NEWSLETTER

Can Human-Machine Collaborative Learning Based on Generative Artificial Intelligence Improve Student Learning Outcomes? A Meta-Analysis of 20 Experimental and Quasi-Experimental Studies

By He, W., Zhao, S., Abulaiti, W., Ta, W., & Xu, E.
Correspondence to: Weigang Ta, Xinjiang Normal University, China, E-mail: taweigang@126.com

AS a result of the application of artificial intelligence (AI) in education, human-machine collaborative learning emerged as a novel learning modality, attracting much attention in academia. The advent of generative AI (Gen AI) gave new impetus to this modality. Nevertheless, there are debates on the effectiveness of Gen AI-based human-machine collaborative learning. This article synthesizes the findings of 20 experimental and quasi-experimental studies, using the meta-analytical techniques, and examines the impact of moderating variables, such as the disciplinary domain, type of knowledge, duration of intervention, on the outcomes of Gen AI-based human-machine collaborative learning.

Research Findings:

- Compared with traditional learning methods, Gen AI-based human-machine collaborative learning is more effective in enhancing student outcomes. Specifically, Gen AI's potent capability of generating content, translating language, understanding contexts, and replicating scenarios, as well as providing instant feedback in customized interaction, can help serve the different needs of various learners and alleviate their cognitive anxiety. Also, Gen AI has the potential to assist learners in enacting brainstorming-based, human-machine collaborative knowledge generation by providing simulated scenarios.
- The analysis of moderating variables reveals that Gen AI-based human-machine collaborative learning is exceptionally effective in the study of procedural knowledge in the domain of social sciences; that its effects are less significant in experiments with enduring durations of intervention; that practices like group learning, defining Al's roles in human-machine interaction, and adopting the flipped classroom have significantly positive impacts on the modality's outcomes; and that there are no significant inter-group differences in the disciplinary domain, type of knowledge, and learning pattern.

This study demonstrates the positive effects of Gen AI-based human-machine collaborative learning on student outcomes, providing implications for the development of pathways for implementing this modality. Future researchers need to pay more attention to improving the pertinence of the modality's design, increasing the weight of communal learning, and enhancing the precision of Al's roles.

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