

## Why teachers should explore ChatGPT's potential

**Many students now use AI chatbots to help with their assignments. Educators need to study how to include these tools in teaching and learning – and minimize the risks.**

**T**eachers were spooked when ChatGPT was launched a year ago. The artificial-intelligence (AI) chatbot can write lucid, apparently well-researched essays in response to assignment questions, forcing educators around the world to rethink their evaluation methods. A few countries brought back pen-and-paper exams. And some schools are 'flipping' the classroom model: students do their assignments at school, after learning about a subject at home.

But after that initial shock, educators have started studying the chatbots' potential benefits. As we report in a News feature (see page 474), experiments to harness the use of ChatGPT in education are under way in many schools and universities. There are risks, but some educators think that ChatGPT and other large language models (LLMs) can be powerful learning tools. They could help students by providing a personalized tutoring experience that is available at any time and might be accessible to more students than human tutors would be. Or they could help teachers and students by making information and concepts normally restricted to textbooks much easier to find and digest.

There are still problems to be ironed out. Questions remain about whether LLMs can be made accurate and reliable enough to be trusted as learning assistants. It's too soon to know what their ultimate effect on education will be, but more institutions need to explore ChatGPT's advantages and pitfalls, and share what they are learning, or their students might miss out on a valuable tool.

Many students are already using ChatGPT. Within months of its launch, reports surfaced of students using the chatbot to do their homework and essays for them. Teachers were often unimpressed by the quality of the output. Crucially, the chatbot was inventing fictitious references or citations. And although it excelled in some mathematical tests<sup>1</sup>, it didn't do as well in others. That's because ChatGPT has not been trained specifically to solve mathematical problems – rather, it finds plausible words to finish a sentence or respond to a query on the basis of billions of pieces of text it has seen.

In a February preprint, researchers described how, in a benchmark set of relatively simple mathematical problems usually answered by students aged 12–17, ChatGPT answered about half of the questions correctly<sup>2</sup>. If the problems were more complex – requiring ChatGPT to do



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four or more additions or subtractions in the same calculation – it was particularly likely to fail.

And the authors of a preprint study published in July found that the mathematical skills of the LLM that underlies ChatGPT might have worsened<sup>3</sup>. In March 2023, the GPT-4 version of the chatbot correctly differentiated between prime and composite numbers 84% of the time. By June, it did so in only 51% of cases. The study's authors note that “improving the model's performance on some tasks, for example with fine-tuning on additional data, can have unexpected side effects on its behavior in other tasks”.

Despite these risks, educators should not avoid using LLMs. Rather, they need to teach students the chatbots' strengths and weaknesses and support institutions' efforts to improve the models for education-specific purposes. This could mean building task-specific versions of LLMs that harness their strengths in dialogue and summarization and minimize the risks of a chatbot providing students with inaccurate information or enabling them to cheat.

Arizona State University (ASU), for example, is rolling out a platform that enables faculty members to use generative AI models, including GPT-4 and Google's Bard – another LLM-powered chatbot. The platform uses a technique called retrieval-augmented generation in ASU courses. ChatGPT or Bard are instructed to seek answers to users' questions in specific data sets, such as scientific papers or lecture notes. This approach not only harnesses the chatbots' conversational power, but also reduces the chance of errors.

One of the greatest risks is that LLMs might perpetuate or worsen long-standing societal concerns, such as biases and discrimination. For example, when summarizing existing literature, LLMs probably take cues from their training data and give less weight to the viewpoints of people from under-represented groups. ASU says that its platform helps to address such concerns by ensuring that the LLMs provide the sources that they used to generate answers, allowing students to think critically about whose

ideas the chatbots present.

Vanderbilt University in Nashville, Tennessee, has an initiative called the Future of Learning and Generative AI. Students who need to use ChatGPT, for courses such as computer science, get access to a paid version. This variant of the chatbot can use other programs to execute computer code, augmenting the bot's mathematical capabilities.

As understanding of the LLMs' power and limitations increases, more university-wide initiatives will no doubt emerge. Using LLMs without considering their downsides is counterproductive. For many educational purposes, error-prone tools are unhelpful at best and, at worst, damage students' ability to learn. But some institutes, such as ASU, are trying to reduce the LLMs' weaknesses – even aiming to turn those into strengths by, for example, using them to improve students' critical-thinking skills. Educators must be bold to avoid missing a huge opportunity – and vigilant to ensure that institutions everywhere use LLMs in a way that makes the world better, not worse.

1. OpenAI. Preprint at <https://arxiv.org/abs/2303.08774> (2023).
2. Shakarian, P. et al. Preprint at <https://arxiv.org/abs/2302.13814> (2023).
3. Chen, L. et al. Preprint at <https://arxiv.org/abs/2307.09009> (2023).

## How our memories of COVID are biased, and why it matters

**Our vaccination status skews our perception of the pandemic's severity, with consequences for people and policy.**

**L**ives are still being lost to COVID-19 every day. And for many left with debilitating after-effects of the disease, it remains a very real, immediate experience. But for many others, the circumstances of the pandemic are becoming a matter of memory. These memories might still be fresh and painful, or more distant and neutralized by the passage of time. Either way, they are almost undoubtedly unreliable.

This is not, in itself, a surprise: that different people can have very different memories of the same past events, and that pre-existing biases can influence these memories, is an established facet of human psychology. But a series of studies reported in a paper<sup>1</sup> this month in *Nature* shows that our impressions of the COVID-19 pandemic's severity, as well as of measures taken to limit the disease's spread, are reliably skewed by a related factor: our vaccination status.

The results give pause for thought as countries exercise their collective memories to examine how authorities handled the pandemic and what should be done differently next time. "When looking back, we should all be aware that

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we have biased memories,” says Cornelia Betsch at the University of Erfurt in Germany, an author of the *Nature* paper. “You could be right or wrong. I could be right or wrong. Or, most likely, we’re all wrong.”

Betsch and her colleagues' project involved surveying more than 10,000 people across 11 countries. For one study, they resurveyed German adults who had been asked in summer 2020 or winter 2020–21 to estimate their risk of SARS-CoV-2 infection, asking them to recall their earlier answers. They embarked on the project in late 2022, after a journalist commented during a conference that people who opposed vaccination seemed to be shifting their narrative of the pandemic. The authors' analysis revealed that unvaccinated individuals who identified strongly with their unvaccinated status were more likely to remember their earlier estimation of the risk as lower than it actually was. Conversely, and more markedly, those who had been vaccinated overestimated their earlier perception of their risk of catching the disease.

As with any study, there are caveats. The data were collected online, and most of the countries sampled are wealthy and in the Northern Hemisphere. The study did not evaluate the effect of the different pandemic policies enacted in different regions. The researchers also surveyed only adults. At this stage, there is no way of knowing how children will remember the pandemic when they are older – or how those memories might colour their decisions should another pandemic occur when they are adults.

Memory bias has been observed in other politically charged settings, including recall of COVID-19 vaccine misinformation<sup>2</sup>, the campaign surrounding Ireland's 2018 referendum on legalizing abortion<sup>3</sup> and the 2021 US Capitol riots<sup>4</sup>. Such bias feeds polarization. Communication is difficult when shared memories diverge. It can influence discussions at every level: within families, in the media and within governments and other authorities.

The conclusions of the latest study are highly relevant to investigations such as the ongoing inquiry into the United Kingdom's handling of COVID-19, a process that has been garnering headlines in the past weeks. Those overseeing such investigations must recognize that personal recollections are clouded by bias. In drawing conclusions about which pandemic interventions were warranted or effective and which were not, it is imperative that investigators rely as much as possible on hard data and evidence.

Many of the conflicts we struggle with today stem from how we view past events now, rather than how we experienced them then. The divergence in our collective memory is also likely to be a significant factor in future pandemics, determining, for example, whether individuals are willing to comply with the associated public-health mandates. How to counter these effects in the future must be a subject for more research today.

1. Sprengholz, P., Henkel, L., Böhm, R. & Betsch, C. *Nature* <https://doi.org/10.1038/s41586-023-06674-5> (2023).
2. Greene, C. M., De Saint Laurent, C., Hegarty, K. & Murphy, G. *Appl. Cogn. Psychol.* **36**, 1200–1208 (2022).
3. Murphy, G., Loftus, E. F., Grady, R. H., Levine, L. J. & Greene, C. M. *Psychol. Sci.* **30**, 1449–1459 (2019).
4. Calvillo, D. P., Harris, J. D. & Hawkins, W. C. *Memory* **31**, 137–146 (2022).