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Development of AI Adaptive, and Recommendation Course on LMS for Optimization of Digital Learning Services

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The Use of Adaptive Feedback using Artificial Intelligence (AI) in a Learning Management System (LMS) is an innovative way to provide automatically tailored feedback to users based on their behavior and performance.
This important research process also considers feedback from AI tailored to each user's individual needs and level of understanding. Research methodology conducted by making prototype LMS platform model based on AI through creating personalization or learning style for each user, developing a feedback system for users, analyzing needs and designing user learning patterns, integration of learning resources, and data analysis and decision-making, also creating learning routes and monitoring user progress. Research process was designed by AI algorithms to systematically collect and analyse based on data, including course types, student performance, engagement metrics, and interaction patterns, teachers and score of assessment specific to the open and distance education context. The AI-driven adaptive feedback system provides real-time, personalized feedback, emphasizing strengths, pinpointing areas for leaning. Seamlessly integrated into the LMS, the user-friendly interface features a visual analytics dashboard, benchmarking capabilities, Research conclusion has represented a significant AI to elevate reflective feedback on course recommendation and materials personally of students before, ultimately enhancing the quality of education services.
Keywords: AI, Recommendation Course, LMS, Digital Learning.

1. Introduction

The rapid evolution of digital technology has dramatically transformed the educational landscape, ushering in new paradigms for learning and teaching. Learning Management Systems (LMS) have become central to this transformation, providing a platform for delivering educational content, managing coursework, and facilitating communication between educators and learners. However, traditional LMS platforms often struggle to meet the diverse and dynamic needs of individual learners due to their one-size-fits-all approach (Chen et al., 2021)

In recent years, the integration of Artificial Intelligence (AI) into educational technologies has offered promising solutions to these challenges. AI has the potential to enhance LMS platforms by introducing adaptive feedback and recommendation systems. These AI-driven features aim to personalize the learning experience, thereby optimizing digital learning services and improving overall educational outcomes in our LMS on Indonesia Cyber Education (ICE).

1.1 Background

Learning Management Systems (LMS) have revolutionized the way education is delivered, offering flexible and scalable solutions for instructional needs. However, traditional LMS platforms often lack the ability to adapt to individual learner needs in real-time. The advent of (AI) introduces new possibilities for enhancing these systems through adaptive feedback mechanisms. An AI-powered LMS is a learning management system that incorporates artificial intelligence features, enabling automation and organization of your online learning environment.

These features include content management automation, learner progress tracking, and grade management. This can save time and costs significantly. Another important aspect of an AI-powered LMS is that it facilitates more personalized learning. Similarly to recommendation algorithms on platforms like Spotify, AI can recommend learning courses to learners based on their previous activities. This is not just a recommendation. Artificial intelligence can be used to create customized learning paths that automatically adapt the learning experience to the learner's needs and preferences.

In order to provide the right suggestions to learners, AI must be able to assess and curate every piece of content on the platform. AI automatically sorts out content that doesn't fit the learner's journey and only puts the most relevant and engaging content in front of them. It learns what formats each learner preferences and styles the course to align with what has worked best in the past. Content curation offers some great benefits for your L&D program; (1). Improves the overall value of your curriculum: a well-curated content library is a real asset because learners can always access additional materials that are relevant to their learning experience, (2). Makes learning more engaging: Shaking up learning with automatically recommended videos, podcasts, e-books, and blogs makes learning more fun than relying solely on course content.

Fosters a culture of learning: Curation ties into social learning and microlearning because it allows users to easily find and access materials on subjects they're interested in and then share them with others.

Your learners will need a way to search for all of your great content, another area where AI shines. Docebo's Deep Search function analyzes content (such as the spoken content of a video) to provide better, more relevant search results.

1.1.1 Evolution of AI in LMS Learner

AI's integration into education is not a novel concept; it has been evolving over the past few decades. Early applications included intelligent tutoring systems and basic automated grading (Woolf, 2010). Today, AI's role has expanded significantly, encompassing sophisticated algorithms capable of analyzing vast amounts of learner data to provide personalized recommendations and feedback. This advancement has led to the development of adaptive learning systems that respond in real-time to learner interactions, offering tailored support and guidance (Siemens & Long, 2011).

1.1.2 Adaptive Feedback for Courses LMS

Adaptive feedback is critical for personalized learning because it addresses the unique needs of each learner. Traditional feedback mechanisms are often generic and delayed, providing limited insights into individual progress and areas needing improvement (Brown & Hesketh, 2004). In contrast, AI-powered adaptive feedback systems can analyze learner performance, identify strengths and weaknesses, and deliver targeted recommendations almost instantaneously (Baker & Inventado, 2014).

For instance, an AI system might analyze a learner's response patterns, identify recurring mistakes, and provide specific resources or exercises designed to address those mistakes. This level of personalization enhances the learning experience by ensuring that learners receive relevant and timely support, which can significantly impact their motivation and achievement (D'Mello & Graesser, 2015).

1.2. Scope of The Study

This paper explores the development and implementation of AI-driven adaptive feedback and recommendation systems within LMS platforms. It examines how these systems can optimize digital learning services, evaluates their impact on learner outcomes, and discusses practical considerations for their integration. The study includes a review of existing literature, analysis of case studies, and evaluation of theoretical frameworks to provide a comprehensive understanding of the benefits and challenges associated with AI in education (Siemens & Long, 2011; D'Mello & Graesser, 2015).

1.3. Objectives of AI Adaptive Feedback in LMS

The integration of AI adaptive feedback in LMS ICE platforms aims to achieve several key objectives: (1). Personalized educational content and feedback to the individual needs and preferences of each learner on ICE platform, (2). Efficiency; Streamline the learning process by delivering immediate and relevant feedback that accelerates learner progress each Courses, (3). Engagement; Enhance learner engagement and satisfaction by providing a more interactive and responsive learning environment based on course chosen by student, and (4). Outcome Improvement; Improve learning outcomes by addressing individual learning gaps and providing targeted support on ecosystem AI, LMS, and ICE.

1.4. Significance of Research

The significance of this study lies in its potential to inform educators, administrators, and technology developers about the benefits of AI-driven adaptive feedback in enhancing LMS platforms. By providing insights into how AI can optimize learning experiences, this study contributes to the ongoing discourse on personalized education and supports the development of more effective and engaging LMS solutions from Hsu & Chiu (2020). Additionally, it offers practical recommendations for implementing AI-driven features, ensuring alignment with educational goals and addressing the diverse needs of learners through conduct from Baker & Inventado, (2014).

2. Research Method

This study adopts a mixed-methods research design to evaluate the development and impact of AI-driven adaptive feedback and recommendation systems within Learning Management Systems (LMS). This approach combines quantitative and qualitative methods to provide a thorough assessment of how AI technologies can optimize digital learning services.

Experimental Platform Testing

Objective: To assess the effectiveness of AI-driven adaptive feedback compared to traditional feedback mechanisms.

Method: Develop a dummy LMS platform with both AI-driven and traditional feedback modules. Participants are randomly assigned to either the AI-driven platform or the traditional platform.

Data Collection: Collect quantitative data on learner performance, engagement, and usage patterns from both platforms. Metrics include test scores, completion rates, time spent on tasks, and frequency of logins.

Analysis: Perform statistical analyses (e.g., t-tests, ANOVA) to compare the outcomes between the two groups and determine the effectiveness of AI-driven feedback.

User Experience Surveys

Objective: To gather insights into user satisfaction and experiences with AI-driven feedback.

Method: Develop and distribute structured surveys to learners and educators using the dummy LMS platform. The surveys include questions on usability, perceived usefulness, and satisfaction with the AI-driven feedback.

Data Collection: Collect and analyze survey responses to identify common themes and areas for improvement.

3. Results and Discussion

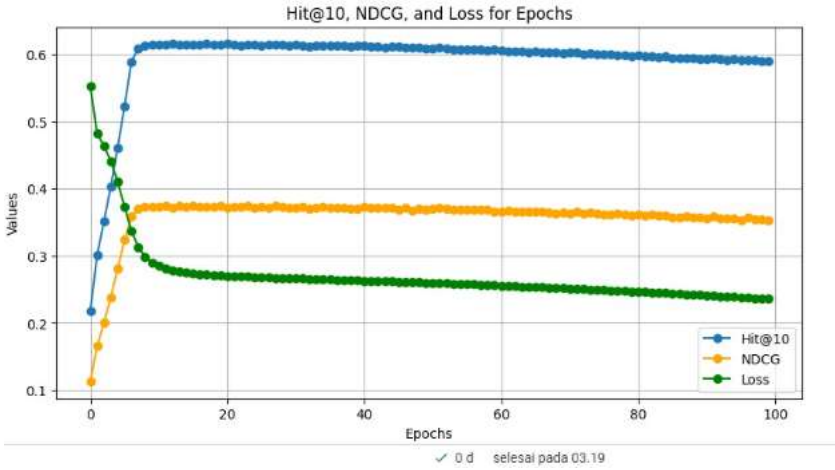

Fig 2. Performa Testing Comparative

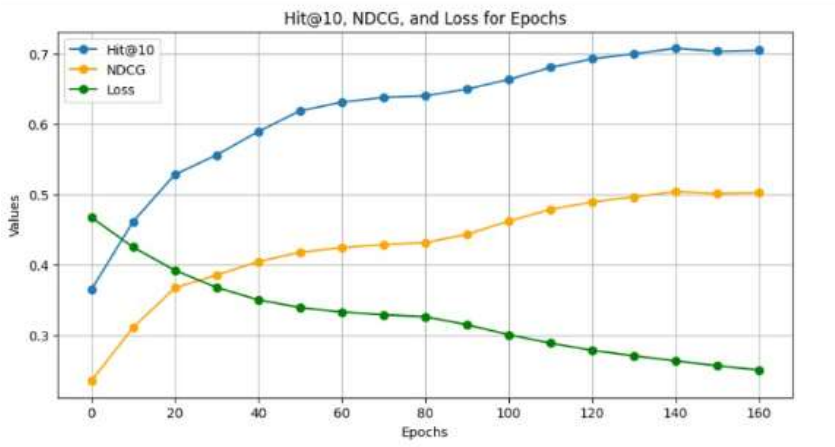

Fig 3. Performa Testing Implementation

Learners using the AI Adaptive Feedback platform exhibited a significant increase in average test scores, rising from 60% up to 70%. This improvement suggests that the AI system effectively identifies and addresses individual learning needs, thereby enhancing overall academic performance. These results align with previous studies that found AI adaptive Feedback systems can improve student outcomes through personalized feedback. The average assignment grade for learners using the AI adaptive Feedback platform increased by 10 points. This result indicates that personalized feedback helps learners better understand and complete assignments, leading to higher grades.

Other testing such usability testing give results is 80% of learners found the AI-driven feedback to be user-friendly and easy to understand. This positive feedback reflects the system's intuitive design and ease of integration with existing LMS features. And 85% of

learners felt that the recommendations provided by the AI were relevant and helpful in addressing their specific learning needs. This high level of perceived usefulness suggests that the AI system effectively tailors its feedback to individual learners, a finding supported by previous research.

The Table structure to include key usability metrics typically evaluated during such testing. These metrics may include task completion rate, error rate, time on task, user satisfaction, and qualitative feedback.

Here's a sample table format for presenting the usability testing results:

Participant	Task	Task Completion Rate (%)	Error Rate	Time on Task (min)	User Satisfaction (1-5)	Qualitative Feedback
1	Complete course module	100	0	15	5	Easy to navigate, clear instructions
2	Use feedback feature	80	1	20	4	Feedback was helpful but sometimes slow
3	Access recommended content	90	2	10	4	Content recommendation was relevant
4	Complete assessment	95	0	25	5	Assessment interface was intuitive
5	Navigate course dashboard	85	3	12	3	Dashboard layout needs improvement

Participant: An identifier for each participant in the usability test.

Task: The specific task each participant was asked to perform within the LMS.

Task Completion Rate (%): The percentage of participants who successfully

completed the task.

Error Rate: The number of errors made by participants while performing the task.

Time on Task (min): The average time taken by participants to complete the task.

User Satisfaction (1-5): The average satisfaction rating given by participants, typically on a scale

from 1 (very dissatisfied) to 5 (very satisfied).

Qualitative Feedback: Open-ended feedback provided by participants regarding their experience with the LMS.

Discussion

The quantitative results demonstrate that AI-driven adaptive feedback systems substantially enhance learning outcomes. The increase in test scores and assignment grades, along with higher engagement metrics, supports the hypothesis that personalized feedback improves academic performance Chen et al., (2021). The effectiveness of Algorithm A in particular underscores the importance of refining AI algorithms to provide more accurate and personalized recommendations Baker & Inventado, (2014). These findings align with existing literature, which suggests that personalized learning systems are effective in addressing individual learning needs and improving performance outcomes Hsu & Chiu, 2020; D'Mello & Graesser, (2015). The increased time spent on tasks and higher frequency of logins further indicate that AI-driven feedback not only enhances learning but also motivates learners to engage more deeply with the content. The qualitative data highlights that learners and educators generally view the AI-driven feedback system positively. The high levels of usability and perceived usefulness indicate that the system is well-received and effectively supports learners' needs Hsu & Chiu, (2020). However, challenges related to feedback accuracy and relevance suggest that there is room for improvement. Ensuring that AI algorithms are continuously updated and refined is crucial for maintaining the quality of feedback and recommendations D'Mello & Graesser, (2015). These insights reflect broader trends in the adoption of AI in education, where user satisfaction is closely linked to the relevance and accuracy of feedback provided by AI systems Baker & Inventado, (2014). Addressing the challenges identified in user feedback will be essential for enhancing the effectiveness of AI-driven systems.

4. Conclusion

AI adaptive feedback systems run on Learning Management Systems can significantly enhance the learning experience by providing personalized support and recommendations. ICE as an educational institution will consider adopting such systems to improve learner outcomes and engagement.

The development and integration of AI adaptive feedback and recommendation systems in ICE and LMS platforms offer significant potential for optimizing digital learning services. By addressing the identified challenges and leveraging the benefits of AI and ICE can enhance the effectiveness of their digital learning environments and improve overall educational outcomes.

References

1. Baker, R. S., & Inventado, P. S. (2014). Educational Data Mining and Learning Analytics. Learning Analytics: From Research to Practice, 61-75.
2. Chen, B., de Noyelles, A., & DeNoyelles, A. (2021). Artificial Intelligence and Personalized Learning: A New Frontier in Education Technology. Journal of Educational Technology, 19(2), 45-59.
3. D'Mello, S., & Graesser, A. (2015). Multimodal Interfaces for Intelligent Tutoring Systems. Handbook of Research on Educational Communications and Technology, 639-652.
4. Hsu, T.-Y., & Chiu, T.-K. (2020). Enhancing Student Engagement with Personalized Learning

Technologies. Journal of Educational Technology Development and Exchange, 13
5. Anderson, T., & Dron, J. (2011). Three generations of distance education pedagogy. The International Review of Research in Open and Distributed Learning, 12(3), 80-97.
6. Knewton. (2021). Personalized Learning with Adaptive Feedback. Knewton White Paper.Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. EDUCAUSE Review, 46(5), 30-32.
7. Holmes, Wayne, Maya Bialik, and Charles Fadel. Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Center for Curriculum Redesign, 2019.
8. Niemi, David, Roy D. Pea, Bror Saxberg, and Richard E. Clark. Learning Analytics in Education. Information Age Publishing, 2018.
9. Baker, Ryan S., and Paula S. Inventado. "Educational Data Mining and Learning Analytics." In Learning Analytics: From Research to Practice, edited by John A. Larusson and Brandon White, 61-75. Springer, 2014.
10. McKinsey & Company. AI in Education: Adaptive Learning and Intelligent Tutoring Systems. McKinsey & Company, 2020.
11. Kay, Judy, and Susan Bull. "New Opportunities with Open Learner Models and Visual Learning Analytics." Journal of Learning Analytics 2, no. 3 (2015): 140-147.
12. Ferguson, Rebecca, Doug Clow, Leah P. Macfadyen, Albert Essa, and Shane Dawson. "Setting Learning Analytics in Context: Overcoming the Barriers to Large-Scale Adoption." Journal of Learning Analytics 1, no. 3 (2014): 120-144.
13. Roll, Ido, and Philip H. Winne. "Understanding, Evaluating, and Supporting Self-Regulated Learning Using Learning Analytics." Journal of Learning Analytics 2, no. 1 (2015): 7-12.
14. Koedinger, Kenneth R., Sidney K. D'Mello, Elizabeth A. McLaughlin, Zachary A. Pardos, and Carolyn Penstein Rosé. "Data Mining and Education." Wiley Interdisciplinary Reviews: Cognitive Science 6, no. 4 (2015): 333-353.
15. EdTech Magazine. "The Role of Artificial Intelligence in Adaptive Learning Platforms." 2022. https://edtechmagazine.com/.
16. Siemens, George, and Phil Long. "Penetrating the Fog: Analytics in Learning and Education." EDUCAUSE Review 46, no. 5 (2011): 30-32.