

AI Avatars in Education: Effects on Knowledge Acquisition, Academic Motivation, and Cognitive Load

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Abstract

Artificial intelligence (AI) is shaping educational environments by enabling new forms of interactive, personalized, adaptive, and student-centered learning. This study investigates the pedagogical potential of AI-powered digital avatars in enhancing three critical learning dimensions: knowledge acquisition, academic motivation, and perceived cognitive load. A total of fifty university students from the University of Messina were randomly assigned to two groups: an AI-avatar interaction group and a control group, completing the same learning task via autonomous Internet search. The AI avatars acted as intelligent virtual tutors, capable of providing multimodal explanations, adaptive pacing, and immediate feedback based on learner performance. Results from a two-way ANOVA revealed a significant main effect of instructional modality on overall learning outcomes, $F(1, 44) = 4.66$, $p = .036$, $\eta^2 = 0.096$, indicating that students interacting with AI avatars achieved higher knowledge gains and greater motivation than those using traditional learning methods. No significant gender or interaction effects were observed, suggesting that avatar-based instruction offers inclusive benefits across diverse learners. Participants in the avatar group also reported reduced cognitive strain and greater engagement, demonstrating the potential of AI-driven agents to foster more effective and enjoyable learning experiences. These findings contribute to the growing body of research supporting the integration of intelligent tutoring systems and conversational AI in digital education. By leveraging personalization, social presence, and multimodal interaction, AI avatars can act as scalable and accessible tools to improve learning outcomes and motivation in higher education. This study highlights the importance of evidence-based design in developing AI technologies that promote equity, engagement, and efficiency in future learning environments.

Keywords: Artificial Intelligence; Digital Education; Intelligent Virtual Tutors; Multimodal Interaction; Personalized Learning