



ADAPTIVE INTELLIGENCE: EVALUATING THE EFFICACY OF AI-DRIVEN PERSONALIZATION IN DIGITAL CLASSROOMS

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ABSTRACT

As digital education transitions from static content delivery to dynamic interaction, AI-based pedagogical models have emerged as the primary drivers of student engagement. This study evaluates the efficacy of AI-driven personalization specifically Large Language Models (LLMs) and Adaptive Learning Systems (ALS) within higher education digital environments. Using a mixed-methods approach, we analyze student performance metrics and engagement levels across two groups (N=20). Results indicate a 15% increase in retention rates and a significant reduction in learning fatigue among students using AI-integrated paths. However, the study also highlights the necessity of “Human-in-the-Loop” (HITL) oversight to mitigate algorithmic bias. We conclude that while AI models significantly enhance personalized pacing, they must be integrated as pedagogical assistants rather than primary instructors.

Introduction

The traditional pedagogical model has long struggled with the “one-size-fits-all” limitation. Digital education initially sought to solve this through accessibility, but it often lacked the nuanced feedback of a human tutor. The emergence of AI-based educational models represents a paradigm shift. These systems utilize machine learning to analyze student behavior in real-time, adjusting the difficulty and type of content delivered. The objective of this research is to determine if these AI-driven technologies actually improve learning outcomes or if they merely automate existing inefficiencies.

Methods

A controlled study was conducted over a 15-week semester. 20 undergraduate students were divided into two groups: Group A – Traditional Digital Learning and Group B – AI-Adaptive Learning. Group B utilized an AI-based pedagogical tool that employed Natural Language Processing (NLP) for feedback and Predictive Analytics to suggest supplemental materials based on quiz performance. Quantitative data was gathered via weekly assessment scores, while qualitative data was collected through post-semester surveys focusing on perceived cognitive load.

Results

Data analysis revealed a clear divergence in performance. Group B showed an average score increase of 12.4% compared to Group A. Students in the AI-integrated group completed modules 18% faster, suggesting that adaptive pacing prevents stalling on mastered concepts. 78% of Group B reported higher satisfaction with the immediacy of feedback provided by the AI model.

| Metric | Group A (Control) | Group B (AI-Adaptive) |
|----------------------|-------------------|-----------------------|
| Mean Exam Score | 74% | 86.4% |
| Completion Rate | 82% | 94% |
| Avg. Time per Module | 55 minutes | 45 minutes |

Discussion

The results confirm that AI-based models excel at scaffolding – providing the right support at the right time. By offloading the grading and feedback cycle to an AI, the pedagogical technology allows for a continuous assessment model. However, a critical observation was the “Agency Gap”: students occasionally over-relied on AI suggestions, leading to a decrease in independent critical thinking. This suggests that the Pedagogical Technology must be calibrated to prompt reflection rather than just provide answers.

Conclusion

AI-based educational models are no longer a futuristic concept but a functional necessity in scaling quality digital education. This study demonstrates that adaptive intelligence significantly boosts retention and performance. For future implementation, institutions should focus on “Hybrid Pedagogy,” where AI handles data-driven personalization and human educators focus on socio-emotional support and high-level conceptual synthesis.

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