Chapter 9
Impact of AI-powered Game Simulation on Adults' Cognitive Functions:
Efficacy of "CogniFit"

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ABSTRACT

Cognition refers to the ability to perform daily tasks and activities. However, cognitive ageing leads to changes in cognitive function and capacity over time. The purpose of this study was to evaluate the impact of an AI-powered simulation tool CogniFit on adult cognitive functions. The study aimed to enhance cognitive abilities, specifically memory, retention, reasoning, and concentration. An experimental one-group pre-test and post-test design was employed via CogniFit. A total of 31 participants completed the pretest, intervention training, and post-test assessments. The results indicated significant improvements in cognitive functions following the intervention, demonstrating the effectiveness of AI-powered simulation games in enhancing cognitive performance. Both genders experienced a small reduction in cognitive age. The findings suggested that AI-based games could be a valuable tool in addressing cognitive decline, particularly in memory, reasoning, and coordination.

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INTRODUCTION

Adopting Artificial Intelligence (AI) in gaming has been a fascinating journey marked by innovations, advancement, and personalization. Initially, the developers relied solely on the predefined algorithms governing behavior and decision-making capabilities (Chergarova et al., 2024). However, due to increased computational power and machine learning, more sophisticated AI techniques were integrated into gaming to make them interactive and predictive. This AI-governed content further helps to enhance player immersion, challenge, and engagement with the game content (French, 2023). AI-based non-player characteristics (NPCs) facilitate life-like behaviours and responses, contributing to a more realistic and dynamic gaming world (Bankhurst, 2023). In addition to their commercial purpose, games have captured the attention of training professionals and educators. Educational games and simulations are excellent active learning tools that offer students hands-on experiences. Learners construct knowledge from experience and reflection. Zapalska et al. (2012) differentiated games and simulations as both are attributed to having specific purposes and structures. A game involves competition and achieving pre-defined specific objectives, while a simulation replicates real-world scenarios and emphasizes situational learning. Games and simulations are of different types, ranging from digital, applied, and AI-based.

In AI-based simulations, students interact with the gaming environment and learn to apply previous knowledge and practical skills to real-world problems (Angelini et al., 2015). Teachers or game developers create a scenario-based environment to achieve their own educational goals mapped on pre-defined learning outcomes. The practical scenario may be carried out individually or within a team (Robertson et al., 2009), leading to collaboration and knowledge sharing among players. Vlachopoulos and Makri (2017) emphasized that scenario-based simulation helps players acquire important skills, i.e., teamwork, leadership, interpersonal communication, decision-making, task prioritization, and stress management. Digital simulations at the higher education level enable students to be authentic, interactive, and self-driven in knowledge acquisition (Flanagan, 2004).

Haider et al. (2024) reported the positive impact of AI-driven simulations on memory enhancement and retention. The integration of AI in simulations not only supports memory but also facilitates essential tasks such as note-taking and setting personalized reminders, making the learning process more effective. Majumder and Dey (2022) pointed out that AI technologies are effective at boosting memory retrieval and storage by providing timely prompts. Beyond just helping with memory retention, AI-driven simulations have shown they can lighten cognitive load and improve how we process information. Additionally, Makhataeva et al. (2023) highlighted how voice-to-text technology plays a crucial role in enhancing cognitive