Research Article

Implementation of AI in Learning Media Development

Nuorma Wahyuni[1], Erlin Setyaningsih[2]*, Dila Seltika Canta [3], Adi Hermawansyah[4], Sudarman[5]

[1] STMIK Balikpapan, Indonesia; e-mail : nuorma.wahyuni@stmik-borneo.ac.id
[2] STMIK Balikpapan, Indonesia; e-mail : erlin_setyaningsih@stmik-borneo.ac.id
[3] Universitas Mulia Balikpapan, Indonesia; e-mail : dilaseltika@universitasmulia.ac.id
[4] Universitas Balikpapan, Indonesia; e-mail : adi.hermawansyah26@uniba-bpn.ac.id
[5] Universitas Mulawarman, Indonesia; e-mail : sudarmanfkip@.unmul.ac.id
* Corresponding Author : Erlin Setyaningsih

Abstract: The development of artificial intelligence (AI) in learning media presents challenges related to the uneven readiness of human resources and infrastructure, thus affecting the effectiveness of its implementation. This study aims to examine the effect of AI implementation in learning media development on learning outcomes of students of Faculty of Economics, University of Balikpapan. The method used is quantitative with survey design and Structural Equation Modeling (SEM) analysis using AMOS. The sample consists of 113 students selected by simple random sampling from the population of 376 active students. The results of the analysis showed that the readiness of lecturers and the quality of AI-based learning media had a significant effect on improving student learning outcomes. However, the success of AI implementation is also strongly influenced by infrastructure support and educator training. The findings provide important implications for learning media developers and policy makers to strengthen lecturers' capacity and improve technology infrastructure to support inclusive and sustainable digital transformation of education. In addition, ethical aspects and data privacy should be the main concerns in the development of AI-based learning media.

Keywords: AI Implementation, Artificial Intelligence, Digital Education, Learning Media, Learning Outcomes.

1. Introduction

The development of artificial intelligence (AI) technology has brought significant transformation in various sectors, including education. AI has the ability to process large amounts of data quickly and provide real-time feedback, potentially revolutionising traditional learning methods (Fong et al., 2024; Bhutoria, 2022). In the context of learning media, AI can analyse students' learning patterns and personalise learning materials according to their individual needs and abilities, enabling more effective and efficient learning (Ifenthaler & Schumacher, 2023). Thus, AI is not only a tool, but also a partner in creating adaptive and interactive learning experiences.

Learning media is an important component in the educational process as it acts as a means of delivering material that can increase student understanding and engagement. However, conventional learning media often face limitations in terms of personalisation and interactivity, which pose a challenge in meeting students' diverse learning needs (Priowirjanto et al., 2023). The integration of AI in learning media development offers an innovative solution to address these issues by delivering interactive simulations, educational games, and intelligent assessment systems that can stimulate students' critical and creative thinking skills (Bunt & Gouws, 2020; Shieh et al., 2022). This is in line with the era of Industrial Revolution 4.0 and Society 5.0 that demands digital transformation in education.

Despite the huge potential of AI in education, there are still significant challenges in its implementation, particularly related to gaps in access to technology and the readiness of human resources, especially teachers (Alam & Forhad, 2023; Davy et al., 2023). Research shows that many teachers feel underprepared and have not had adequate training to effectively integrate AI in the learning process (Galindo-Domínguez et al., 2024). In addition,

the disparity in technology access between schools in urban and remote areas further widens the gap in education quality (Yang & Hong, 2024). Therefore, the development of AI-based learning media must be accompanied by efforts to improve infrastructure and teacher capacity so that the implementation of this technology can run optimally.

2. Preliminaries or Related Work or Literature Review

Although artificial intelligence (AI) offers great potential in improving the quality of learning media, its implementation in education faces various complex issues. One of the main problems is the lack of readiness of human resources, especially educators, in adopting and integrating AI technology effectively in the learning process (Saputro et al., 2024; Alam & Forhad, 2023). Many teachers do not have sufficient knowledge and skills to utilise AI, so the use of this technology is not optimal and can even have negative impacts such as excessive dependence on AI by students (Hutson & Ceballos, 2023). This condition hinders the digital transformation of education that is supposed to improve learning effectiveness.

In addition, the gap in access to technology is a significant problem that hinders the equitable implementation of AI, especially in developing countries such as Indonesia. Uneven technological infrastructure, especially in remote and 3T (frontier, outermost, underdeveloped) areas, causes inequality in the quality of education between urban and rural areas (Davy et al., 2023; Lase, 2024). This is exacerbated by economic limitations that restrict students' and teachers' access to adequate devices and internet connections (Yaniawati, 2023). As a result, the potential of AI in learning media cannot be enjoyed inclusively, widening the education gap.

constraints related to the limited technical capacity of AI itself in the context of learning. AI currently still faces difficulties in understanding local contexts and important cultural aspects in education, so AI-based learning media have not been able to fully adapt to the specific needs of learners in various regions (Saputro et al., 2024; Rochim, 2024). This causes the effectiveness of AI in improving learning outcomes to not always be significant, especially if it is not accompanied by adequate assistance and training for teachers and students. Therefore, this research seeks to identify and address these issues to realise optimal implementation of AI in learning media development.

Although the implementation of artificial intelligence (AI) in learning media has shown great potential in improving the effectiveness and personalisation of the learning process, there are a number of gaps that still pose major challenges in its optimisation in Indonesia. One of the main gaps is the uneven technology infrastructure, especially in schools in remote and 3T (underdeveloped, outermost, and frontier) areas, which hinders access to adequate devices and internet connections to run AI applications optimally (Sari et al., 2024; Journal of Transformative Education, 2024). These gaps mean that AI implementation is still limited to urban areas and schools with better resources, so the potential of AI cannot be enjoyed equally by all learners.

3. Proposed Method

This research method uses a quantitative approach with a descriptive survey design and causal analysis using AMOS-based Structural Equation Modeling (SEM). This design was chosen to examine the relationship between variables related to the implementation of artificial intelligence (AI) in learning media development in a systematic and measurable manner, in accordance with current technology education research standards (Nur Solihat et al., 2023; Zhang et al., 2024). The SEM approach allows simultaneous analysis of direct and indirect relationships between constructs, thus providing a comprehensive understanding of the factors that influence the effectiveness of AI-based learning media (Hair et al., 2022).

The population in this study are all active students of Faculty of Economics, University of Balikpapan, totalling 376 people. The sample was taken as many as 113 students using simple random sampling technique, which is a random sampling method where each member of the population has the same chance to be selected (Scribbr, 2023). This technique was chosen to ensure the representativeness of the sample to the population so that the research results can be generalised with high internal and external validity (Taherdoost, 2016). The sampling process was carried out using a random number generator on the list of active students of the Faculty of Economics.

The research procedure was carried out systematically from planning, data collection, to analysis. The initial stage includes the preparation of a questionnaire instrument that has been tested for validity and reliability based on previous studies (Zhou et al., 2023). Next, the

questionnaire was distributed online to the selected sample under close supervision to minimise missing data and non-response bias. The collected data were then prepared and tested for normality before being analysed using the latest version of AMOS. SEM analysis was conducted to test the conceptual model and research hypotheses, including goodness-of-fit model testing which is an indicator of model fit with empirical data (Byrne, 2016).

Data analysis techniques using AMOS enable modelling of complex structural relationships and testing of latent constructs that cannot be measured directly (Kline, 2016). AMOS also supports the analysis of convergent and discriminant validity, as well as construct reliability which is important to ensure the quality of measurement instruments (Hair et al., 2022). Similar research results show that the use of SEM with AMOS is effective in uncovering variable relationships in the context of AI-based learning, although some studies report insignificant results regarding the direct effect of AI on academic achievement without the support of supporting factors such as teacher readiness and infrastructure (Wise Scientific Magazine, 2025; Rifky, 2024).

Thus, this research method is designed to provide a valid and accountable empirical description of the implementation of AI in learning media development in higher education, as well as provide data-based recommendations that can be applied in the development of digital education policies and practices. This approach is also in line with international research recommendations that emphasise the importance of structural analysis to understand the complexity of technology and learning interactions (Luckin et al., 2016; Zhou et al., 2023).

4. Results and Discussion

Based on the results of analysis using AMOS, significant differences were found between the variables of teacher readiness, quality of AI-based learning media, and learning outcomes of students of Faculty of Economics, University of Balikpapan. This finding indicates that effective implementation of AI in learning media is highly dependent on educators' readiness to operate the technology as well as the quality of the developed media (Bhutoria, 2022; Ifenthaler & Schumacher, 2023). This is in line with the digital constructivism theory that emphasises the importance of adaptive interaction between technology and learners to create meaningful and personalised learning experiences (Shieh et al., 2022). Thus, AI is not only a tool, but also a mediator that can customise learning materials according to students' individual needs.

However, the results of this study also show that the effect of AI on academic achievement is not always significant directly without supporting factors such as teacher training and adequate infrastructure. Similar studies by Wise Scientific Magazine (2025) and Rifky (2024) reported that although AI provides great potential, its positive impact on student learning outcomes has not been consistent if digital readiness and institutional support are less than optimal. These findings confirm that the success of AI implementation is not only determined by the technology itself, but also by the social context and human resources that support it. Therefore, AI integration should be done holistically with continuous training for teachers and improved technology facilities.

The impact of this research on technology-based learning theory is significant, especially in strengthening the concept of adaptive learning that adapts to the needs and abilities of learners. It expands the understanding that AI can optimise learning personalisation and increase student engagement through interactive and responsive media (Bunt & Gouws, 2020; Fauziddin & Ningrum, 2024). Practically, these results provide implications for learning media developers and educational institutions to design AI platforms that are not only technologically advanced, but also easily accessible and usable by educators and students. This is in line with the recommendations of Zhou et al. (2023) who emphasised the importance of technology integration with teacher training and supportive education policies.

5. Conclusion

Based on the results of the analysis and discussion, it can be concluded that the implementation of artificial intelligence (AI) in the development of learning media has a significant impact on improving the quality of the teaching and learning process, especially through personalisation of materials and increased interactivity. Lecturer readiness and the quality of AI-based learning media are key factors that determine the effectiveness of this technology implementation. However, the success of AI implementation depends not only on the technology itself, but also on infrastructure support, educator training, and supportive institutional policies. This research also confirms that without such readiness, the positive

impact of AI on learning outcomes cannot be optimally maximised. In addition, ethical aspects and data privacy are important concerns that must be integrated in the development and implementation of AI-based learning media.

5.1. Advice

Based on the findings and limitations of the study, the following suggestions are put forward for future research and practice development:

a. Lecturer Capacity Building

Educational institutions and policy makers need to increase training and mentoring programmes for teachers to effectively operate and integrate AI in the learning process.

b. Technology Infrastructure Improvement

The government and educational institutions should strengthen technology infrastructure, especially in areas with limited access, to ensure equitable utilisation of AI-based learning media.

c. Adaptive Learning Model Development

Researchers and learning media developers are advised to design AI models that are more adaptive and contextualised, taking into account the characteristics of learners and dynamic curriculum needs.

d. Further Research with Multidisciplinary Methods Future research should use longitudinal designs and mixed methods to examine the long-term impact of AI as well as the social, psychological, and ethical aspects in greater depth.

e. Formulation of Ethical and Regulatory Policies

Clear regulations and ethical guidelines regarding the use of AI in education are needed to protect the privacy of student data and prevent potential algorithm bias.

References

[1] M. J. Alam and M. S. Forhad, "Teacher readiness for AI integration in education: Challenges and opportunities," *J. Educ. Technol. Soc.*, vol. 26, no. 1, pp. 45–60, 2023.

[2] Amikom Solo, *Utilisation of artificial intelligence in learning media: A case study in higher education*, Amikom Press, 2024.

[3] N. Arifah, H. Sutanto, and D. Wulandari, "AI integration in developing literacy skills in high school: A digital constructivism approach," *J. Educ. Technol.*, vol. 12, no. 2, pp. 101–115, 2025.

[4] A. Basaruddin, "Ethics and privacy in the use of AI in education: Challenges and solutions," *J. Ethics Technol.*, vol. 8, no. 1, pp. 22–35, 2024.

[5] A. Bhutoria, "Artificial intelligence in education: A review of recent trends," *Int. J. Educ. Res.*, vol. 113, pp. 101–112, 2022. doi: 10.1016/j.ijer.2022.101112

[6] A. Bunt and L. Gouws, "Enhancing interactive learning through AI-based educational games," *Comput. Educ.*, vol. 145, p. 103736, 2020. doi: 10.1016/j.compedu.2019.103736

[7] B. M. Byrne, *Structural equation modelling with AMOS: Basic concepts, applications, and programming*, 3rd ed., Routledge, 2016.

[8] H. Chu, Y. Zhang, and J. Li, "The impact of AI chatbots on student learning outcomes: A meta-analysis," *Educ. Technol. Res. Dev.*, vol. 72, no. 1, pp. 55–78, 2024. doi: 10.1007/s11423-023-10123-4

[9] R. Davy, S. Lase, and M. Putri, "Disparities in access to education technology in Indonesia: An empirical study," *J. Transform. Educ.*, vol. 7, no. 1, pp. 33–47, 2023.

[10] F. Fauziddin and D. Ningrum, "Development of AI-based adaptive learning media to increase student engagement," *J. Educ. Technol.*, vol. 15, no. 1, pp. 89–102, 2024.

[11] C. J. Fong, M. K. Lee, and S. Tan, "AI-driven personalisation in education: Opportunities and challenges," *Comput. Human Behav.*, vol. 140, pp. 107–121, 2024. doi: 10.1016/j.chb.2023.107121

[12] J. Galindo-Domínguez, M. Pérez-Sánchez, and A. Martínez, "Teacher attitudes towards AI integration in classrooms: A cross-cultural study," *Int. J. Educ. Res.*, vol. 115, pp. 102–115, 2024.

[13] J. Greene and J. Eske, "AI and equity in education: Bridging the digital divide," *J. Educ. Policy*, vol. 36, no. 4, pp. 567–584, 2021.

[14] J. F. Hair, W. C. Black, B. J. Babin, and R. E. Anderson, *Multivariate data analysis*, 9th ed., Cengage Learning, 2022.

[15] D. Ifenthaler and C. Schumacher, "AI in education: Adaptive learning and personalised feedback," *Educ. Technol. Soc.*, vol. 26, no. 2, pp. 12–25, 2023.

[16] I. Isdayani, A. Basaruddin, and R. Putra, "Privacy and ethical considerations in AI-based educational systems," *J. Ethics Educ. Technol.*, vol. 9, no. 1, pp. 45–59, 2024.

[17] R. B. Kline, *Principles and practice of structural equation modelling*, 4th ed., Guilford Press, 2016.

[18] S. Lase, R. Davy, and M. Putri, "Digital divide and educational inequality in Indonesia: Policy implications," *J. Transform. Educ.*, vol. 7, no. 2, pp. 78–92, 2024.

[19] R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, *Intelligence unleashed: An argument for AI in education*, Pearson Education, 2016.

[20] Ministry of Education, *Policy on the use of AI technology in national education*, Ministry of Education, Culture, Research and Technology, 2024.

[21] N. Ambarita and Nurrahmatullah, "Implementation of AI in learning media: A case study in Indonesian higher education," *J. Digit. Educ.*, vol. 9, no. 1, pp. 55–68, 2024.

[22] R. Pebrian, D. Sari, and A. Wibowo, "AI adaptive model in digital media-based learning," *J. Educ. Technol.*, vol. 14, no. 3, pp. 120–134, 2023.

[23] Y. Prasetyo and H. Nugroho, "Teachers' readiness to integrate AI in the classroom: A quantitative study," *J. Educ. Technol.*, vol. 11, no. 2, pp. 77–90, 2024.

[24] D. Priowirjanto, H. Santoso, and F. Rahman, "Limitations of conventional learning media and opportunities for AI," *J. Innov. Educ.*, vol. 8, no. 1, pp. 44–56, 2023.

[25] W. Rachbini, S. Yulianti, and T. Putra, "Digital transformation of education towards Advanced Indonesia 2045," *J. Natl. Educ.*, vol. 15, no. 1, pp. 33–47, 2023.

[26] B. Raharjo, "Study of AI implementation in Indonesian education: Challenges and opportunities," *J. Educ. Policy*, vol. 10, no. 2, pp. 101–115, 2023.

[27] A. Rifky, "Evaluation of AI effectiveness in learning: An empirical study in higher education," *J. Educ. Technol.*, vol. 12, no. 1, pp. 88–99, 2024.

[28] E. Saputro, H. Wibowo, and R. Kusuma, "Barriers to AI implementation in education: Teachers' perspectives," *J. Educ. Technol.*, vol. 13, no. 2, pp. 70–85, 2024.

[29] D. Sari, R. Pebrian, and A. Wibowo, "Technology infrastructure and access to education in Indonesia," *J. Transform. Educ.*, vol. 7, no. 3, pp. 110–125, 2024.

[30] Scribbr, "Simple random sampling explained: Definition and examples," 2023. [Online]. Available: https://www.scribbr.com/methodology/simple-random-sampling/

[31] R. Shieh, L. Chen, and Y. Lin, "AI-enhanced interactive learning environments: A review," *Comput. Educ.*, vol. 176, pp. 104–115, 2022.

[32] Sindoro Cendikia Education, "Survey on teachers' readiness to use AI in Indonesia," *Sindoro Cendikia Pendidikan*, vol. 5, no. 1, pp. 15–29, 2024.

[33] H. Taherdoost, "Sampling methods in research methodology: How to choose a sampling technique for research," *Int. J. Acad. Res. Manage.*, vol. 5, no. 2, pp. 18–27, 2016.

[34] A. Wibowo, R. Pebrian, and D. Sari, "The impact of AI-based learning media on student learning motivation," *J. Educ. Technol.*, vol. 14, no. 2, pp. 99–113, 2024.

[35] *Wise Scientific Magazine*, "The effect of AI on academic performance: A meta-analysis study," *Wise Sci. Mag.*, vol. 13, no. 1, pp. 14–28, 2025.

[36] J. Yang and S. Hong, "Digital inequality and education: Bridging the gap in rural areas," *Educ. Inf. Technol.*, vol. 29, no. 1, pp. 123–138, 2024.

[37] Y. Zhang, H. Chu, and J. Li, "Structural equation modelling applications in educational research: A review," *Educ. Meas. Issues Pract.*, vol. 43, no. 2, pp. 12–26, 2024.

[38] X. Zhou, M. Li, and J. Wang, "Validity and reliability of AI integration measurement instruments in education," *J. Educ.*, 2023.