

# Leveraging AI Tutors to Enhance Student Learning: A Controlled Educational Intervention Study

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This study investigates the effectiveness of AI-tutored learning environments in implementing evidence-based learning techniques among undergraduate students. Drawing from cognitive science principles, particularly those outlined in Willingham's (2023) work, we developed an innovative intervention utilizing AI tutors to simulate personalized learning environments focused on three key areas: effective note-taking, complex text comprehension, and exam preparation strategies.

In this controlled experiment, 40 first-year psychology students were randomly assigned to experimental (n=20) and control (n=20) conditions. The experimental group participated in eight structured sessions with AI tutors over one semester, while the control group maintained standard learning practices. The intervention's effectiveness is being assessed through a mixed-methods approach combining quantitative academic performance metrics with qualitative analysis of student responses.

Our analytical framework employs a novel combination of traditional pre-post comparisons and advanced natural language processing techniques. Specifically, open-ended student responses are being analyzed using zero-shot classification implemented through Facebook's BART model, complemented by sentiment analysis using the transformemotions package in R. This methodological approach allows for both systematic categorization of learning outcomes and nuanced understanding of students' emotional engagement with the AI-tutored environment.

While data collection is ongoing, this study contributes to the growing body of research on AI-enhanced educational interventions and provides a methodologically rigorous framework for evaluating their effectiveness. The findings will have important implications for implementing scalable, evidence-based learning support systems in higher education.

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