Shaping GenAI for Education

Investigators: Osbert Bastani, Hamsa Bastani

Background

The rapid rise of GenAI has created both significant opportunities and risks for education. In 2023, the first large-scale field study assessing the impact of unfettered access to GenAI demonstrated that it can negatively affect student learning outcomes. As companies increasingly build GenAI systems designed to function as tutors, there is an urgent need for a foundational science of GenAI tutoring. Understanding how to rigorously evaluate these tutors and identifying the ingredients that facilitate rather than harm learning is critical.

The Big Idea

Establish a scientific foundation for evaluating and designing GenAI tutors to improve student learning outcomes.

Why does this matter? Ensuring the widespread adoption of AI in education leads to positive learning outcomes is essential for the future of teaching. This research addresses the risks and potential harms of GenAI tutors while promoting evidence-based educational tools.

What will you do? The research aims to create a rigorous benchmark for evaluating GenAI tutors based on actual student learning, not just user preferences. Additionally, it investigates novel methodologies for designing tutors that are effective in improving learning outcomes.

How will you do it? To build the benchmark, a platform will be designed to teach students concise topics and assess learning through quizzes rather than preference-based metrics. For tutor design, the research will explore neuro-symbolic GenAI tutors that require students to engage deeply with problems before receiving help, reinforcement learning approaches to generate personalized practice problems and hints based on individual learning trajectories, and Shapley value analyses to quantify the impact of prompt elements on tutor effectiveness. Together, these approaches provide both practical tools for GenAI tutoring and a scientific understanding of effective teaching strategies.

Impact

This research has the potential to shape the positive transformation of education by ensuring GenAI tutors enhance learning. It leverages Penn's interdisciplinary strengths, combining AI expertise in Penn Engineering with behavioral science insights from Wharton. Collaborations with the Graduate School of Education will further integrate learning science, providing a foundation for more effective, scalable and equitable educational technology.

Learn More