Chapter 16
Navigating the Use of AI in Engineering Education Through a Systematic Review of Technology, Regulations, and Challenges

Novrindah Alvi Hasanah
https://orcid.org/0000-0001-9328-5065
Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

Miladina Rizka Aziza
https://orcid.org/0000-0001-8832-7398
Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

Allin Junikhah
https://orcid.org/0009-0001-5432-2457
Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

Yunifa Miftachul Arif
https://orcid.org/0000-0002-2183-0762
Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

Manuel B. Garcia
https://orcid.org/0000-0003-2615-422X
FEU Institute of Technology, Philippines

ABSTRACT

The integration of artificial intelligence (AI) into engineering education has emerged as a transformative force, offering innovative tools to enhance teaching, learning, and administrative processes. This study presents a systematic review of the current landscape, focusing on the AI technologies application, the regulatory frameworks, and the challenges encountered in engineering education. The findings reveal how AI can improve student learning outcomes, personalize educational experiences, and automate complex

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processes. The review also addresses critical issues, such as ethical considerations and the imperative for regulatory compliance. Furthermore, it identifies key barriers to adoption, such as technological limitations and the preparedness of educators and students to embrace AI-powered solutions. This study provides a comprehensive understanding of the potential and limitations of AI in engineering education, offering actionable insights for educators, policymakers, and stakeholders aiming to foster effective and ethical AI integration in academic settings.

INTRODUCTION

Artificial intelligence (AI) has quickly become a transformative agent in education (Garcia, Arif, et al., 2024; Mangubat et al., 2025; Miller et al., 2025). In engineering education, educators can adopt advanced AI technologies to develop personalized, efficient, and engaging learning experiences (Gantalao et al., 2025; Ocak et al., 2023). For instance, generative AI (GenAI) systems (e.g., ChatGPT) offer personalized assistance that enables students to solve problems actively and foster a deeper understanding of engineering concepts (Qadir, 2023). The integration of AI with existing technologies, such as virtual reality (VR) and augmented reality (AR), allows learners to immerse themselves in simulated environments where they can engage with complex engineering topics more intuitively and experientially (Schleiss et al., 2022). The emergence of AI-driven tools—including machine learning (ML), natural language processing (NLP), and intelligent tutoring systems (ITS)—has opened new frontiers in engineering education. These tools, including AI-powered robots and tutors, enable learners to progress at their own pace and address areas of difficulty. Maximizing the usage of these pedagogical tools creates a more equitable and data-rich learning environment (Johri, 2020). Studies highlight the potential of these technologies to enhance student motivation and engagement by promoting interactive and accessible learning (Heck & Schouten, 2021). Collectively, these innovations help develop critical thinking skills and better prepare students for the complexities of the engineering profession.

However, with great power comes great responsibility—especially as we enter a realm where AI technologies require carefully crafted regulatory frameworks to ensure their ethical and responsible deployment. The thoughtful implementation of AI in education is critical, particularly given the sensitivity of student data and the potential for biases embedded in algorithms. Compliance with frameworks such as the General Data Protection Regulation (GDPR) is essential to safeguard student privacy and data security. Moreover, institutional policies must take a leading role in establishing transparency and accountability mechanisms that address algorithmic bias and promote the fair and equitable adoption of AI in educational contexts (Silva & Janes, 2023). Yet, translating these broad principles into practical guidelines remains a challenge as institutions struggle to balance innovation with regulatory compliance (Lu et al., 2022). In addition, the practical application of AI in engineering education is hindered by several barriers, including the high costs associated with acquiring and maintaining AI tools and a lack of technical expertise among educators. These efforts are further complicated by ethical concerns, particularly the persistence of biases within AI models (Heyn et al., 2021). The systemic nature of these challenges calls for a multifaceted approach—one that includes cost-effective solutions, professional development for educators, and strong institutional commitment.