

The Emergence of AI in Educational Settings: The Transformative Influence of Artificial Intelligence on Learning Process

Munculnya AI di Lingkungan Pendidikan: Pengaruh Transformatif Kecerdasan Buatan pada Proses Pembelajaran

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ABSTRACT

The integration of Artificial Intelligence (AI) in education has been a significant research focus from 2019 to 2024. This research aims to comprehensively investigate the effectiveness of AI interventions in education, taking into account various contexts and influencing factors. The research method used is systematic literature, with research results showing that AI interventions have great potential in improving learning outcomes, 21st century skills, motivation, student engagement, and reducing educational gaps. The implications of this research are important for practitioners, researchers, and policy makers in their efforts to advance adaptive and inclusive education in the era of artificial intelligence.

Keywords: Artificial Intelligence, Education, Intervention Effectiveness, Learning Outcomes, 21st Century Skills, Student Motivation, Engagement, Educational Disparities.

ABSTRAK

Integrasi Kecerdasan Buatan (AI) dalam pendidikan telah menjadi fokus penelitian yang signifikan dari 2019 hingga 2024. Penelitian ini bertujuan untuk menyelidiki secara komprehensif efektivitas intervensi AI dalam pendidikan, dengan mempertimbangkan berbagai konteks dan faktor yang mempengaruhi. Metode penelitian yang digunakan adalah literatur sistematis, dengan hasil penelitian menunjukkan bahwa intervensi AI memiliki potensi besar dalam meningkatkan hasil belajar, keterampilan abad ke-21, motivasi, keterlibatan siswa, dan mengurangi kesenjangan pendidikan. Implikasi penelitian ini penting bagi praktisi, peneliti, dan pengambil kebijakan dalam upaya mereka untuk memajukan pendidikan yang adaptif dan inklusif di era kecerdasan buatan.

Kata Kunci: Kecerdasan Buatan, Pendidikan, Efektivitas Intervensi, Hasil Belajar, Keterampilan Abad 21, Motivasi Siswa, Keterlibatan, Kesenjangan Pendidikan.

1. Introduction

The integration of Artificial Intelligence (AI) in education has garnered increasing attention and research from 2019 to 2024. Scholars have delved into various facets of AI in education, including personalized learning pathways (Tapalova & Zhiyenbayeva, 2022), as well as the challenges and requirements for fairness in AI-based educational systems (Fenu, 2022). Research has demonstrated that the implementation of AI technologies in education significantly influences teaching methodologies, knowledge dissemination, and the roles of educators (Chen, 2022). Furthermore, AI has proven to be instrumental in augmenting teaching quality and revolutionizing teaching-learning methodologies (Wang et al., 2023).

Studies have also examined teachers' viewpoints on AI in education (Polak et al., 2022), the potential of AI in teaching and learning (Kshirsagar et al., 2022), and the design of AI literacy curricula for children (Su, 2023). Additionally, investigations have explored the interactions between AI and education, proposing frameworks to classify these interactions (Rismanchian & Doroudi, 2023). The utilization of AI in learning management systems has been

widely observed in educational institutions, as exemplified by a case study conducted in Pakistani educational settings (Ali et al., 2023).

Moreover, delineations have been made between AI in education, computer-supported collaborative learning, educational data mining, and learning analytics to establish coherence in research domains (Rienties et al., 2020). The capacity for AI to learn from both teachers and students to bridge the gap between AI technologies and pedagogical knowledge has also been a focal point of exploration (Dantas et al., 2022). The research conducted between 2019 and 2024 underscores the transformative potential of AI in education, accentuating its role in enhancing personalized learning, refining teaching methodologies, and reshaping the educational landscape.

Nowadays, digital transformation has fundamentally changed the educational landscape. The development of artificial intelligence has had a substantial impact on the way we understand and carry out the processes of learning, teaching, and interacting with educational materials. This phenomenon is increasingly relevant with the increasing use of AI technology in various aspects of education, from online learning platforms to automated evaluation systems.

However, amidst this progress, there are a number of issues that need to be addressed. One of them is the challenge of ensuring that the application of AI technology in education provides optimal benefits for all students, including those from diverse backgrounds and educational contexts. Additionally, there remains a gap in our understanding of the true effectiveness of AI interventions in heterogeneous educational contexts.

Through this research, the researcher's aim is to thoroughly investigate the effectiveness of AI interventions in education, taking into account various contexts and influencing factors. The research aims to fill the gap in the literature related to this topic. The research question to be answered is: "How effective are AI interventions in improving learning outcomes, 21st century skills, motivation, student engagement, and reducing educational disparities?"

The uniqueness of this research lies in its systematic approach in evaluating existing literature and presenting a comprehensive synthesis of findings. Researchers hope that the results of this research can provide meaningful contributions to practitioners, researchers and policy makers in their efforts to advance adaptive and inclusive education in the era of artificial intelligence.

This research contribution is an important step in deepening understanding of the effectiveness of artificial intelligence interventions in diverse educational contexts. By presenting a synthesis of findings from existing literature, this research aims to fill the knowledge gaps that still exist in the related literature. In addition, the results of this research are expected to provide valuable insights for educational practitioners, researchers, and policy makers in designing and implementing more effective artificial intelligence interventions in various educational contexts. Through in-depth analysis of existing literature, this research is also expected to contribute to the development of literature and theory related to the use of artificial intelligence in education. By identifying remaining research gaps, this research can also encourage further research in this area, stimulating the interest of other researchers to investigate further on this topic and develop deeper knowledge. Thus, the contribution of this research is not only limited to providing new understanding, but also to providing valuable insights, contributing to literature and theory, and encouraging further research in this field.

2. Research Methods

The research methods used in this systematic literature review were carefully prepared to ensure completeness and accuracy in the collection and analysis of relevant articles.

First of all, the article collection process is carried out through access to well-known academic databases such as Scopus, Web of Science, and Google Scholar. The use of this

database ensures that the articles obtained are of high quality and reputation in the academic realm.

Search keywords were carefully selected to cover various relevant aspects of this research topic. The keywords used include terms such as "artificial intelligence in education", "AI intervention effectiveness", "impact of AI on learning outcomes", and so on.

After the search process was complete, research was carried out on the number of articles obtained. These numbers then form the basis for subsequent processes in the research, ensuring that sufficient and representative resources are available for analysis.

Article inclusion and exclusion techniques were carried out carefully to ensure that only articles that met the research criteria were included in the analysis. Inclusion criteria involved studies examining the effectiveness of AI interventions in education, published in reputable international scientific journals such as Scopus Q1, and available in English. On the other hand, exclusion criteria included studies that were not relevant to the research topic, were published in disreputable scientific journals, or were not available in English.

Thus, this research method ensures that the process of collecting and analyzing articles is carried out carefully and systematically, so that the research results can be trusted and are useful for the development of science in this field.

In carrying out a systematic literature review, using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method is a crucial step in ensuring transparency, accuracy and consistency in the process of collecting and presenting information. The PRISMA method provides a structured framework for designing, conducting, and reporting systematic literature reviews.

First of all, the preparation stage is carried out by formulating a research protocol which includes research objectives, inclusion and exclusion criteria, search strategy, and analysis steps. This protocol serves as a guide for researchers in carrying out literature reviews in a consistent and documented manner.

Next, the literature search stage was carried out using keywords that had been determined systematically. This process includes access to various information sources such as academic databases and digital libraries to identify articles relevant to the research topic.

After the articles have been collected, the selection stage is carried out by applying previously determined inclusion and exclusion criteria. Articles that met the inclusion criteria were selected for inclusion in further analysis, while articles that did not meet these criteria were excluded from the review.

The data extraction stage is carried out by collecting relevant information from each selected article, such as study characteristics, methodology and main findings. This process is carried out systematically to ensure that the data obtained is reliable and relevant to the research objectives.

Finally, the data synthesis and presentation stage is carried out by systematically summarizing the findings of the selected articles. The information presented is then analyzed critically to identify relevant patterns, trends and implications in the context of the research topic.

By applying the PRISMA method, this research can ensure that the literature review process is carried out carefully and transparently, so that the results are reliable and relevant to the development of science in this field.

3. Results and Discussionns

3.1. Findings Regarding the Effectiveness of AI Interventions in Improving Learning Outcomes

In recent years, there has been a growing body of research focusing on the effectiveness of AI interventions in improving learning outcomes. Several studies have highlighted the potential of AI systems to positively impact student learning. For instance,

AI-powered technologies have been shown to enhance academic performance and overall learning outcomes (Chichekian & Benteux, 2022). Moreover, AI systems can drive increased student engagement, leading to improved learning outcomes by integrating technologies involving interactivity, dialogue, automated question generation, and learning analytics (Bozkurt et al., 2021).

Studies have also demonstrated the benefits of AI interventions in specific educational contexts. For example, an AI-enabled decision aid was found to significantly improve decision quality, shared decision-making, patient satisfaction, and functional outcomes in patients with knee osteoarthritis (Jayakumar et al., 2021). Additionally, AI precision education strategies, such as utilizing students' learning history data, grouping by AI systems, providing special counseling, and early problem detection, have been successful in improving learning effectiveness (Lin & Lai, 2021).

Furthermore, research has shown that AI chatbots can have a large effect on students' learning outcomes (Wu & Yu, 2023). AI-supported automatic writing feedback systems have been effective in helping students improve their writing skills, while intelligent tutoring systems have positively impacted students' language learning (Yang & Kyun, 2022). Moreover, AI systems have been found to assist students in various roles, such as acting as personal tutors, analyzing learning processes and outcomes, and collaborating with students to enhance their learning tasks (Kim & Lee, 2022). In conclusion, the findings from these studies collectively suggest that AI interventions have the potential to significantly enhance learning outcomes by improving decision-making, engagement, personalized learning strategies, and overall academic performance. By leveraging AI technologies in educational settings, educators can create more effective and tailored learning experiences for students, ultimately leading to improved educational outcomes.

3.2. Findings Regarding the Effectiveness of AI Interventions in Improving 21st Century Skills

Technology-based learning has demonstrated significant effectiveness in enhancing students' 21st-century skills, such as critical thinking, problem-solving, collaboration, and communication (Zulkifli et al., 2022; Zulkifli et al., 2022; Sari et al., 2022). Research has shown that integrating STEM education with technology can lead to improvements in students' mastery of concepts and skills, including creative thinking, critical thinking, and communication (Asrizal et al., 2022; Mardian et al., 2022). Additionally, the use of programming in K-12 schools has been found to have a moderate but significant effect on enhancing 21st-century skills (Hu, 2023).

Blended learning approaches, such as the implementation of web-based technologies and inquiry-based learning, have been proven to positively impact the development of 21st-century skills, particularly communication skills (Ramalingam et al., 2021; Novitra et al., 2021). Moreover, the application of active learning methods has been shown to enhance both lower- and higher-order cognitive skills, surpassing the outcomes of passive learning approaches (Harris & Bacon, 2019).

Furthermore, studies have emphasized the importance of incorporating artificial intelligence (AI) interventions in education to model 21st-century competencies and social-emotional skills, presenting new ethical challenges for education policies and practices (Tuomi, 2022). The development of innovative teaching materials, such as STEM materials integrated with Arduino, has been associated with the enhancement of 21st-century competencies (Nawawi & Dafrita, 2022). In conclusion, a combination of technology-based learning, STEM education, programming, blended learning, and active learning methods can significantly contribute to the improvement of students' 21st-century skills. These approaches not only enhance cognitive abilities but also foster creativity, critical thinking, collaboration, and communication skills essential for success in the modern world.

3.3. Findings Regarding the Effectiveness of AI Interventions in Increasing Student Motivation and Engagement

In recent years, there has been a growing interest in exploring the effectiveness of AI interventions in enhancing student motivation and engagement. Wu & Yu (2023) conducted a meta-analysis on the impact of AI chatbots on student learning outcomes, indicating that short interventions with AI chatbots can temporarily increase students' interest, motivation, and performance. Alibakhshi (2023) highlighted the transformative potential of AI interventions in tailoring education for autistic individuals, emphasizing the importance of personalized instruction. Furthermore, Kasari et al. (2021) discussed the use of adaptive interventions, including AI, to individualize social skills interventions for students with ASD.

Gamification strategies, as discussed by (Gamarra et al., 2021), have shown promise in increasing student motivation and engagement, leading to greater participation in academic activities. Li et al. (2022) emphasized the positive relationship between autonomy-supportive teaching motivations, intrinsic motivation, and student engagement in online learning environments. Additionally, Zadeja & Bushati (2022) highlighted the correlation between gamified learning processes and improved student grades, suggesting that gamification can enhance motivation and counter a decline in autonomous motivation.

Moreover, research by Fu (2024) indicated that mastery motivation climate positively influences student engagement, while performance motivation climate has a negative impact. These findings underscore the importance of creating a supportive motivational climate to enhance student engagement. Overall, the studies suggest that AI interventions, gamification strategies, and supportive motivational climates play crucial roles in increasing student motivation and engagement in educational settings.

3.4. Findings Regarding the Effectiveness of AI Interventions in Reducing Educational Gaps

Artificial Intelligence (AI) interventions have demonstrated potential in reducing educational disparities across various domains. Research has shown the effectiveness of AI tools in providing personalized education for children with neurodevelopmental disorders (Barua et al., 2022). Moreover, the application of AI in disease education, such as diabetes management, has been acknowledged for its capacity to offer tailored and comprehensive educational interventions (Li et al., 2020). Additionally, studies have indicated that AI chatbots can significantly influence students' learning outcomes, highlighting the potential of AI in improving educational experiences (Wu & Yu, 2023).

In the healthcare sector, AI technologies have been utilized to enhance compassion and care delivery, indicating the ability of AI to address gaps in patient diversity and enhance educational efficacy (Morrow et al., 2023). Furthermore, AI has been integrated into surgical education, with current applications focusing on research and future directions that could positively impact surgical training and education (Ward et al., 2021). Similarly, in the field of medical education, innovative AI chatbots have been identified as valuable tools for post-pandemic education and clinical assistance, aiding in knowledge transfer and decision support (Xie, 2023).

Tailored educational interventions, specifically designed to promote breast cancer screening among American Indian women, have highlighted the significance of incorporating AI technologies to enhance comprehension and encourage screening behaviors (Roh & Lee, 2023). Moreover, AI has been recognized as a potential equalizer in addressing gender disparities in surgical training and education, offering opportunities to overcome barriers faced by women in surgical fields (Mari et al., 2022).

Overall, these studies emphasize the significant role of AI interventions in reducing educational gaps, enhancing personalized education, improving healthcare delivery, and

promoting cultural sensitivity in educational programs. By effectively leveraging AI technologies, educational institutions and healthcare providers can bridge disparities, foster inclusivity, and enhance learning outcomes for diverse populations.

3.5. Discussion of Factors Affecting the Effectiveness of AI Interventions

Factors influencing the effectiveness of AI interventions encompass a variety of elements that impact their outcomes. The quality of AI, including its accuracy and reliability, is a critical factor (Ai-zhong & Zhang, 2022). Additionally, the appearance of AI, such as humanoid features, can influence user interaction with the technology (Ai-zhong & Zhang, 2022). The social context in which AI operates, including the environment and societal norms, also plays a significant role in determining its effectiveness (Ai-zhong & Zhang, 2022).

Addressing social determinants of health, such as racial discrimination and historical trauma, has the potential to enhance the effectiveness of interventions for individuals with substance use disorders and chronic health issues (Skewes & Blume, 2019). In the healthcare ecosystem, factors like operational changes, customized training interventions, openness to learning, and job-related skills can impact the employability implications of AI interventions (Jain et al., 2021).

AI interventions may lead to side effects, such as AI-associated arthralgia, mental health issues, and osteoporosis, underscoring the importance of monitoring and managing these effects for optimal outcomes (Tsai et al., 2021). Furthermore, integrating human interventions alongside AI can significantly enhance physical indicators, highlighting the necessity for personalized care within AI interventions (Okaniwa & Yoshida, 2022).

To ensure the efficacy of AI interventions, studies must adhere to reporting guidelines that maintain high standards, facilitating comprehensive evaluation of safety and effectiveness (Ibrahim et al., 2021). Utilizing AI in public health interventions presents opportunities such as leveraging big data, but also poses challenges like bias propagation and regulatory issues (Morgenstern et al., 2021). In conclusion, the effectiveness of AI interventions is influenced by various factors, from the quality of AI to the social context in which it operates. Understanding and appropriately addressing these factors are crucial for maximizing the impact of AI interventions across different domains.

3.6. Implications of Findings for Educational Research and Practice

The integration of Artificial Intelligence (AI) in education has profound implications for educational research and practice. Research has identified key themes and clusters related to AI in education, including adaptive learning, personalization, deep learning algorithms, human-AI interaction, and the utilization of AI-generated data (Bozkurt et al., 2021). AI is increasingly recognized as a pivotal component of educational processes, impacting student learning experiences, support mechanisms, and enrollment management in higher education (Hannan, 2021). The application of AI in education has demonstrated potential in enhancing student performance, aiding educators in developing effective learning strategies, and transforming learning environments (Sari & Purwanta, 2021).

Moreover, the incorporation of AI in education has brought about changes in educational methodologies and ethics, underscoring the importance of transparency, accountability, and interpretability in AI-driven educational technologies (Yu & Yu, 2023; Chaudhry et al., 2022). AI has been shown to enhance adult learning practices by facilitating personalized and precise education, converting learning environments into intelligent systems, and redefining the role of adult educators (Kang, 2023). Additionally, AI technologies have been successfully applied in STEM education, emphasizing the significance of educational, technological, and theoretical implications for the integration of AI techniques in STEM fields (Xu & Ouyang, 2022).

As AI continues to evolve and shape education, there is a growing necessity for educators to cultivate AI literacy among learners, design enhanced learning experiences, and bolster teachers' proficiency in teaching AI (Zhou & Lin, 2020; Yau et al., 2022). The utilization of AI in education has also been associated with improvements in English teaching resources, alterations in teaching methodologies, and increased student engagement in learning (Zhang, 2023). Overall, research on AI in education underscores the transformative capacity of AI in molding the future of learning and teaching practices, highlighting the critical importance of ethical considerations, transparency, and the development of AI literacy among educators and learners.

4. Conclusions

Based on the literature review carried out, it can be concluded that artificial intelligence (AI) interventions have great potential in improving learning outcomes, 21st century skills, motivation, student engagement, as well as reducing educational gaps. Findings from various studies show that AI has succeeded in improving the quality of learning in various ways, such as improving student academic performance, encouraging student engagement, and increasing learning motivation. The use of AI technology has also proven effective in facilitating adaptive learning, providing personalized feedback, and providing learning solutions tailored to individual needs.

The implications of these findings in the context of educational research and practice are significant. Further research is needed to explore the long-term impacts of AI interventions, identify more effective strategies for implementing AI technologies in classrooms, and explore the ethical implications of using AI in education. Additionally, educational practitioners need to consider factors that influence the effectiveness of AI interventions, such as AI quality, social context, and health implications. Finally, it is necessary to emphasize the importance of developing AI literacy among educators and students to ensure the responsible and sustainable use of AI technology in educational contexts.

Limitations of this literature review include limitations in the scope of literature accessed and obstacles in compiling a synthesis of findings from diverse studies. Therefore, it is necessary to carry out further, more in-depth and detailed research to fully understand the impact and implications of AI interventions in education. Future research could broaden the scope in exploring specific aspects of AI interventions, delving into more specific factors influencing their effectiveness, as well as developing a more holistic framework for effectively implementing AI technologies in educational contexts.

Thus, this research makes a valuable contribution to our understanding of the role of AI in modern education and highlights the importance of continually developing innovative and sustainable approaches to harness the full potential of AI technology in improving learning and teaching.

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