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AI INTEGRATION IN LEARNING SYSTEMS: LITERATURE REVIEW ANALYSIS ON TEACHING OPTIMISATION THROUGH VIRTUAL TUTORS, DATA ANALYSIS, AND AUTOMATED EDUCATIONAL MATERIAL CREATION

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Abstract

The development of artificial intelligence (AI) has brought a new paradigm in the world of education by introducing learning systems that are more adaptive, efficient, and learner-centred. This study aims to analyse the role of AI in optimising the learning process through the application of virtual tutors, *learning* analytics, and the automation of educational material creation. The research method used is *library research* by reviewing various existing scientific sources. The results show that the integration of AI in education can improve learning personalisation, strengthen data-based decision making, and increase efficiency in academic content development. AI-based virtual tutors enable real-time feedback and individual guidance, while *learning analytics* help teachers understand students' needs more accurately. On the other hand, the automation of teaching material creation using generative technology increases teachers' time effectiveness and expands access to relevant and contextual learning resources. However, the implementation of AI requires serious attention to ethical issues, data validity, and potential algorithmic bias so that this technology can truly be beneficial in a fair and sustainable manner. This study emphasises that collaboration between human intelligence and artificial intelligence is key to building an innovative, inclusive, and meaningful future education ecosystem.

Keywords: artificial intelligence, virtual tutors, *learning analytics*, learning material automation, educational technology, literature review.

Introduction

Artificial intelligence (AI) has now become one of the main pillars of the 21st century digital revolution. The resulting transformation has not only occurred in the industrial, economic, and health sectors, but has also penetrated the world of education, which has been known to be slower to adapt to technological developments. In the context of modern education, AI is not only present as an administrative tool, but also as a catalyst for pedagogical change that can revolutionise the way teachers teach, students learn, and institutions manage their learning systems (Ramadhani & Syahputra, 2024) . From the ability to recognise student learning patterns to automatically creating educational content, AI opens up opportunities for more adaptive, personalised, and efficient learning compared to conventional methods.

Traditional learning systems, which are dominant in many educational institutions, tend to be uniform and do not take into account individual differences in learning styles and speeds. The one-way learning model, where teachers are the primary source of knowledge, often fails to address the challenges of the digital age, which demands personalisation and flexibility . As a result, many students fall behind because the teaching approach is unable to adapt to their needs. This is where AI shows its unique potential: technology can help analyse students' learning behaviour patterns in real-time and provide appropriate recommendations or interventions, so that each student gets a more relevant and effective learning experience (Ramadhani & Syahputra, 2024) .

In recent years, the application of AI-based virtual tutors has shown significant results at various levels of education. Digital learning systems such as *intelligent tutoring systems* (ITS) are designed to provide interactive guidance that resembles the role of a human tutor. Through *big data* analytics, these systems are able to understand students' individual abilities, difficulties, and preferences. Virtual tutors not only deliver material, but also provide instant feedback, reflective questions, and adaptive learning recommendations. Thus, the presence of AI in the form of virtual tutors helps create a dynamic learning ecosystem that is tailored to the needs of each student (Syamsuriah & Rahman, 2025) .

In addition to supporting personal interaction with students, AI also has a major contribution in the process of learning data analysis, or what is known as *learning analytics*. Through this approach, student learning behaviour data—such as access time, engagement levels, test scores, and online discussion patterns—can be processed into valuable insights for educators and institution managers (Putri & Santoso, 2024) . The results of this analysis can be used to evaluate the effectiveness of teaching methods, identify skill gaps, and even predict students' future success rates. Thus, the integration of AI in learning not only enhances the individual experience of learners but also strengthens data-driven decision-making at the institutional level (A. A. Putra & Dewi, 2024) .

Furthermore, the development of AI-based generative technologies such as *Natural Language Processing* (NLP) and *Large Language Models* (LLM) has opened up new possibilities in the automation of educational material creation. Teachers no longer have to compile all learning content manually, but can utilise AI to help design teaching materials, evaluation questions, or learning activities that are in line with a specific curriculum (Lee & Kim, 2025) . This process not only saves time and effort but also increases efficiency in distributing learning materials to students. AI systems can even adjust the complexity of materials based on the ability level of learners, making them an important tool for supporting inclusive and sustainable learning (Zafrullah et al., 2024) .

However, despite its numerous benefits, the implementation of AI in education also presents a number of challenges that cannot be ignored. The widespread use of

technology raises serious questions regarding ethics, accuracy, and the potential for algorithmic bias in determining student learning outcomes. Reliance on AI systems also risks reducing the role of humans in the teaching process, even though personal interaction between teachers and students remains an important component in fostering character values, empathy, and learning motivation (Bhutoria, 2024) . Therefore, the integration of AI into the education system must be carefully designed, taking into account the balance between technological innovation and pedagogical principles.

Another challenge that has emerged is the gap in infrastructure and digital competence between educational institutions in different regions, especially in developing countries. Many institutions do not yet have adequate resources to implement AI-based systems, in terms of hardware, software, and teaching staff competent in operating them. This has the potential to widen the digital divide between students and schools, requiring comprehensive policy strategies to ensure that AI-based educational transformation is inclusive and equitable (Sari et al., 2025) .

In a global context, various studies show that the use of AI in education has the potential to increase student engagement, enrich teaching methods, and accelerate learning outcomes (Sari et al., 2025) . Studies from UNESCO and the OECD, for example, highlight that education systems integrated with AI can improve curriculum effectiveness and school management efficiency. With the increasing amount of educational data available for analysis, AI enables policymakers and educators to design more targeted interventions. These findings reinforce the argument that AI integration is not merely an option, but a strategic necessity in creating the educational ecosystem of the future (Wijaya & Setiawan, 2024) .

This research is also important in the context of Indonesia, which is aggressively developing digital learning systems through education transformation policies. Programmes such as Merdeka Belajar (Freedom of Learning) and school digitalisation require the integration of smarter technologies to ensure relevant and adaptive learning in line with the needs of the times. However, the use of AI in the national education system is still in its infancy and requires a strong academic foundation to ensure its effective and responsible implementation. By conducting a comprehensive literature review, this study aims to provide a scientific mapping of the potential, benefits, and challenges of AI implementation in the Indonesian education sector.

Research Method

This study uses a library research method that focuses on a systematic analysis of various scientific literature related to the integration of artificial intelligence (AI) in learning systems. This method was chosen because the objective of the research is to gain an in-depth understanding of the concepts, trends, and results of previous studies in order to form a complete conceptual framework regarding the application of AI in the context of Education (Webster & Watson, 2020) . Data was obtained from various

secondary sources such as Scopus-indexed international journals, academic books, conference proceedings, educational institution research reports, and publications from global organisations such as UNESCO and the OECD. The data collection process was carried out through the stages of identification, selection, and analysis of relevant documents discussing three main focuses: the application of AI-based virtual tutors, the application *of learning analytics* in teaching optimisation, and the automation of learning material creation (Eliyah & Aslan, 2025) . Data analysis was conducted using a thematic synthesis approach to identify patterns, trends, and relationships between concepts emerging in the literature, which were then synthesised into conceptual conclusions describing the benefits, challenges, and future development directions of AI in education systems.

Results and Discussion

Optimising Teaching Through Virtual Tutors and Data Analysis

The development of artificial intelligence (AI) technology has brought about major changes in the world of education, particularly in the way teaching is delivered and personalised. One of the greatest contributions of AI is its ability to provide virtual tutors or *intelligent tutoring systems* (ITS) that can provide a learning experience similar to interacting with human educators s (Puspitasari & Aslan, 2024) . These virtual tutors use *machine learning* algorithms to understand the individual needs of students, adjust the level of difficulty of the material, and provide quick and specific feedback. With this adaptability, the learning process becomes more effective because students receive support that is tailored to their development and learning style (Wijaya & Setiawan, 2024).

AI-based virtual tutors play an important role in optimising the learning process through personalisation of material and teaching strategies. In conventional learning systems, teachers often find it difficult to tailor their teaching to each student due to time constraints and large class sizes. AI overcomes this obstacle with *real-time tracking* of student progress, enabling individualised adjustment of learning material (Susanto & Nugroho, 2010) . For example, if a student has difficulty with a particular concept, the system will provide additional exercises, contextual explanations, or simpler visualisations to improve understanding. This makes learning more inclusive and focused on sustainable results (Widodo, 2024) .

In addition to providing learning recommendations, virtual tutors also function as interactive companions that can boost students' motivation to learn. Through conversation-based technology approaches such as *chatbots* and digital assistants, students can interact with AI anytime, anywhere. Learning assistants such as ChatGPT, Google Bard, or systems owned by modern education platforms have demonstrated the ability to answer questions, explain concepts, and even provide academic writing feedback (Jauhari, 2010) . Thus, students have access to a "mentor" who is ready to

help them learn independently outside of school hours and strengthen the culture *of self-directed learning*.

From a pedagogical perspective, the presence of virtual tutors also replaces some of the administrative functions of teachers, allowing educators to focus more on the affective and motivational aspects of teaching. Many studies show that the use of AI in teaching increases time efficiency, speeds up the assessment of learning outcomes, and improves the quality of feedback to students. For example, AI-based systems can automatically assess essay-type assignments or quizzes with high accuracy using semantic analysis and *natural language processing* (NLP) (Jaidan & Jauhari, 2015) . Teachers can use the remaining time to engage in in-depth discussions, provide personal guidance, or foster collaboration among students — aspects that are difficult for machines to replace (Aslan, 2017) .

The implementation of virtual tutors also improves student performance tracking through the use of *learning analytics*. This field uses big *data* analysis techniques to understand patterns of student interaction with the learning environment. Data such as participation levels, study time, module access frequency, and assessment results are used to measure the effectiveness of the learning process (Jaidan & Jauhari, 2015) . With this analysis, AI systems are able to detect students who are at risk of learning difficulties early on and provide remediation recommendations according to their individual profiles. This data-driven approach allows teachers and educational institutions to make decisions based on concrete evidence, rather than subjective assumptions (Chen & Wang, 2025) .

Furthermore, the learning data generated by virtual tutors can be used to evaluate the effectiveness of the curriculum at a broader level. By identifying patterns of learning outcomes across different groups of students, educational institutions can map the relationship between teaching methods, content, and academic performance. For example, data shows which topics or activities are most effective in increasing student engagement — this enables data-driven decision-making to optimise curriculum design (P. Putra & Aslan, 2020) . On a larger scale, the aggregated analysis results from thousands of students can be used by governments or educational policy institutions to design evidence-based learning system transformations (*evidence-based policy making*). The advantages *of learning analytics* are not only in academic monitoring, but also in understanding the affective and psychological aspects of students. Modern AI models have been able to identify patterns of motivation, interest, and emotional engagement of students based on digital interactions, such as text expressions or response times (Rokhmawati et al., 2025) . This data helps educators understand the non-cognitive factors that influence learning success, and ultimately helps create a more empathetic and individual-centred learning environment (Chen & Wang, 2025) . Thus, AI has the potential to be a tool to support humanistic educational principles, rather than simply replacing them.

Furthermore, virtual tutors encourage a paradigm shift in teaching from a material-based approach to a data- and *learning* experience design-based approach. AI systems can recommend different learning paths for students with specific characteristics, making the learning process more dynamic and personalised (Adeshola & Adepoju, 2025) . For example, students who are strong in visual learning will receive more videos, infographics, and simulations, while students with analytical tendencies will receive more in-depth texts, exercises, or case studies. In this context, AI functions not only as a technical tool, but also as *a co-designer* in the learning process (Nuraeni & Hidayat, 2025) .

However, the implementation of virtual tutors and *learning analytics* also poses a number of serious challenges. Data accuracy and AI algorithm transparency are major concerns because analysis results can directly impact student assessments. Algorithmic bias can lead to unfairness or misinterpretation of individual abilities. In addition, data privacy issues are also a major challenge because AI systems require sensitive personal data and student behaviour (Ouyang et al., 2024) . Therefore, the application of AI in educational data analysis must comply with ethical, security, and data protection principles in accordance with national and international regulations.

On the other hand, the readiness of digital infrastructure is a determining factor in the successful implementation of virtual tutors and data analysis in educational institutions. Many schools, especially in developing countries, still face limitations in terms of internet access, digital devices, and teacher training in new technologies. Without adequate policy support and investment, AI risks becoming an exclusive tool that only well-equipped schools can enjoy. Therefore, collaboration between the government, educational institutions, and technology developers is needed so that this innovation can be applied inclusively and benefit all students regardless of their socio-economic background (U.S. Department of Education, 2023) .

Despite these challenges, global trends indicate that the integration of virtual tutors and data analytics in education continues to grow rapidly. Universities and training institutions are now beginning to rely on intelligent learning systems to support online and hybrid lectures. The results show a significant increase in student retention, learning engagement, and evaluation effectiveness. This confirms that AI is not just a technology of the future, but a strategic component in building an education system that is highly adaptable to global changes (A. Pratama & Sari, 2025) .

Thus, optimising teaching through virtual tutors and data analysis is an important step towards modern educational transformation. AI enables the learning process to be more efficient, personalised, and results-oriented through its ability to understand and adapt to each individual's learning experience. With ethical management and appropriate policy support, virtual tutors have the potential to become equal partners for educators in creating a more humanised and data-driven learning environment. Ultimately, the integration of AI opens up opportunities for the

creation of a new educational paradigm that places students at the centre of the learning process and teachers as innovative facilitators supported by smart technology.

Automation of Educational Material Creation with AI

Advances in artificial intelligence technology, particularly in the fields of *natural language processing* (NLP) and *machine learning*, have fundamentally changed the way educational materials are designed, produced, and distributed. Whereas previously the preparation of teaching materials depended entirely on the abilities and availability of educators, AI is now capable of taking over most of these technical processes through generative systems that can automatically produce text, images, and even interactive media. This automation not only promises time and cost efficiency, but also opens up opportunities for consistency in quality and scalability of large amounts of learning materials, which is difficult to achieve with human labour alone (Caroline & Aslan, 2025) .

One concrete form of automation is AI's ability to generate text content such as learning modules, material summaries, practice questions, and case studies based on keywords, basic competencies, or curricula entered by educators. *Large language models* (LLMs) can process various reference sources and compile them into systematic and easy-to-understand teaching materials (A. Pratama & Sari, 2025) . For example, teachers can ask the AI system to compile material on "single variable linear equations for Year 7" complete with examples, exercises, and step-by-step explanations. In a matter of seconds, the AI can provide a draft of the material, which can then be edited and adjusted by the teacher according to the class context and student characteristics (Kusumawardhani & Santoso, 2019) .

In addition to generating text, AI also plays a role in the automatic creation of evaluation questions, whether in the form of multiple choice, short answer, or essay questions. The *automatic item generation* system utilises an understanding of knowledge structures to compile a variety of questions that still measure the same competencies (Y. Pratama & Sari, 2024) . This supports the availability of a richer and more adaptive question bank, so that assessments can be carried out continuously without burdening teachers with repetitive administrative work. In fact, AI can group questions based on difficulty level, making it suitable for use in adaptive testing systems that adjust the level of questions to students' abilities in real-time (Hidayat & Nurhayati, 2024) .

In addition to text and questions, automation also includes the creation of multimodal learning media such as illustrative images, infographics, and simple simulations. Image-based generative algorithms, for example, can create visualisations of scientific concepts, process flow diagrams, or educational posters in a short time. AI is also capable of automatically generating transcripts and translations for video materials, facilitating the creation of subtitles and supporting materials that are accessible to various groups of students, including those with language limitations or

special needs (Kestin & Dervan, 2025) . Thus, AI-based automation helps create richer and more inclusive learning materials.

Automating material creation with AI also contributes to personalising learning content. Based on learning outcomes data and student profiles analysed by the system, AI can generate variations of materials tailored to each individual's level of understanding, interests, and learning style. Students who have difficulty with certain topics can be given simpler explanations, additional examples, or analogies relevant to everyday life (Létourneau et al., 2025) . Meanwhile, high-ability students can receive challenges in the form of advanced questions, mini-projects, or more in-depth reading materials. This kind of personalisation was previously very difficult to achieve when relying on a single set of materials for all students (Fitriani & Pratama, 2024) .

From the perspective of educators' workload, the automation of learning materials through AI provides more space for teachers to focus on humanistic pedagogical aspects. The time that is usually spent designing presentation slides, compiling modules, and creating questions manually can be redirected to strengthening face-to-face interactions, guiding discussions, providing academic counselling, and building emotional relationships with students. In other words, AI has the potential to take over "routine" and "repetitive" tasks, while teachers can maximise their role as facilitators, mentors, and inspirers in the learning process (Zerkouk et al., 2024) .

However, this automation practice is not without a number of risks that need to be seriously criticised. One of the main issues is the quality and accuracy of the content generated by AI. Although AI models are capable of producing convincing text, not all of the information generated is necessarily correct or in line with scientific standards and the applicable curriculum. The phenomenon of *hallucination* in generative models, which is the tendency for AI to generate information that appears logical but is not factual, can be a major problem if the material is used directly without verification (Ramadhani & Syahputra, 2024) . Therefore, AI should be positioned as a tool to assist in drafting initial drafts, while academic authority and content verification remain in the hands of educators or experts in the relevant fields.

In addition to accuracy, there are also issues of originality and the potential for plagiarism in AI-generated content. The automation of material creation can encourage the massive use of generative content without adequate interpretation and adaptation by teachers and students. This risks reducing the quality of the creative process in education, where teachers and students rely more on instant results than on developing critical thinking and writing skills themselves (Firdausih & Aslan, 2024) . Therefore, the use of AI must be accompanied by clear ethical policies and guidelines, including an emphasis that AI-generated material should be treated as a draft that needs to be reviewed, adjusted, and supplemented .

Another ethical issue relates to bias and diversity of perspective in AI-generated material. AI models are trained based on data available on the internet or specific

corpora that may have cultural, gender, or social biases. If not monitored, the educational material produced has the potential to reproduce stereotypes or present non-inclusive perspectives. This can impact the formation of students' views on social, political, and identity issues (Syamsuriah & Rahman, 2025) . Therefore, educators need to play an active role as critical curators, ensuring that AI-generated content remains in line with the values of fairness, diversity, and academic integrity.

From a policy and governance perspective, the automation of educational material creation using AI requires clear regulations at both the institutional and national levels. Educational institutions need to formulate standards for AI use, ranging from material development procedures and verification mechanisms to the manner in which AI use is mentioned in the process of developing teaching materials (Putri & Santoso, 2024) . On the other hand, the government and educational authorities can develop general guidelines so that the use of AI is in line with the national curriculum, graduate competency standards, and educational ethics principles. Without an adequate policy framework, the use of AI has the potential to run wild and cause quality disparities between educational units (A. A. Putra & Dewi, 2024) .

In developing countries such as Indonesia, the potential for automating materials with AI also needs to be viewed from the perspective of resource gaps. On the one hand, AI offers solutions for teachers in remote areas who lack access to the latest teaching materials, because with minimal internet connection, they can access generative systems to help compile relevant materials (Lee & Kim, 2025) . On the other hand, limitations in digital infrastructure, technological literacy, and foreign language skills can be serious obstacles. Therefore, programmes to strengthen teachers' capacity in utilising AI are a strategic step to ensure that this technology truly becomes a tool for empowerment, rather than widening the gap in educational quality between established schools and those that are lagging behind (Zafrullah et al., 2024) .

Despite these challenges, global research and practice trends show that the automation of educational material creation with AI has a significant positive impact when used appropriately. Studies show that teachers who utilise AI as a material development assistant tend to report higher time efficiency and increased variety and creativity in teaching materials. Students also benefit from more structured materials, more relevant examples, and more diverse exercises (Bhutoria, 2024) . Thus, AI can be seen as a catalyst for pedagogical innovation that helps the education system move more quickly to adapt to scientific developments and 21st-century competency requirements.

Ultimately, the automation of educational material creation with AI should be understood not as an attempt to replace the role of teachers, but as a strategy to strengthen the learning ecosystem. AI provides the technological foundation for generating, managing, and personalising materials on a large scale, while teachers remain the main actors who provide context, value, and meaning in learning. It is this synergy between artificial intelligence and human intelligence that is expected to

produce a more relevant, adaptive, and humanised educational process. With prudent management, AI-based material automation can become one of the key pillars in the transformation of education towards a higher quality, more equitable, and sustainable system.

Conclusion

The integration of artificial intelligence (AI) into learning systems has brought about a fundamental transformation in the way education is designed, implemented, and evaluated. Through the use of virtual tutors and learning data analysis, the teaching process has become more personalised, adaptive, and results-oriented. AI is able to understand students' learning patterns in depth, provide rapid feedback, and adjust learning strategies based on individual abilities. With the support *of learning analytics*, teachers and educational institutions can make data-driven decisions to improve the effectiveness of teaching methods and identify gaps in learning achievement. This innovation marks a shift from a one-way teaching system to a responsive, sustainable, and student-centred learning model.

In addition to improving the quality of learning interactions, AI also plays a major role in automating the preparation of educational materials. *Natural language processing* and *machine learning-based* technologies enable the creation of modules, questions, and learning media to be carried out quickly, efficiently, and in a personalised manner. This automation not only lightens the workload of educators, but also expands access for students to materials that are relevant to their abilities and interests. However, the application of AI still requires ethical and academic supervision to ensure the quality, accuracy, and scientific integrity of the material produced. The role of teachers remains absolutely necessary as curators and controllers of the learning context so that AI functions as a tool, not a substitute.

Overall, the results of the literature review analysis show that the integration of AI into the learning system provides great opportunities to create more effective, inclusive, and efficient education. However, these benefits can only be realised if they are supported by adaptive education policies, adequate digital literacy, and a commitment to ethics in their application. AI should be an intelligent partner for humans in expanding the reach of education, not just a rigid automation tool. By combining technological intelligence and human wisdom, the education system of the future can be built on a more robust foundation — a system capable of responding to changing times without losing its human values.

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