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Generative AI in STEM within Technology Education: Opportunities, Barriers, and Perspectives from Taiwan

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Abstract

STEM-based learning is globally recognized as an effective approach to fostering interdisciplinary skills and preparing students for complex, real-world challenges. In Taiwan, technology education has increasingly embraced STEM principles, particularly in secondary technology subjects, as a strategy for promoting meaningful learning outcomes. It is common to observe technology teachers incorporating STEM concepts into their classroom practices. However, teacher training programs in Taiwan lack dedicated courses on STEM-based learning, leaving educators to address challenges in preparing content across disciplines such as science, engineering, and mathematics. While experienced teachers leverage their expertise to design lessons, novice educators often struggle with implementing comprehensive STEM education due to limited background knowledge. Recent advancements in generative artificial intelligence (GenAI) present new opportunities for STEM teaching. Despite its potential, little research has explored how GenAI can support STEM-based learning by ensuring consistent lesson quality across teachers. This study seeks to address this gap and examine how GenAI can enhance STEM education. Using a quantitative research approach, this study investigates Taiwanese technology teachers' confidence in using GenAI and their primary concerns. Data were collected from 67 secondary school technology teachers across Taiwan, all teaching students aged 13 to 15. The study addresses two key questions: What is the confidence level of technology teachers in using GenAI for STEM education? What are their main concerns regarding its use? Key findings reveal that (1) 39% of teachers reported neutral confidence in using GenAI, while 36% expressed low confidence. (2) The lack of peer support and teaching resources emerged as the most significant concerns. (3) Confidence levels were a critical factor influencing teachers' ability to integrate GenAI into curriculum design. These findings underscore the need for targeted professional development programs to enhance teacher confidence and provide sufficient resources. Facilitating teacher engagement through collaborative platforms can promote the effective integration of GenAI into STEM education, improving teaching practices and student learning outcomes.

Keywords: STEM-based learning, Generative AI, Teacher confidence, AI challenges in STEM Education