

Artificial Intelligence Technologies in STEM Education: A Systematic Literature Review of Applications, Outcomes, and Implementation Challenges

Mohammed Y M Mai

Sultan Idris Education University, Perak, Malaysia

Abstract:

Background: Science, technology, engineering, and mathematics (STEM) education has become a principal testing ground for artificial intelligence (AI) technologies. Despite rapid growth in deployments, the literature remains fragmented across disciplines and educational levels.

Purpose: This systematic literature review synthesises empirical evidence from 54 included studies (2020–2026) to map AI technology types, educational purposes, learning outcomes, and implementation challenges across K-12 and higher education STEM contexts.

Methodology: Seven databases (Scopus, Web of Science, ScienceDirect, SpringerLink, IEEE Xplore, ERIC, Google Scholar) were searched following PRISMA 2020 guidelines (Page et al., 2021). From 1,267 identified records, 54 studies met inclusion criteria after sequential screening. Thematic synthesis was applied (Thomas & Harden, 2008).

Findings: Five themes emerged: types of AI deployed; personalised learning and assessment; student outcomes; teacher readiness; and ethical and implementation challenges. Benefits are documented across mathematics, computer science, and robotics education; teacher preparation and algorithmic bias remain key barriers.

Conclusion: AI can meaningfully enhance STEM learning when embedded in coherent pedagogical designs, but technology-first adoption without teacher preparation and ethical governance consistently underperforms.

Keywords:

Artificial intelligence in education, STEM education, systematic literature review, intelligent tutoring systems, adaptive learning, robotics, learning analytics, generative AI.