InsPIRE Insight

GenAI for teaching and learning: a Human-in-the-loop Approach

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KEY IMPLICATIONS

1. Generative AI (GenAI) tutors are most effective when designed with a "human-in-the-loop" approach, ensuring pedagogical alignment and accuracy before deployment.
2. A Socratic tutoring style—where the AI guides students through questioning rather than giving direct answers—can lead to higher learning gains and deeper engagement.
3. Continuous feedback loops between students, faculty, and developers are essential for refining GenAI tools and building trust in their use.

BACKGROUND

GenAI has the potential to offer personalized learning at scale, but ensuring these tools contribute to intended learning outcomes requires careful design. Statistics courses at the university often have large, diverse cohorts where 90% of students historically request tutoring support. This initiative sought to address this demand responsibly by integrating a GenAI tutor into a statistics course.

FOCUS OF INITIATIVE

The initiative focused on developing and implementing a "Socratic GenAI tutor" for undergraduate statistics. Unlike standard chatbots, this tool was engineered to facilitate inquiry-based, step-by-step problem solving. The project aimed to validate the tool's effectiveness regarding response accuracy, engagement quality, and learning gains through a rigorous human-in-the-loop process involving course coordinators and students.

KEY OUTCOMES

- **Improved Learning Gains:** In experimental studies, students using the Socratic GenAI tutor showed higher learning gains compared to a control group using a baseline chatbot, particularly when they engaged in questioning the AI.
- **High Accuracy:** Validation by subject matter experts (instructors) confirmed an accuracy rate exceeding 80% for the tool's responses.
- **Student Preference:** Students preferred the Socratic guidance for its explanations,

though they noted that response times could be improved.
- **Faculty Empowerment:** A faculty-facing analytics dashboard was created to allow instructors to monitor topics asked, cognitive levels of questions, and student feedback in real-time.

SIGNIFICANCE OF OUTCOMES

- **Implications for practice:** Educators can leverage GenAI not just for content delivery, but for active scaffolding of learning. The success of the Socratic approach suggests that prompt engineering should focus on *how* AI interacts with students, not just *what* it knows. Furthermore, the inclusion of a faculty dashboard ensures that AI adoption does not black-box student learning; instead, it provides instructors with data to improve their teaching strategies.
- **Implications for policy:** The "human-in-the-loop" methodology—spanning co-design, pre-testing, and pilot feedback—serves as a model for responsible AI governance in higher education. It demonstrates that successful AI integration relies on ongoing collaboration between technologists and educators, rather than a "deploy and forget" strategy.

PARTICIPANTS/SCOPE

The initiative targeted a statistics course with approximately 600 students per cohort. The experimental phase involved 45 student volunteers, and the pilot study is currently being rolled out in real classroom settings.

METHODOLOGY/APPROACH

The project followed a four-stage deployment approach:

1. **Co-Design:** Coordinators and developers designed the Socratic behaviors and the faculty dashboard requirements.
2. **Instructor Validation:** Faculty tested the bot for accuracy and engagement quality before student access.
3. **Experimental Study:** A randomized control trial compared the Socratic GenAI tutor against a baseline GPT-4 model to measure learning gains.
4. **Real Class Pilot:** The tool was deployed in live classes with continuous "feedforward" loops where instructors monitored downvoted responses to refine the system.

References

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Link to full article at
https://www.solaresearch.org/wp-content/uploads/2025/02/LAK25-CompanionProceedings.pdf
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