AI and College Student Learning: Causal Effect and Behavioural Process from a Field Experiment

College students' use of AI for learning is increasingly common, yet the conditions under which AI helps or harms learning remain unclear. This study has two goals: (1) to estimate the causal effects of brief versus engaging use of AI during a learning task, and (2) to analyse the behavioural processes involved when students interact with AI. The study took place in a peer-led team learning programme for undergraduate introductory STEM courses at a university. Using a customised interface, 660 students were randomly assigned to no use, brief use, or engaging use of ChatGPT for a course-specific quiz administered in late 2023. The dataset includes 2,045 student-problem observations comprising timestamped quiz responses, student-AI interaction messages, and exit survey data. Drawing on learning theories for the AI era, this study considered user behaviours such as compliance, trust in AI, AI literacy, and active inquiry. It estimated complier average causal effects and applied natural language processing and machine learning models to understand students' behavioural processes.

Three findings emerge. First, more than half of the students assigned to the AI conditions did not comply with using AI, indicating that in this peer-led context, students trusted knowledgeable human peers more than AI for a quiz task. Second, among compliers, brief AI use had a negative and significant effect on quiz performance. In contrast, engaging AI use had a positive, significant, and sizable effect on quiz grades. Third, analyses of behavioural processes reveal heterogeneity that helps explain these opposing causal effects.

These findings underscore the importance of developing trustworthy AI tools as well as fostering students' trust in them; the central role of AI literacy and competence in enabling effective, responsible, and ethical AI use for learning; and the promise of user-AI teaming as a direction for designing AI tools that support equitable learning opportunities in higher education.