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REDESIGNING BLENDED LEARNING MODELS IN THE ERA OF ARTIFICIAL INTELLIGENCE

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ABSTRACT

Objective: This study explores the role of Artificial Intelligence (AI) as a transformative technology in education, particularly in the context of blended learning. It aims to assess the impact of AI tools on learning personalization, assessment automation, and student-teacher interaction while addressing ethical and operational challenges.

Research Design & Methods: This study utilizes a library research method, analyzing various AI tools and their application in education, including smart tutoring systems such as Google Classroom, ChatGPT, Turnitin, and Gradescope.

Findings: The findings suggest that AI tools significantly enhance learning outcomes and student engagement by personalizing learning experiences and automating assessments. However, challenges such as over-reliance on AI, privacy risks, and ethical concerns need to be addressed for the successful integration of AI in education.

Implications & Recommendations: The study recommends that AI integration in education should be balanced through collaboration between governments, educational institutions, and technology providers and supported by clear regulations to reduce risks. Educators also need to combine AI with effective pedagogical practices to support the development of critical thinking and problem-solving skills in students.

Contribution & Value Added: This research contributes to the understanding of how AI can enhance blended learning by offering a comprehensive analysis of its tools and their impact on education. It also provides practical recommendations for educators and policymakers to optimize the use of AI while addressing its challenges in the digital age.

Keywords: Artificial Intelligence (AI), Blended Learning, Student Engagement

JEL codes: I20, I21, I23

Article type: research paper

INTRODUCTION

The rapid development of artificial intelligence (AI) technology has opened up new opportunities to enhance the learning process in the digital transformation of education. AI can simulate human intelligence in performing tasks such as decision-making, speech/image recognition, and problem-solving (Wasim & Zaheer, 2023). The development of artificial intelligence (AI) technology has offered new opportunities to enhance evaluation and personalization in learning, especially in improving the effectiveness of blended learning. AI-based assessment tools are able to provide real-time feedback, helping students improve their technical skills through a more adaptive and targeted approach. The use of AI analytics tools can also assist educators in designing more adaptive approaches to meet the learning needs of students in technical areas. (Ciolacu & Svasta, 2021). AI also allows educators to predict student performance and intervene early based on their online behavior (Xu et al., 2021). Studies show that the

application of AI in learning can not only increase student engagement, but also provide more accurate and effective feedback (Alshahrani, 2023).

Blended learning has become one of the most effective methods in modern education. It combines the advantages of face-to-face learning with the flexibility of online learning, allowing students to learn outside the conventional classroom (Xu et al., 2021). Blended learning has the potential to improve the quality of education by combining the advantages of face-to-face and online learning. The integration of technology in blended learning can enrich students' learning experience, increase engagement and develop pedagogical skills (Demiroz, 2016; Leonielyn G. Malicay, 2023). It also allows for greater flexibility and personalization of learning (Hanč et al., 2024; Ibiloye, 2021).

The integration of AI technology in blended learning models provides an opportunity for the development of more personalized and interactive learning resources. The technology enables the creation of smart learning spaces, where students can engage in learning activities that promote the development of critical thinking and problem-solving skills (Zheng, 2020). According Ruan (2022) in his research, the use of adaptive AI systems in blended learning can improve student engagement and learning outcomes. Recent studies have shown that AI is not only able to increase student engagement but can also promote more sustainable and inclusive learning through automation of administrative tasks and delivery of more structured learning materials (Alshahrani, 2023).

In the implementation of blended learning that needs to be addressed through careful redesign. This includes ensuring student engagement remains high, overcoming technological complexities, and bridging the digital access gap (Zhi & Thoe, 2024). For example, in Indonesia, the geographical conditions consisting of mountains, lowlands, plateaus, and valleys make internet access difficult in remote areas, making virtual learning a challenge (Prahmana et al., 2021). his requires an alternative solution to overcome the digital access gap. In addition, it is necessary to consider students' readiness to adopt digital transformation in learning. This prompts the need to redesign blended learning models that integrate AI. While AI offers great potential, its application also faces ethical challenges that need to be considered in redesigning learning models. Issues such as fairness, privacy, transparency, and human-AI cooperation need to be addressed (Pandey et al., 2024).

Redesigning blended learning models allows educational institutions to adapt to the needs of 21st-century students, capitalize on technological advances, and create a more inclusive learning environment (Nseibo et al., 2023). With the right approach, blended learning can significantly improve student achievement and retention, as well as prepare them for an increasingly digital world. Therefore, redesigning the blended learning model is crucial to ensure the effectiveness and relevance of education in the modern era. Redesigning blended learning models with AI can help bridge the gap. The blended learning model in the AI era requires a comprehensive approach that considers technological, pedagogical, and ethical aspects.

In an attempt to redesign learning models in the era of artificial intelligence (AI), it is important to pay attention not only to technological aspects and cognitive learning but also aspects of emotional (EQ) and spiritual intelligence (SQ). A holistic education should include the development of a balance between academic, emotional, and spiritual intelligence to form individuals who are able to contribute effectively to society. The EQ aspect helps students manage emotions, increase empathy, and develop social skills that are important in collaborating and interacting in the world of work and social life. Meanwhile, the SQ aspect provides a spiritual foundation that supports wise and meaningful decision-making in life, especially in the face of complexity and moral challenges in the digital era. The integration of AI technology with learning that emphasizes EQ and SQ enables the creation of a more humane and relevant education model. This model not only prepares students with the technical skills needed to face the challenges of the 21st century, especially in this era of Artificial Intelligence (AI) but is also equipped with emotional and spiritual intelligence that will support a more balanced and sustainable personal development. Thus, this education model will be more adaptive to technological developments while remaining rooted in human values, creating a more balanced and sustainable personal development.

LITERATURE REVIEW

Blended Learning

The increasing availability of information and communication technology (ICT) is driving the adoption of blended learning as a method that allows flexible access to learning materials, while reducing overcrowding in physical classrooms (Kumar et al., 2021). Blended learning is defined as a combination of face-to-face learning and internet-based technology, which aims to increase the effectiveness and flexibility of learning. According Cronje (2020) the blended learning is a combination of face-to-face learning and internet-based technology, which aims to increase the effectiveness and flexibility of learning. Muxtorjonovna (2020) describes that blended learning is the integration of face-to-face, internet and distance learning, which increases flexibility and accessibility to improve student motivation and learning achievement.

Blended learning is a learning approach that combines the conventional face-to-face learning method with online learning, offering an innovative approach to education by combining the advantages of traditional and digital methods. Some studies show the effectiveness of blended learning in improving student learning outcomes. A research in SMA Negeri 1 Sumbawa Besar proved that blended learning method can improve students' social skills, academic skills, and learning effectiveness in Civic Education subject (Suhandi et al., 2022). Another study on nursing students also showed significant improvement in learning outcomes after implementing blended learning (Rina Nur Hidayati et al., 2023). Zydney et al., (2020) dan Boelens et al., (2017) stated that blended learning provides flexibility in terms of time, place, pace, and learning path. However, this increased flexibility also provides greater autonomy for students, which may reduce social interaction between teachers and students as well as between students. Blended learning is proven to have a significant positive impact in improving student learning outcomes, especially through the incorporation of online and face-to-face assignments that can stimulate deeper understanding.

Although blended learning offers various advantages, its online learning part often presents challenges, such as problems in self-regulation and difficulties in using learning technology (Muhria et al., 2023). The implementation of blended learning is also influenced by several factors such as adequate technological infrastructure, student independence, and teacher preparation (Muslikhah & Sriyanto, 2022). By considering these factors, blended learning can be implemented more effectively, thus providing flexibility and improving the quality of learning. The overall goal of this approach is to create an inclusive and student-centered learning environment that allows them to thrive and reach their full potential.

Allen et al (2007) classified the blended learning into four categories based on the proportion of online learning from traditional learning (none), web-facilitated (below 30%), blended learning (between 30% and 79%), to mostly online learning (above 80%). Nida et al., (2020) suggested that flipped classroom and station rotation are two blended models that are explicitly mentioned. In the flipped classroom model, students learn the material online before the face-to-face meeting, while the station rotation model involves rotating between online and face-to-face learning in one learning session. Blended learning integrates various resources, both physical and virtual, implemented through various approaches, as presented in Table 1.

Artificial Intelligence in Education (AIEd)

The development of information technology in recent decades has brought significant changes in various fields, including education (Crompton et al., 2024). One of the most important innovations impacting education is the implementation of Artificial Intelligence in Education (AIEd). AIEd focuses on the utilization of artificial intelligence (AI) technology to support and improve learning, teaching, and decision-making in educational settings. Education is now undergoing a transformation from using conventional learning methods that tend not to be adaptive to the individual needs of students, AIEd is now present as a solution to create a more personalized learning system.

Table 1. Blended Learning Approach

Live Face to Face (Formal)		Live Face to Face (Informal)	
1. Instructor-led classroom		1. Collegial connections	
2. Workshops		2. Work teams	
3. Coaching/monitoring		3. Role modeling	
4. On-the-job (OTJ) training			
Virtual Collaboration/Synchronous		Virtual Collaboration/Asynchronous	
1. Live e-Learning classes		1. E-mail	
2. E-mentoring		2. Online bulletin boards	
		3. Listservs	
		4. Online communities	
Self-paced learning		Performance Support	
1. Web learning modules		1. Help System	
2. Online resource links		2. Print job aids	
3. Simulations		3. Knowledge databases	
4. Scenarios		4. Documentation	
5. Video and audio CD/DVDs		5. Performance/decision support tool	
6. Online self-assessments			
7. Workbooks			

Source: [Rossett et al., \(2003\)](#)

Artificial Intelligence in Education (AIEd) is a definition of the use of AI technologies to support learning, teaching, or decision-making in an educational context. The use of intelligent technology to provide personalized guidance, support, as well as real-time feedback to students makes learning more effective and efficient ([Hwang et al., 2020](#)). [Chen et al., \(2020\)](#) reviewed the impact of AI on education, particularly in administration, instruction, and learning. The study shows that AI has been widely adopted in various forms such as web-based education systems, chatbots, and humanoid robots, all of which play a role in optimizing administrative tasks and curriculum personalization for students. Along with the rapid changes in skill needs in the digital age, AIEd aims to develop a learning system that is flexible and adaptable to the dynamic needs of the job market. This ensures that students gain relevant and up-to-date skills through AI-powered learning ([Tapalova & Zhiyenbayeva, 2022](#)). A systematic literature review on AIEd shows a significant improvement in the application of artificial intelligence in education, as well as increasing scholarly interest in its trends and usage patterns. Over two decades, data-driven research has also highlighted a surge in the number of publications in this field, with particularly rapid growth in recent years ([Chen et al., 2020](#); [Guan et al., 2020](#); [Li et al., 2022](#)).

In this context, [Deng \(2020\)](#) argue that there are four main approaches, including:

1. Acting humanly
AI systems can perform tasks or interact with the environment in a manner similar to humans.
2. Thinking humanly
AI systems can think and process information as humans do.
3. Think rationally
AI systems can perform logical and rational thinking in the decision-making process.
4. Act rationally
AI systems are able to act and respond to situations in a rational way, based on logic and predetermined goals.

Systematic reviews of AIEd-related topics, such as AI applications or learning analytics, have been conducted in the context of e-learning ([Tang et al., 2023](#)), blended learning ([Bergdahl et al., 2020](#)), and collaborative learning ([Tan et al., 2022](#)). The integration of blended learning with artificial intelligence (AI) shows great potential in improving educational experiences and outcomes. AI applications are mainly applied in the online asynchronous individual learning component, which enables student flexibility and autonomy ([Park & Doo, 2024](#)). This combination results in an intelligent blended learning process that uses AI methods such as user modeling, adaptation, machine learning, chatbots, and semantic text recognition tools, aiming to improve

learning success and reduce drop-out rates (Ciolacu & Svasta, 2021). The implementation of AI in blended learning has shown positive results, including improved learning outcomes, student engagement, and a more personalized learning experience. AI technologies, such as ChatGPT, can increase student motivation and self-learning by providing immediate feedback and assistance (Alshahrani, 2023). However, it is important to consider the ethical aspects and ensure that the use of AI remains humanized to achieve better educational goals. With the advancement of AI technology, especially in the development of generative AI, it is expected that more research will emerge on its integration with blended learning. This has the potential to revolutionize educational practices and create a more sustainable and scalable education system.

METHODS

The approach taken in this research uses the library research method (literacy review). The library method, also known as library research, is a data collection technique that is often used in qualitative research. This method includes searching and analyzing various literature sources, such as books and articles, to obtain secondary data relevant to the research topic (Mutiarani et al., 2022). The purpose is to build a theoretical basis, understand the issue under study, and identify gaps in existing research (Handayani & Astuti, 2023).

This approach allows researchers to analyze and evaluate various relevant literature related to blended learning models and the application of artificial intelligence in education. The literature analysis allowed us to explore various applications of artificial intelligence (AI) in education, such as recommendation systems for personalized learning, chatbots for learning support, and analytics tools to monitor student progress. This approach provided insights into how technology can strengthen asynchronous and collaborative learning, and create a more interactive learning environment. It also helps researchers identify challenges and limitations in the implementation of AI-based blended learning models, such as student engagement issues, self-regulation, and the digital divide. In addition, this analysis revealed research gaps that require further exploration, so that researchers can propose innovations in the development of more effective learning models and best practices for AI integration.

Altogether, the desk-based observation method provides a solid foundation for researchers to design further research, both through primary data collection and more detailed model development, so that the results not only enrich theoretical understanding but also provide practical guidance for implementation in wider education.

RESULT

In the recently years, artificial intelligence (AI) has taken an increasingly important role especially in the world of education. The main goal of using Artificial Intelligence (AI) in blended learning is to improve the effectiveness, efficiency and personalization of the learning process. This is achieved by incorporating AI technology into traditional teaching approaches and digital learning. Artificial Intelligence (AI) has become a critical component in supporting more effective and efficient blended learning. AI enables personalization of learning, optimization of the teaching process, and increased student engagement. AI-based systems can help educators manage classes, provide automated feedback, and personalize learning experiences according to individual student needs, thereby improving learning outcomes.

Artificial Intelligence (AI) has enhanced blended learning significantly by addressing challenges such as personalizing learning experiences, automating assessments, and improving student-teacher interactions. Here are some detailed explanations of how AI contributes to these areas:

1. Personalization

Personalization of learning experiences is one of the main challenges of AI in education. AI can understand the individual needs and preferences of students, allowing for customization of learning materials and delivery methods (Dayal et al., 2023; De Sá et al., 2024). Personnel challenges to AI in blended learning include various aspects that may hinder the adoption and effectiveness of this technology in educational settings. One of the main challenges is the variation in technological skills among teachers and students, where not all individuals have the same ability to use AI-based tools, which may result in gaps in the learning experience. In addition, resource limitations, such as inadequate hardware and internet connectivity, are barriers for many institutions to integrate AI effectively. Doubts and uncertainties among educators on how best to utilize AI can also hinder innovation in teaching. In addition, issues related to the quality of data used to train AI systems can affect the accuracy and reliability of the results obtained. Privacy and ethical issues, especially related to the collection of students' personal data, add to the complexity of AI implementation. Therefore, addressing these challenges requires a comprehensive approach, including training, pedagogical support, and attention to relevant ethical issues.

2. Automating Assessment

The challenge of automating assessment in the context of AI in blended learning includes a number of aspects that affect the effectiveness and reliability of the evaluation process. One of the main issues is the ability of AI to understand and score subjective answers, such as essays or critical analysis, which require a deeper understanding of context and nuance than objective answers. Limitations in AI scoring algorithms can result in inaccurate or biased scoring, especially if the system is not trained with high-quality, representative data. In addition, educators are often hesitant to fully rely on automated systems, as they are concerned about the validity and transparency of the assessment results provided. Other challenges include the need to ensure the security and privacy of student data in the automated assessment process, as well as the difficulty in integrating AI assessment systems with existing curricula. Therefore, to overcome these challenges, there needs to be collaboration between technology developers and educators, as well as the development of clear standards to measure the effectiveness and fairness of automated assessment systems.

3. Improving Student-Teacher Interaction

The challenge of improving student-teacher interaction in the context of AI in blended learning involves several factors that can affect the dynamics of communication and engagement. One of the main challenges is the reliance on technology that can create emotional distance between students and teachers, reducing the opportunity to build more personalized and direct relationships. In addition, AI's limited ability to mimic the nuances of human communication can hinder deeper interactions, such as empathy and understanding, which are important in the learning process. Students' uncertainty about how and when they can interact with teachers through AI-based platforms may also reduce their active participation. In addition, not all teachers have sufficient skills in using AI tools to enhance interaction, which may result in suboptimal utilization of the technology. Limited time management during blended learning sessions can also make it difficult for teachers to give sufficient attention to all students, especially in large groups. Therefore, to overcome these challenges, it is important for educational institutions to provide training and support for teachers in utilizing AI technologies, as well as creating an environment that encourages active and collaborative interactions between students and teachers. Table 2 shows that several types of AI for blended learning are useful and can be implemented not only for students but also for teachers to overcome challenges.

DISCUSSION

In the implementation, AI has contributed to blended learning by helping to overcome various challenges that arise in the learning process, such as personalization of the learning experience, automation of assessment, and improvement of student interaction. AI enables the development of adaptive learning systems that can tailor materials to students' individual needs and abilities, thus creating a more relevant and effective experience. In addition, AI also supports the automation of

assignment and exam grading, providing quick and objective feedback and reducing teachers' workloads. In terms of interaction, AI technologies such as chatbots and virtual assistants can provide real-time learning assistance, support collaboration between students, and ensure greater accessibility to learning resources, especially in remote areas.

Table 2. Example Tools for AIED

Type of AI	Roles and Benefits	Example Tools
Intelligent Tutoring Systems (ITS)	ITS uses AI algorithms designed to mimic the role of a teacher in providing guidance and instruction to students. This system has a crucial role in improving the quality of learning, especially in blended learning.	a. Carnegie Learning b. ALEKS (Chen et al., 2020)
Automated Grading Systems (AGS)	A system that uses technology to automatically assess and grade assignments, exams, or other academic work.	a. Plagiarism Check Tool (ex: Turnitin) b. Gradescope c. Kahoot d. Socrative (Shrungare, 2023)
Learning Management Systems (LMS)	A technology-based platform designed to manage, distribute and administer learning experiences.	a. Google Classroom b. Canvas LMS c. Edmodo d. Moodle
Chatbots dan Asisten Virtual Berbasis AI	Technology that uses artificial intelligence to interact with users through text- or voice-based conversations.	a. ChatGPT b. Jill Watson c. Dialogflow d. Perplexity AI e. IBM Watson Assistant (Adiguzel et al., 2023)

While the implementation of Artificial Intelligence (AI) in blended learning has offered many advantages in terms of efficiency and personalization, there are a number of ethical and operational issues that need to be taken seriously. Artificial Intelligence (AI) leads to a potential dependency for its users which leads to a decrease in their decision-making ability and reduces or even eliminates their motivation to manually search for information and think independently. In addition, technical issues related to misuse of AI, job replacement by AI, and privacy issues are also important concerns. There is also the risk of high plagiarism. In this case, regulation, ethics, and a deeper understanding of the limitations and potential of AI are needed to effectively reduce its negative impact in education (Miftahul Huda & Irwansyah Suwahyu, 2024). Thus, the use of AI can be optimized to enhance the learning experience without compromising students' decision-making ability and motivation. To achieve this, collaboration between various stakeholders, including governments, educational institutions, and technology providers, is essential in creating a safe and effective learning environment, where strict regulations can reduce the risk of plagiarism and misuse of AI.

Table 3. Contributions of AI to Blended Learning

Challenge in Blended Learning	Contribution of AI
Learning Effectiveness	1. Integrating motivation strategies with the reward system (Troussas et al., 2020) 2. Making the learning system more flexible because it can be done anywhere and anytime (Lin & Mubarok, 2021) 3. Supports the development of competence, independence, and relationships between students (Lin & Mubarok, 2021)

Challenge in Blended Learning	Contribution of AI
Control and Flexibility	<ol style="list-style-type: none"> 1. Provides easy access to information and prompt support according to individual needs (Sánchez-Ruiz et al., 2023), and improves learning outcomes (Phillips et al., 2020) 2. Improving the school experience (Chatzara et al., 2019) 3. Providing customized instruction and support (Phillips et al., 2020; Liao & Wu, 2022) 4. Support classroom administration (Phillips et al., 2020) as well as management through monitoring students, classroom dynamics, and goal achievement (Mavrikis et al., 2019). 5. Assisting instructors in customizing materials and monitoring student learning progress (Phillips et al., 2020), as well as reducing teacher workload and saving time (Lechuga & Doroudi, 2023; Lin & Mubarak, 2021)
Transforming Learning and Improving Performance	<ol style="list-style-type: none"> 1. Helping novice learners improve their knowledge and skills in specific areas, such as, programming languages, dance movements, or English speaking skills (Lin & Mubarak, 2021; Yang et al., 2013) 2. Enabling students' individual vocabulary acquisition and evaluation to improve reading and listening comprehension (Jia et al., 2012) 3. Improves students' performance and critical thinking through peer assessment and commentary (J.-W. Fang et al., 2021)
Supports communication between teachers and students	<ol style="list-style-type: none"> 1. Helps teachers organize student groups and select appropriate materials for different teaching strategies (Lechuga & Doroudi, 2023). 2. Classify students and customize the learning environment according to their individual abilities and characteristics (Fang et al., 2022). 3. Support diverse methods in collaborative learning (Lechuga & Doroudi, 2023). 4. Helps teachers to interact with students and notify them when intervention is needed (Van Leeuwen, 2019).

CONCLUSION

Artificial intelligence (AI) has opened up new opportunities to improve the learning process in the digital transformation of education. AI-based assessment tools provide real-time feedback, helping students improve their technical skills through a more adaptive and targeted approach. Blended learning, which combines face-to-face and online learning, has become one of the most effective methods in modern education. The integration of AI technology in the blended learning model enables the creation of smart learning spaces and can improve student engagement and learning outcomes. However, the implementation of blended learning faces challenges such as ensuring student engagement, overcoming technological complexities, and bridging the digital access gap. Redesigning blended learning models with AI requires considering technological, pedagogical, and ethical aspects, as well as aspects of emotional intelligence (EQ) and spirituality (SQ), to form balanced individuals. AI has improved blended learning by addressing challenges such as personalizing the learning experience, automating assessment, and improving student-teacher interaction. However, there are also ethical and operational issues that need to be taken seriously, such as potential dependency on AI, job replacement, privacy concerns, and high risk of plagiarism. Collaboration between various stakeholders is essential in creating a seamless learning environment.

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