

THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE PERSONALISATION OF DIGITAL LEARNING: A SYSTEMATIC REVIEW OF CURRICULUM ADAPTATION AND PUPILS' ACADEMIC ACHIEVEMENT

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Abstract

This study aims to examine the role of artificial intelligence in the personalisation of digital learning through a systematic review of curriculum adaptation and pupils' academic achievement. Artificial intelligence is increasingly being applied in education due to its ability to analyse pupils' learning data in real time, adapt learning materials, and provide relevant feedback tailored to individual needs. Through a personalised approach, AI enables the learning process to become more adaptive, flexible and learner-centred. The findings indicate that AI contributes to supporting curriculum adaptation by tailoring content, the pace of learning and learning strategies to better suit learners' characteristics. Furthermore, AI also has a positive impact on pupils' academic achievement by enhancing their understanding of the subject matter, their motivation to learn and their engagement in the learning process. Nevertheless, the implementation of AI in education still faces challenges such as data privacy, infrastructure readiness, teacher competence, and the digital divide. Therefore, the integration of AI into digital learning must be carried out wisely, ethically, and sustainably in order to provide optimal benefits for improving the quality of education. **Keywords:** artificial intelligence; personalised digital learning; curriculum adaptation; pupils' academic achievement; systematic review.

Introduction

Advances in digital technology have brought about significant changes in various sectors of life, including education. The integration of technology into the learning process not only facilitates access to information, but also opens up opportunities to create more flexible and adaptive learning experiences. In this context, artificial intelligence (AI) has emerged as an innovation with the potential to fundamentally transform the education system (Rahmawati et al., 2025). Artificial intelligence enables learning systems to gain a deeper understanding of individual pupils' characteristics through complex data analysis. This technology is capable of identifying learning patterns, the pace of comprehension, and the specific needs of each student. Consequently, AI is key to developing personalised and adaptive learning approaches (Nasution and Aslan, 2025).

Personalised learning is a concept that places the student at the centre of the educational process, by tailoring content, methods and the pace of learning to individual needs. This approach is believed to enhance student engagement and

motivation. In its implementation, AI acts as a facilitator that automates this tailoring process in real time (Liriwati, 2023).

In recent years, the use of AI in digital learning has increased significantly, particularly through e-learning platforms and smart learning systems. These systems utilise machine learning algorithms to provide content recommendations, measure learning progress, and deliver instant feedback. This demonstrates that AI functions not merely as a tool, but as a core component of modern learning design (Kasman et al., 2025). One key aspect of AI implementation is its ability to adapt the curriculum. An adaptive curriculum allows learning materials to be dynamically tailored to pupils' ability levels and needs. With the help of AI, the curriculum is no longer static but evolves in line with each pupil's individual progress (Rahmawati et al., 2025).

AI-based curriculum adaptation also enables more effective differentiated learning. High-achieving pupils can be given more complex challenges, whilst those experiencing difficulties can receive additional support. This has the potential to reduce the learning outcomes gap between pupils (Firdaus et al., 2026). Furthermore, AI also contributes to improving the efficiency of the learning assessment process. Through automated data analysis, AI systems can provide accurate and continuous formative assessment. This information can be used by teachers to make more informed pedagogical decisions (Arnadi et al., 2024).

The impact of AI implementation in education is not limited to the learning process but also extends to pupils' academic outcomes. A number of studies indicate that the use of AI-based adaptive learning systems can significantly improve conceptual understanding, information retention and pupils' examination results (Anua et al., 2025). However, the implementation of AI in education also faces various challenges. Data privacy issues are a major concern, given that AI systems rely on the collection and analysis of large volumes of student data. Furthermore, there are concerns regarding algorithmic bias, which may affect equity in the learning process (Williamson, 2024). The readiness of infrastructure and human resources is also a key factor in the successful implementation of AI in education. Not all educational institutions have access to adequate technology, particularly in developing regions. Furthermore, teachers need to possess sufficient digital competence to utilise this technology optimally (Rahmawati et al., 2025).

In the Indonesian context, the implementation of AI in education is still in its early stages, yet shows great potential. With the increasing use of digital learning platforms, opportunities to integrate AI into the education system are becoming more accessible. This is in line with the government's efforts to promote digital transformation in the education sector (Waelen, 2023).

Based on the above, it is important to conduct a systematic review of the role of artificial intelligence in the personalisation of digital learning, particularly regarding curriculum adaptation and its impact on pupils' academic achievement. This article

aims to comprehensively examine relevant research findings, thereby contributing to the development of future educational policies and practices.

Research Methodology

This study employs a literature review approach using a systematic review method to identify, analyse and synthesise various research findings regarding the role of artificial intelligence in the personalisation of digital learning, particularly in curriculum adaptation and pupils' academic achievement. Data sources were drawn from scientific journals, books and other documents. The literature selection process was based on inclusion and exclusion criteria covering topic relevance, methodological quality and contribution to the field of AI-based education. The collected data were then analysed qualitatively using thematic analysis techniques to identify patterns, trends and existing research gaps. (Forsat et al., 2020); (Elijah and Aslan, 2025).

Results and Discussion

The Role of AI in Curriculum Adaptation

Artificial intelligence (AI) has become a key driver of educational curriculum transformation by enabling the analysis of learning data on a large scale and generating recommendations for dynamic adjustments to teaching materials, meaning that the curriculum is no longer static but responsive to the individual needs of pupils (Votto et al., 2021). The primary mechanism enabling curriculum adaptation is machine learning algorithms that process students' learning trajectories—such as task completion times, error patterns and engagement levels—to determine the most suitable learning path for each learner (Aslan and Arifudin, 2025).

Adaptive learning platforms utilise predictive models to assess mastery of competences at a granular level; the system uses these assessment results to organise the sequence of material, the level of difficulty, and personalised remedial or enrichment activities for each student (Sanawan et al., 2026); (Muharrom et al., 2023).

The implementation of AI in curriculum design also opens up opportunities for the automation of evidence-based syllabus development, where aggregate data from the student population helps curriculum designers determine the priorities for competencies and the most empirically effective learning resources (Rosalina and Anindya, 2025). In addition to content adaptation, AI supports the differentiation of learning methods through recommendations on instructional styles—such as visual, auditory or practical instruction—so that learning activities can be tailored to pupils' preferences and cognitive styles to enhance the effectiveness of subject mastery (Rodhiah et al., 2025).

AI enhances the diagnostic capabilities of the curriculum by providing real-time analysis to identify competence gaps at both individual and group levels, enabling teachers or learning systems to design pedagogical interventions more quickly and with greater precision (Astuti et al., 2023). The integration of AI into the curriculum

evaluation process enables continuous and adaptive formative assessment; this automated assessment not only measures final outcomes but also provides actionable feedback for the design of subsequent learning pathways (Rifky, 2024).

At the policy and curriculum management level, data insights from AI systems can be used to formulate more responsive macro-level curriculum policies—for example, adjustments to the allocation of learning time, teacher competence development needs, or revisions to competence standards based on trends in actual student achievement (Rahman and Aslan, 2025). Whilst offering significant benefits, AI-based curriculum adaptation faces ethical and operational challenges, including issues of student data privacy, algorithmic transparency, and the potential for bias in automated assessment, which must be addressed through robust governance and ethical guidelines (Pujiono et al., 2024). The readiness of infrastructure and educators' competencies are critical factors—without adequate connectivity, relevant software, and improved digital literacy for teachers, the potential of curriculum adaptation will not be realised evenly, particularly in resource-constrained areas (Plan, 2016); (Aslan, 2023).

Case studies across various institutions show that the integration of AI into the curriculum can enhance the inclusivity of learning by providing alternative learning pathways for pupils with special educational needs, for example through adapted materials or intelligent tutoring systems that adjust the pace and approach to teaching (Jamilah et al., 2025); (Aslan and Wahyudin, 2020). The design of future curricula utilising AI should prioritise the principles of human-centred design, whereby technology complements the role of teachers and preserves pedagogical autonomy, ensuring that curriculum decisions continue to take into account pedagogical values and local contexts alongside algorithmic recommendations. Furthermore, the integration of AI requires adjustments to curriculum content to incorporate AI literacy and digital ethics as core competencies, so that pupils are not merely beneficiaries of technology but also understand the social, ethical and functional implications of AI in their lives (Huda and Suwahyu, 2024).

Overall, AI-based curriculum adaptation offers opportunities to make learning more personalised, responsive and data-driven; however, the success of this transformation depends on the right combination of technology, human capabilities (teachers and policymakers), as well as an ethical framework and infrastructure that support fair and sustainable implementation.

The Impact of AI on Pupils' Academic Achievement

Artificial intelligence (AI) is increasingly being used in education due to its ability to deliver more personalised, rapid and data-driven learning, enabling pupils to receive material tailored to their individual needs and level of mastery. In the context of academic achievement, AI has the potential to help students understand material more effectively, as the system can dynamically adjust the pace of learning, the level of

difficulty and the form of feedback (Hossain et al., 2025). One of the most tangible impacts of using AI is increased learning efficiency, as students can access additional explanations, adaptive exercises and automatic feedback at any time without having to wait for direct guidance from a teacher. This makes the learning process more flexible and enables students to correct mistakes more quickly, which ultimately supports improved learning outcomes (Harahap et al., 2023).

AI-based adaptive learning platforms have also been shown to help students gain a more targeted learning experience, as the system is able to detect gaps in understanding and then provide appropriate reinforcement material. Research findings indicate that AI-based adaptive learning has a strong positive correlation with the academic achievement of secondary school students (Ghedabna et al., 2024).

At primary school level, the use of AI via platforms such as Khan Academy has shown a significant improvement in learning outcomes in the experimental group compared to the control group. Students' average scores increased more significantly in classes using AI-based adaptive learning, and statistical tests revealed a statistically significant difference, confirming that this technology is effective in improving academic achievement (Dwi Puja Syaharani, 2024). AI also contributes to enhancing learning motivation, as pupils tend to be more active when learning feels tailored to their abilities and pace. Systems that provide personalised recommendations, progressive exercises and instant feedback can create a more engaging learning experience, thereby increasing pupil engagement and impacting academic achievement (Nisa et al., 2021); (Hasan et al., 2021)

On the other hand, AI helps students develop independent learning as they can control their own learning process through features such as material navigation, self-assessment and the adjustment of learning targets. This independence is important because students who are able to manage their own learning tend to achieve better academic results than those who rely entirely on the teacher's instructions (Alekseenko, 2023).

AI also functions as a diagnostic tool that enables teachers to monitor pupils' learning progress more accurately and quickly. Data from AI systems can indicate which areas pupils have mastered and which still require improvement, allowing teachers to provide more targeted interventions to support academic achievement (Adnin et al., 2024). In AI-based learning, automated feedback is a key factor that helps students correct their mistakes immediately. This type of feedback makes the learning process more efficient, as students do not have to wait long to identify where they have gone wrong; consequently, their understanding of the material improves and learning outcomes are enhanced (Act, 2024).

However, the impact of AI on academic achievement is not always entirely positive if its use is not properly guided. Several studies highlight that excessive use of AI can diminish critical thinking and independent analytical skills, as students risk becoming overly reliant on technology to complete tasks and understand the material

(Sukmaningsih, 2025). Over-reliance on AI can also result in students being less practised in solving problems independently, even though this ability significantly influences long-term academic success. Therefore, the use of AI must be balanced with learning strategies that encourage reasoning, discussion and active reflection, so that academic achievement improves not only in terms of marks but also in the quality of understanding (Rahmawati et al., 2025).

In terms of educational equity, AI has the potential to support pupils from diverse socio-economic backgrounds by providing broader access to learning resources. However, research also indicates that these benefits are heavily influenced by access to devices, internet connectivity and teacher readiness; consequently, the positive impact on academic achievement may vary across different groups of pupils (Nasution and Aslan, 2025).

AI in education also supports differentiated learning, an approach that tailors teaching materials to individual needs. This approach is important because students have different learning speeds and cognitive styles, and AI systems are able to provide more appropriate learning pathways, thereby increasing the chances of academic success (Liriwati, 2023).

At university level, the use of AI is reported to assist students in finding materials, completing assignments and understanding complex concepts, but guidance is still required to ensure the technology is used productively. Thus, AI can enhance academic achievement when used as a learning aid, rather than as a substitute for students' own thinking processes (Kasman et al., 2025).

Overall, AI has a positive impact on students' academic achievement through personalised learning, rapid feedback and increased engagement with learning; however, its effectiveness is highly dependent on teacher support, ethical use and the readiness of the infrastructure. Consequently, AI should be positioned as a pedagogical partner that enhances the quality of learning, rather than as a sole solution for improving academic outcomes.

Conclusion

Artificial intelligence plays a vital role in the personalisation of digital learning, as it is capable of tailoring learning materials, methods and pace to the individual needs of each pupil. In the context of curriculum adaptation, AI makes the learning process more flexible, responsive and data-driven, enabling teachers to design more targeted teaching strategies. This demonstrates that AI is not merely a technological tool, but also a key component in the transformation towards a more effective and inclusive education system.

In terms of academic achievement, the use of AI has been shown to have the potential to improve pupils' learning outcomes through rapid feedback, tailored content recommendations, and real-time monitoring of learning progress. The personalisation enabled by AI can help pupils understand the material better, boost

their motivation to learn, and encourage independent learning. However, these benefits will only be optimised if supported by the role of teachers, adequate infrastructure, and prudent use.

Overall, this systematic review confirms that AI makes a significant contribution to supporting digital learning that is more adaptive and student-centred. Nevertheless, its implementation must continue to take into account ethical considerations, data privacy, the digital divide, and the readiness of educators. With proper management, AI can serve as a strong foundation for creating an education system that is more personalised, high-quality, and sustainable.

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