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Effectiveness of Artificial Intelligence-Based Learning Analytics Tool in Supporting Personalized Learning in Higher Education

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Abstract: Effectiveness of Artificial Intelligence-Based Learning Analytics Tool in Supporting Personalized Learning in Higher Education. **Objective**: The use of Artificial Intelligence (AI) in higher education has become one of the significant innovations to improve the quality of learning, especially through personalization. However, the effectiveness of AI-based learning analytics tools in supporting learning personalization in Indonesian higher education is still not widely explored. This research aims to evaluate the effectiveness of AI-based analytics tools in supporting learning personalization and identify challenges in its implementation. **Method**: This research uses descriptive qualitative method with in-depth interviews, observation, and document analysis. The respondents included 10 lecturers and 15 students from three universities in Indonesia who have implemented AI-based tools in the learning process. Data were analyzed using thematic analysis techniques to identify key patterns and trends. **Finding**: The results show that AI-based analytics tools are effective in improving learning personalization. Students using the tool recorded an average academic grade improvement of 15.03%, while lecturers found it helpful in understanding students' learning needs. The main challenges identified were low digital competency (50% of respondents) and concerns regarding data privacy (30% of respondents). **Conclusion:** AI tools have great potential to support personalized learning, but their success depends on digital literacy training and more transparent data management. This research has implications for the importance of investing in technology-based education infrastructure and policies to ensure sustainable adoption.

Keywords: artificial intelligence, personalized learning, higher education, technology effectiveness.

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INTRODUCTION

In the current digital era, the integration of technology in higher education has become increasingly vital to enhance the quality of learning (Sunandi et al., 2023). One significant innovation is the use of Artificial Intelligence (AI) to personalize the learning process. AI enables the customization of teaching materials and learning methods according to individual student needs, potentially improving learning outcomes and student motivation (Fatmawati et al., 2024).

However, the adoption of AI-based educational technology in Indonesia still faces significant challenges. According to the 2023 report by the Indonesian Internet Service Providers Association (APJII), the country's digital literacy rate is only 51.29% of the total population. Moreover, research by (Rifky, 2024) reveals that less than 25% of higher education institutions in Indonesia have significantly implemented AI-based technology in their learning processes. This figure is considerably lower

compared to neighboring countries such as Singapore and Malaysia, which have achieved adoption rates exceeding 50%. These data highlight the urgent need for research on the effectiveness of AI-based analytical tools in supporting personalized learning within the Indonesian context.

Several previous studies have demonstrated the benefits of AI in higher education. For instance, (Zawacki-Richter et al., 2019) emphasized AI's ability to enhance access and quality of learning through personalized approaches. However, most of these studies focus on global or developed country contexts, without addressing the specific challenges and opportunities in developing countries like Indonesia. Recent literature reviews from the past three years, such as studies by (Ahmad et al., 2024) and (Harahap et al., 2023), also underscore the importance of integrating AI with pedagogical approaches to support learning effectiveness. Nevertheless, few studies have explored the specific implementation of AI-based analytical tools in Indonesian higher education institutions.

This research offers a new approach in evaluating the effectiveness of AI-based learning analytics tools in Indonesian higher education, which has not been widely explored in the local context. As such, this study is expected to make a significant contribution to the existing literature.

The urgency of this research lies in the pressing need to improve the quality of higher education through technology. By understanding the effectiveness of AI-based learning analytics tools, educational institutions can make better decisions in implementing technology to support personalized learning (Rifky, 2024). This research is important as it contributes to the literature on educational technology, particularly in the context of developing countries. By evaluating the effectiveness and challenges of implementing AI-based analytical tools, the findings of this study are expected to provide practical guidance for higher education institutions in designing technology implementation strategies. Furthermore, this research offers insights for policymakers to formulate regulations that support the sustainable adoption of educational technology.

The main objective of this research is to measure the effectiveness of using AI-based learning analytics tools in supporting personalized learning in Indonesian universities. It also aims to identify the factors that influence the successful implementation of such technology. This research is designed to address several key questions, namely 1) How do AI-based analytical tools support personalized learning in Indonesia?, 2) What are the challenges and opportunities in implementing these tools in Indonesian higher education institutions compared to other countries?, 3) What factors influence the successful adoption of AI-based analytical tools in supporting personalized learning?

The results of this study are expected to provide practical benefits for higher education institutions in designing AI implementation strategies for personalized learning. In addition, the findings can serve as a reference for other researchers interested in similar topics, as well as assist policy makers in formulating regulations related to the use of AI in education.

METHOD

Participants

The participants in this study were lecturers, students, and system administrators from three universities in Indonesia that have implemented AI-based learning analytics tools. The population included all users of these tools in the selected universities, while the sample consisted of 10 lecturers and 15 students. A purposive sampling technique was used, selecting participants based on their experience with the tools and their active involvement in the AI-supported learning process.

Research Design and Procedures

This study used a descriptive qualitative research design to explore the effectiveness of AI-based learning analytics tools in supporting

personalized learning. The research was conducted over a period of four months, from September to December 2024. The procedures included the following steps:

1. Identifying universities that implement AI-based learning analytics tools.
2. Selecting participants using purposive sampling.
3. Collecting data through in-depth interviews, observations, and document analysis.
4. Triangulating data to ensure validity.
5. Analyzing and synthesizing data using thematic methods.

Instruments

The research employed the following instruments:

1. Interview Guidelines: Developed to explore participants' experiences and challenges with the AI tools. Questions were adapted from Creswell & Poth (2016) to align with qualitative research standards.
2. Observation Sheets: Used to document the interaction of participants with the AI tools during learning sessions. The observation criteria focused on the frequency of tool usage, user interaction patterns, and its impact on learning outcomes.
3. Document Analysis Guide: Designed to review system reports and analytics outputs to complement observational and interview data. To ensure validity and reliability, the instruments were reviewed by field experts and pilot-tested with a small group of participants before full deployment.

Data Analysis

The data were analyzed using a thematic analysis technique as described by Miles, Huberman, & Saldaña (2014). The analysis followed these steps:

1. Data Reduction: Filtering relevant data by categorizing it into themes related to the study objectives.
2. Data Display: Presenting the reduced data in the form of narrative descriptions, tables, and charts.
3. Conclusion Drawing and Verification: Synthesizing findings and verifying them through triangulation across interviews, observations, and document analysis.

■ RESULT AND DISCUSSION

The results of the study are presented in the form of graphs, tables, or descriptive. Analysis and interpretation of these results is needed before being discussed. The table is written in the middle or at the end of each text description of the results / acquisition of research. If the table width is not enough to be written in half a page, it can be written in full page. The table title is written from the left centered, all words begin with uppercase letters, except conjunctions. If more than one line is written in a single space (at least 12). For example, can be seen in Table 1 below.

The results of this study are presented in accordance with the research objectives, namely measuring the effectiveness of using Artificial Intelligence (AI)-based learning analysis tools in supporting personalized learning in higher education. The research data were obtained through in-depth interviews, observations, and document analysis, which were then analyzed using thematic methods. The following are the findings based on the research objectives.

Effectiveness of Using AI-Based Learning Analytics Tool

Based on interviews with lecturers and students, most respondents stated that AI-based learning analytics tools are able to support learning personalization by providing recommendations for teaching materials and methods that suit individual needs. The following is the observation data:

Table 1. The percentage of respondents' perceptions regarding the effectiveness of AI-based analysis tools

Factor	Number of Respondents who Agree	Percentage
Specific material recommendations	25	83.33%
Learning needs analysis	27	90.00%
Ease of use	22	73.33%

The table above shows that the majority of respondents agree that AI-based analytics tools contribute significantly to the personalization of learning. The highest percentage is found in the aspect of learning needs analysis (90%), followed by specific material recommendation (83.33%) and ease of use (73.33%). This result indicates that the data-driven analysis feature is one of the main advantages in supporting the effectiveness of adaptive learning in higher education.

The use of Artificial Intelligence (AI)-based technologies in education has become one of the main solutions to overcome the challenges of personalizing learning in the digital era (Hakeu et al., 2023) . This research explores the effectiveness of AI-based learning analytics tools in helping lecturers and students achieve more specific and individualized learning goals. The tool utilizes user interaction data to provide relevant learning recommendations, enable lecturers to design evidence-based teaching strategies, and help students achieve optimal learning outcomes.

The results of this study show that 90% of respondents feel AI-based tools help them understand more detailed learning needs. The tool not only suggests study materials, but also learning methods that suit individual learning styles, such as visual, auditory, or kinesthetic. This finding is consistent with research (Zawacki-Richter et al., 2019) , which shows that AI can improve access and quality of learning through a personalized approach. The 15% improvement in academic performance among students using AI recommendations supports the claim that this technology has a real impact in improving learning outcomes.

AI-based analytics tools also provide great benefits to lecturers (Harahap et al., 2023) . By providing data that analyzes student performance, lecturers can design more relevant and in-depth materials according to the needs of their classes. For example, the interviews showed that lecturers found the AI tool's analysis reports helpful, which provided insights into the material that students found difficult to understand. This allows lecturers to focus teaching time on topics that require more attention, thus creating efficiency in the learning process.

On the other hand, students feel more motivated to learn when they get relevant material and delivered through methods they like. This is in line with Research Nugroho & Harida, (2020) shows that relevant and interesting learning approaches, such as using stand-up comedy, significantly increase students' learning motivation. Students who received material with this method showed higher motivation than the control group. This finding supports the claim that delivering relevant and preferred material to students can increase their engagement and motivation in learning.

Although the AI tool showed high effectiveness, this study identified some key challenges in its implementation. One of the main obstacles is the low level of digital competency among lecturers and students. As many as 50% of respondents mentioned that they need additional training to make the most of these tools. In addition, concerns over data privacy also emerged as a significant issue, with 30% of respondents expressing distrust in the management of their data by AI-based systems.

This finding is reinforced by Greller and Drachsler's (2017) research, which highlights the importance of privacy regulations and digital literacy training in the implementation of data-driven learning technologies. In the Indonesian

context, this challenge is even more complex due to limited infrastructure in some universities. (Ahmad et al., 2024)

The use of AI-based analytics tools has a significant impact, both socially and academically. Academically, it allows students to learn more efficiently, thus improving their performance in class. Socially, it provides a sense of inclusivity, where students with special needs or learning styles can experience learning on par with their peers. (VanLehn et al., 2020) notes that AI-based learning technologies increase the sense of learning satisfaction among students, especially in the context of heterogeneous classes.

This research reinforces the findings of (Luckin & Holmes, 2016) , which states that AI has great potential in supporting adaptive education in the future. However, in the local context of Indonesia, this research highlights the importance of adapting to local challenges such as inadequate infrastructure and low digital literacy. As such, this research provides new insights into how AI can be implemented in the context of education in developing countries.

The results of this study have practical and theoretical implications. Practically, it is important for universities to provide digital literacy training and build infrastructure that supports AI implementation. Theoretically, this study enriches the literature related to educational technology, especially in the context of using AI for personalized learning in developing countries.

Thus, although challenges in the implementation of AI in higher education still exist, the potential of this technology to improve the quality of learning remains undeniable. Further research is needed to explore how to overcome these challenges and maximize the benefits of AI in the context of global education.

Contribution of AI Tools to Personalized Learning

Observation analysis results show that the AI tool helps lecturers to understand students' learning styles more deeply. System log data shows that students who use recommendations from AI experience a 15% improvement in academic performance compared to students who do not use the tool.

Table 2. The improvement in student academic performance by AI tool user group

Group	Average Value Before	Average Value After	Improved
Using AI	72.5	83.4	15.03%
Not Using AI	71.3	74.6	4.63%

Figure 2 shows that students who used the AI-based analysis tool experienced a more significant improvement in academic performance compared to the group that did not use the tool. The AI user group recorded an average increase in grades of 15.03%, while the non-user group only experienced an increase of 4.63%. This data indicates that AI tools can support more effective and targeted learning, especially in helping students achieve more optimal learning outcomes.

The results showed that students using AI-based learning analytics tools experienced a significant improvement in academic performance, with an average increase of 15.03% in grades. This aligns with VanLehn et al. (2020), who emphasized that personalized learning supported by AI can optimize academic outcomes by adapting to individual student needs. The findings also resonate with Zawacki-Richter et al. (2019), who highlighted that AI enhances learning engagement through tailored recommendations. For instance, students received specific learning suggestions, such as focusing on visual learning resources for complex topics or scheduling additional practice exercises during their most productive hours. These personalized recommendations encouraged students to adopt

efficient study habits, ultimately boosting their performance.

Artificial Intelligence (AI)-based learning analytics tools offer a significant contribution in supporting personalized learning in higher education (Marlin et al., 2023). This study found that this tool is able to provide recommendations tailored to individual student learning needs. The recommendations include learning materials, delivery style, and optimal study time based on student interaction data with the system. This finding corroborates the results of research conducted by Song et al. (2021), who mentioned that AI technology in education can improve students' learning experience by making learning more relevant and need-based.

In this study, students who utilized recommendations from AI tools showed a significant academic performance improvement of 15% compared to students who did not use such tools. This improvement not only reflects the effectiveness of AI in supporting academic achievement, but also indicates that students are more engaged in their learning process. (VanLehn et al., 2020) in their research also found that personalization of technology-based learning can increase student engagement, which is one of the indicators of successful learning. (Hilal et al., 2024)

In addition to students, AI tools also provide great benefits for lecturers. Through the analytical data generated by the tool, lecturers can understand students' learning patterns, identify their difficulties, and develop more relevant learning materials. In the interviews conducted in this study, lecturers stated that the tool helps them save time in the teaching planning process, allowing them to focus more on effective delivery methods. For example, one lecturer mentioned that the AI tool reports provided insights into topics that were difficult for the majority of students to understand, allowing lecturers to allocate additional time on these topics.

However, while the contribution of AI tools to personalized learning is significant, their effectiveness still depends on how students and lecturers utilize these tools. This study revealed that students who actively use the features provided by AI tools, such as study suggestions or additional exercises, tend to get better learning outcomes than students who only use these tools passively. This confirms that the success of AI-based personalized learning also depends on active user participation, as concluded by (Holmes & Tuomi, 2022) in their study on technology adoption in education.

On the other hand, the study also noted that the implementation of AI in personalized learning faces challenges, such as the need for better digital literacy and the provision of training for lecturers and students. As a measure to overcome these obstacles, higher education institutions need to adopt a comprehensive approach, including intensive training and policies that support the optimal utilization of this technology.

Overall, the contribution of AI-based learning analytics tools in learning personalization is highly relevant to support adaptive and inclusive higher education. By utilizing this technology, educational institutions can create learning environments that are more responsive to students' individual needs, while improving teaching efficiency. The results of this study provide an important foundation for broader implementation of AI in the education sector, especially in the context of developing countries such as Indonesia.

Challenges in Using AI Tools

Through interviews with system administrators, some of the main obstacles in using AI tools were found to be the lack of digital competence of lecturers and students (50%), as well as concerns related to user data privacy (30%). This data was reinforced by the results of focus group discussions, where students

mentioned that they felt less confident in utilizing AI technology to its full potential.

Table 3. illustrates the proportion of challenges faced in the use of AI-based analytical tools.

Key Challenges	Number of Respondents	Percentage
Low digital competency	15	50%
Data privacy and security	9	30%
Infrastructure availability	6	20%

Table 3 shows three main challenges in the implementation of AI-based analytical tools: low digital competence (50%), concerns about data privacy and security (30%), and limited technological infrastructure (20%). This data underscores the importance of digital literacy training and transparency in data management to increase user trust, as well as the need to develop more adequate infrastructure to support the effective adoption of AI technologies in higher education.

The AI tools provided concrete, actionable suggestions that improved the learning process. For example, one student struggling with advanced mathematical concepts was directed to visual simulations and interactive tutorials, which significantly improved their comprehension. Similarly, students with inconsistent study patterns received personalized schedules that optimized their learning sessions. Lecturers also benefited from these insights, using analytics reports to identify topics where students faced challenges, such as statistical analysis or critical reading skills, and adjusting their teaching methods accordingly.

While Artificial Intelligence (AI)-based learning analytics tools have great potential to support learning personalization, this research identifies a number of challenges that hinder their optimal implementation. The first challenge is the low level of digital literacy among lecturers and students. Based on the results of interviews and focus group discussions, as many as 50% of respondents admitted that they find it difficult to understand and utilize the features provided by AI tools. This limitation is mainly experienced by lecturers who have minimal technological background, thus requiring additional training to operate the system effectively. This finding is in line with research (Ahmad et al., 2024) , which shows that digital literacy is an important factor in the successful adoption of data-driven technologies in education.

The second challenge is concerns related to data privacy and security. Around 30% of respondents expressed doubts about how their personal data, such as learning patterns, study time, and evaluation results, are used and stored by the system. This issue is increasingly relevant in the digital era, where data protection is one of the main concerns in the use of technology. Holmes et al. (2022) note that transparency in the management of user data is key to building trust in the use of AI-based technologies. In the context of higher education in Indonesia, the lack of regulations governing data privacy in the education sector is a challenge that requires serious attention.

In addition, limited technological infrastructure is also an obstacle in the application of AI tools. Some universities, especially those in remote areas, do not have adequate access to stable internet networks and hardware compatible with AI technologies. This results in a gap between institutions that have sufficient technological resources and those that do not, reducing the opportunity for equitable technology adoption. Luckin et al. (2016) mentioned that infrastructure availability is a key prerequisite for the successful implementation of AI technology in education.

Another challenge identified was resistance to change. Some faculty and students tend to be comfortable with traditional learning methods and are skeptical of the effectiveness of new technologies. This creates a cultural barrier that requires a strategic approach to change mindsets

and increase acceptance of AI technologies. As noted by Song et al. (2021), successful technology adoption depends not only on the availability of tools, but also on users' readiness to change the way they work and learn.

Thus, while AI-based analytics tools show great potential in improving the personalization of learning, these challenges require integrated solutions. Universities need to provide digital literacy training, build adequate infrastructure, establish transparent privacy policies, and create a culture that supports technology adoption. Addressing these challenges will ensure that AI tools can be used to their full potential to support more adaptive and inclusive learning.

Thematic Analysis Results

From the thematic analysis, the main themes that emerged were "increased learning engagement" and "improved teaching efficiency". Respondents emphasized that the tool helps students focus more on relevant topics and makes it easier for lecturers to design effective teaching strategies.

Artificial Intelligence (AI)-based learning analytics tools have been proven to play a significant role in improving student engagement and the efficiency of the learning process in higher education. In this study, student engagement increased when they received personalized learning recommendations. AI tools allow students to focus on material that is relevant to their needs, thus reducing the time spent on learning topics they have already mastered. This finding is in line with VanLehn's (2011) research, which states that AI-based learning technology is able to create a more purposeful and engaging learning experience, increasing student motivation in the learning process.

From the lecturer's perspective, the tool provides analytical reports that help them understand students' learning patterns, so that they can develop teaching materials that better suit the needs of the class. For example, lecturers who participated in this study stated that the AI tool identifies topics that are most difficult for students to understand based on analysis of their interactions with the system. With this information, lecturers can allocate additional time to cover such material, while reducing time for topics that most students have already mastered. This creates efficiency in the use of teaching time, which is especially important in the context of large classes.

In addition, this study shows that students who use AI tools feel more valued as individuals, as they get personalized attention through personalized learning. This increased their confidence in completing academic tasks and contributed to improved learning outcomes. Luckin et al. (2016) also noted that personalized learning supported by technology increases students' sense of inclusion and satisfaction, especi in a heterogeneous classroom environment.

However, these benefits are not just limited to increasing student engagement. AI tools also help create operational efficiencies in the learning process. For example, they are able to automate the process of grading simple assignments and providing immediate feedback to students, thus reducing lecturers' workload. In this way, lecturers can focus on strategic aspects of teaching, such as curriculum development and student mentoring.

Nonetheless, the success of this increased engagement and efficiency requires support from various parties, including educational institutions that provide training for lecturers and students to optimally utilize the technology. As a practical implication, the results of this study suggest the need for the development of digital literacy training programs and broader technological support in higher education, so that the full potential of AI-based tools can be harnessed.

Overall, the increased learning engagement and efficiency generated by AI-based tools reflect the great potential of these technologies in revolutionizing the way learning is done. With the right implementation strategy, AI tools can be an effective solution to create more adaptive, inclusive, and efficient learning in higher education.

The results of this study make additional contributions to the existing literature. For example, this study corroborates the findings of Luckin et al. (2016), which showed that AI is capable of providing significant benefits in education if implemented correctly. However, this study also highlights the local Indonesian context, where factors such as infrastructure and digital literacy pose unique challenges that affect AI implementation.

The novelty in the previous research, based on the article "Systematic review of research on artificial intelligence applications in higher education - where are the educators?" by (Zawacki-Richter et al., 2019) , lies in their focus on classifying and analyzing in-depth AI applications in higher education. They identified four main areas of AI application: adaptive and personalization systems, assessment and evaluation, profiling and prediction, and intelligent tutoring systems. This study is unique in that it uses a systematic framework to evaluate 146 articles published between 2007 and 2018, with an emphasis on trends in research methodology, geographical distribution, and the involvement of educational disciplines.

The main strength of this research is the critical reflection on the limitations of previous research, such as the lack of integration of theoretical pedagogical perspectives in AI implementation, the lack of studies that consider ethical risks, and the low contribution of the education discipline compared to computer science. This provides an important basis for future research that integrates educational approaches with AI technologies in a more balanced manner, so as to not only support teaching, but also build trust and ethics in the use of these technologies in higher education.

The practical implication of this research is the need to integrate digital competency training for lecturers and students as part of the implementation of AI-based technologies. Theoretically, this research provides insights into how AI can support the personalization of learning in the context of higher education in developing countries.

These results and discussion show that while AI tools have great potential in supporting personalized learning, their success depends on the readiness of the overall education ecosystem. Therefore, further research is needed to explore how AI can be more broadly integrated in the higher education system.

■ CONCLUSION

This research shows that Artificial Intelligence (AI)-based learning analytics tools have significant effectiveness in supporting personalized learning in higher education. Key findings show that 90% of respondents agreed that the tool helps analyze learning needs, while 83.33% stated that the tool provides relevant material recommendations. Students using AI recorded a 15.03% increase in average academic grades. In addition, the tool also helps lecturers design more relevant and efficient teaching strategies. This research addresses the objective of evaluating the effectiveness of AI tools in personalizing learning as well as identifying challenges in their implementation. The findings highlight that despite their effectiveness, barriers such as low digital literacy (50%), privacy concerns (30%), and limited infrastructure (20%) require attention. Theoretically, this study confirms the importance of integrating AI with pedagogical theory. Practically, the results encourage universities to improve digital literacy training, data transparency, and infrastructure investment. The limitations of this study are the focus on a specific geographical context and the qualitative approach. Future research is recommended to use a quantitative or mixed methods approach with a wider range of locations. This research contributes to the AI in education literature, providing practical insights for the development

of more adaptive, inclusive, and sustainable technologies for higher education.

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