativity, in simple terms, and it'll deliver something that makes sense. Here's one example:

### **Special theory of relativity**

Imagine you're in a super-fast spaceship that can go almost as fast as light. If you had a clock inside the spaceship and one back on Earth, you'd notice something weird. The clock on the spaceship would tick more slowly compared to the one on Earth! This idea is called "time dilation," and it means that time can act differently depending on how fast you're moving.

### **General theory of relativity**

This part helps us understand something we all know: gravity, the force that keeps us from floating off into space. Einstein said that space is like a trampoline. If you put a heavy bowling ball (like the Sun) in the middle of it, the trampoline will bend. If you then roll a marble (like Earth) onto the trampoline, it will circle around the bowling ball. That's how planets stay in orbit!

### **Why does this matter?**

These ideas aren't just cool to think about; they help us in real life too! For example, the GPS on your phone has to understand these rules to give you the right directions.

So, in simple terms, the theory of relativity helps us understand how time works and why things move the way they do in the universe.

From a mastery learning perspective, these generative AI systems offer several key advantages. On an economic level, they're significantly cheaper than a personal tutor with domain-specific expertise in the subject being taught. In essence, this means that one-on-one tutoring is now available to anyone with a smartphone or laptop, and not just the affluent.

It also addresses the scalability issue associated with previous software-based mastery learning tools. With a large language model-based generative AI system, you don't need to build an app for every subject taught. As an example, OpenAI

trained GPT-4 on a dataset that's believed—though unconfirmed—to span a petabyte of storage space, and produced a model with over 1.7 trillion parameters.

In practice, this means it can converse with a participant about nearly every conceivable subject—with the exception of relatively new events that the model hasn't yet been trained on.

Obviously, the relative “newness” of generative AI and large language model (LLM) technology means there isn't much data about its efficacy, unlike mastery learning, which has been studied extensively for decades.

A literature review of ChatGPT in education, published in July 2023 by academics from the University of Sevilla and Pablo de Olavide University, acknowledges the dearth of data but highlights some promising early results, particularly when it comes to the delivery of personalized education—which both the 2 Sigma Problem and Mastery Learning either emphasize, or encourage.

## **The promise of personalized education**

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With a few exceptions, teachers have erred on the side of caution in response to generative AI, because of its ability to upend how we assess a student's progress and performance. Fears that it will facilitate cheating and plagiarism lead to the technology being blocked in New York City and Seattle public schools, to name just two school districts.

Others have raised fears over LLM reliability. All LLMs are next-word-prediction machines. Most of the time those predictions are remarkably accurate from a factual standpoint. However, sometimes LLMs hallucinate, returning an answer that sounds plausible but has no factual basis.

It's important to remember the game-changing opportunities this technology offers. The ability of AI to provide personalized, one-on-one education has the potential to level the educational playing field in ways we've only dreamed of.

For instance, take Project Follow Through, an ambitious federal project aimed at boosting the academic success of disadvantaged students. The project envisioned the power of one-on-one instruction but was limited by resources. AI tools have the potential to offer that individualized attention on a scale previously unimaginable, providing new hope for tackling educational inequality.

So while the caution is understandable, the promise of what AI could bring to the world of education is too impactful to ignore. This technology has the potential not just to improve education, but to make high-quality, personalized learning accessible for all.

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