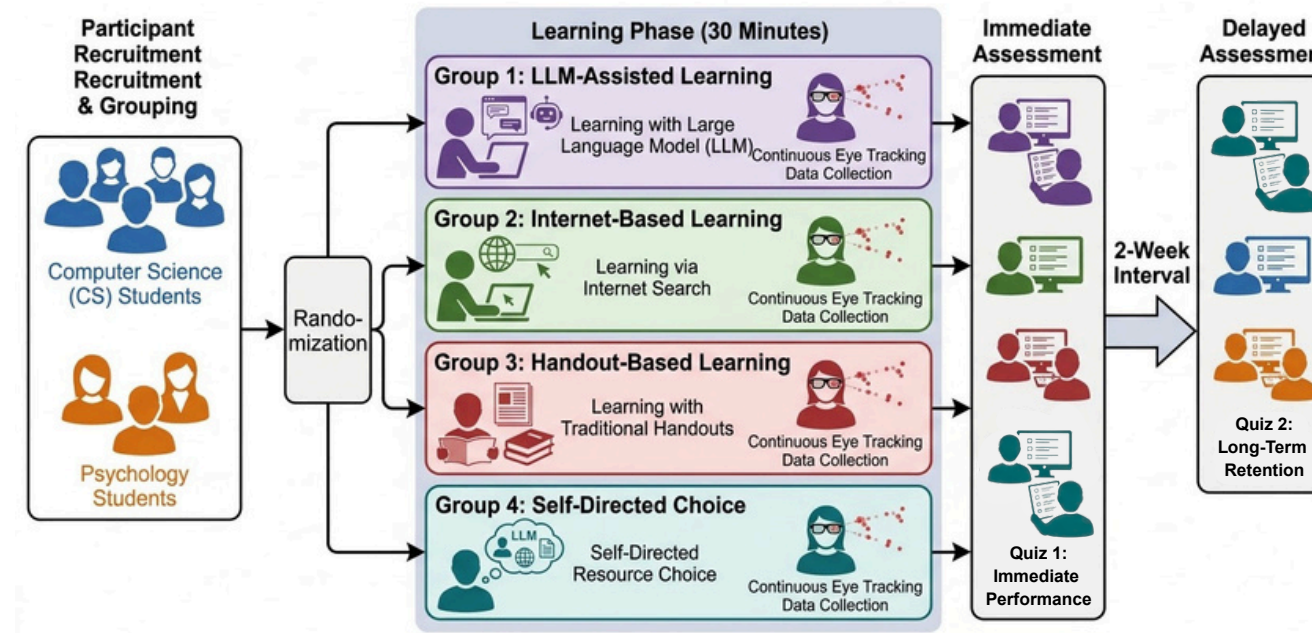


Introduction

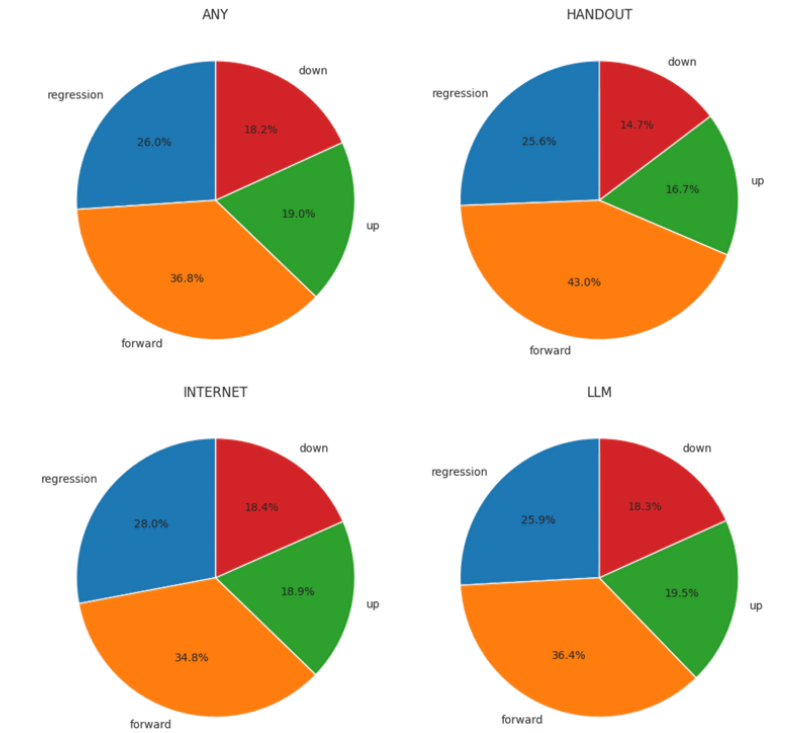
- Artificial Intelligence (AI), particularly Large Language Models (LLMs), is increasingly integrated into education.
- LLMs enable interactive, adaptive, and personalized learning experiences.
- LLMs provide real-time feedback and dynamic explanations, enhancing knowledge acquisition.
- Despite growing adoption, there is limited empirical evidence on the effectiveness of LLMs in education.
- This research explores the role of LLMs in improving student learning outcomes and engagement.

Methodology

Study Design: Comparing Learning Modalities and Cognition



Discussion & Behavioral Insights

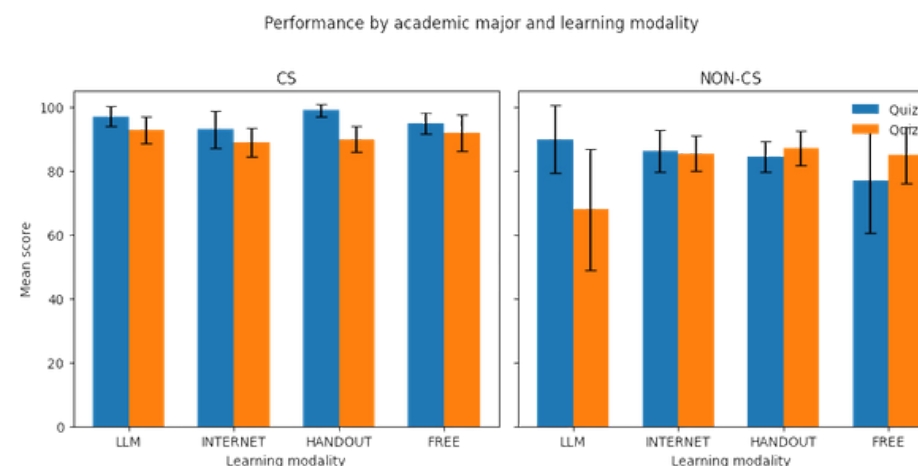


Research Questions



- **RQ1:** Does LLM-assisted learning improve immediate performance compared to internet and handout-based study?
- **RQ2:** Do retention patterns differ across learning modalities?
- **RQ3:** How do visual attention patterns (eye tracking) vary across learning tools?
- **RQ4:** Does learner background (CS vs non-CS) influence learning outcomes and retention?
- **RQ5:** Are LLM-based learning gains sustained after a delay?

Results



- Performance varies by academic major and learning modality.
- CS students show higher overall and more consistent performance.
- NON-CS students show lower scores and greater variability between quizzes.
- Results suggest learner background influences performance patterns across modalities.

Key Findings

- LLMs boost immediate performance, but gains are not sustained over time
- Delayed learning outcomes converge across all study modalities
- Eye-tracking reveals distinct engagement patterns across learning tools
- LLM users show more focused and consistent visual attention

Acknowledgement

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