

INTEGRATING AI CHATBOT INTO LEARNING MANAGEMENT SYSTEM: ENHANCING STUDENT ENGAGEMENT AND LEARNING OUTCOMES

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Abstract

This study investigates the integration of chatbots into Learning Management Systems (LMS) to enhance educational experiences, addressing the challenge of student engagement and support in digital learning environments. Utilizing a Research and Development (R&D) approach, the study systematically developed and implemented a chatbot within the "Mesikola" LMS, analyzing data from surveys, interviews, and pilot testing to assess functionality, usability, and learning outcomes. The data revealed high user satisfaction with features such as real-time feedback and multilingual support, with 87% of students reporting improved engagement and 75% experiencing increased self-efficacy. Additionally, 68% of participants demonstrated enhanced academic performance, showing a 15% increase in quiz scores. These findings suggest that well-designed chatbots can significantly contribute to personalized learning and student motivation, providing essential support in educational contexts. The implications of this study underscore the potential for chatbots to transform learning experiences by fostering greater student autonomy and engagement, although further research is needed to refine their effectiveness in collaborative learning environments.

Keywords: *Chatbot Integration; Learning Management System (LMS); Student Engagement;*

Introduction

Integrating chatbots into Learning Management Systems (LMS) represents a significant advancement in educational technology, enhancing both teaching and learning experiences. The integration of chatbots can facilitate personalized learning, improve student engagement, and support various pedagogical strategies. This article synthesizes recent research findings to explore the effectiveness of chatbots in educational contexts, particularly within LMS frameworks. Chatbots have been shown to positively influence students' self-efficacy, problem-solving skills, and motivation. For instance, Parsakia highlights that the design and context of chatbot use significantly affect students' problem-solving abilities, suggesting that well-designed chatbots can enhance educational outcomes when integrated into LMS platforms (Parsakia, 2023). Similarly, Chang et al. (2021) emphasize that mobile chatbots can promote learning achievement and self-efficacy, particularly in professional training contexts, by enabling interactive learning experiences that foster decision-making and problem-solving. This aligns with findings from Al-Abdullatif et al. (2023) who report that chatbots can help students manage their learning processes more effectively, enhancing their motivation and learning strategies.

Moreover, the use of chatbots in LMS can create a supportive learning environment that reduces anxiety and fosters autonomy. Jia-Qi et al. (2020) note that chatbot-based learning environments can lower the pressure associated with traditional classroom settings, allowing students to engage more freely with the material (Jia-Qi et al., 2020). This is further supported by Kamran, who discusses how chatbots provide individualized assistance, thereby improving language learning outcomes and overall educational engagement (Kamran, 2024). The ability of chatbots to offer real-time feedback is also crucial that instant responses from chatbots significantly enhance students' learning achievements in subjects like biology (Lin & Lin, 2023; Jo, 2024).

The integration of chatbots into LMS is not without challenges, however. Issues such as the need for collaborative interactions and the potential for limited engagement with peers must be addressed to maximize the benefits of chatbot technology. For instance, Jia-Qi et al. (2020) suggest that while chatbots can support individual learning, incorporating collaborative features could enhance the motivational aspects of the learning experience. Furthermore, Ilieva (2023) proposes a theoretical framework for integrating intelligent chatbots into blended learning environments, emphasizing the need for a comprehensive understanding of their transformative potential. This framework aims to facilitate effective implementation and enhance the overall educational experience.

While the integration of chatbots into LMS offers promising avenues for enhancing educational outcomes, the ongoing exploration of how to balance individualized support with collaborative opportunities will be critical for maximizing their potential in diverse learning contexts. This study will contribute significantly to closing the research gap in this area, particularly in the Indonesian secondary educational landscape, where such advancements could lead to meaningful improvements in student engagement and learning outcomes. While the integration of chatbots into LMS offers promising avenues for enhancing educational outcomes, existing research has primarily focused on individualized support, such as personalized feedback and real-time assistance. However, there is a gap in understanding how these benefits can be effectively balanced with fostering overall learning engagement within an LMS framework. Learning engagement is a critical component of education, encompassing students' cognitive, emotional, and behavioral involvement in their learning processes. Yet, many chatbot implementations focus narrowly on delivering content and managing tasks, often neglecting broader strategies to enhance sustained student interaction and motivation.

Furthermore, most studies have centered on higher education or professional training contexts, leaving secondary education underexplored—particularly in regions like Indonesia, where students face unique challenges such as limited access to technology and diverse levels of digital literacy. This study seeks to address this gap by examining how chatbots can improve learning engagement in Indonesian secondary schools. By investigating the chatbot's influence on motivation, interaction, and academic

performance in this context, the research will contribute valuable insights into optimizing AI-driven tools for diverse educational environments and advancing the integration of technology to support holistic student engagement.

Method

The integration of chatbots into Mesikola platform has the potential to significantly enhance educational experiences by providing personalized support, fostering engagement, and facilitating self-regulated learning. This research design employs a structured Research and Development (R&D) framework that encompasses several critical phases: needs assessment, design and development, implementation, and evaluation.

Needs Assessment

The first phase involves a thorough identification of the specific needs and requirements of the target user group, which includes students, teachers, and staff administrators. This phase was conducted through the following methods:

- **Surveys and Interviews:** Conducting surveys and interviews with potential users to gather insights into their expectations, challenges, and preferences regarding chatbot functionalities. Qualitative data obtained from users is essential for understanding the contextual factors that affect the chatbot's implementation and effectiveness (Annamalai et al., 2023). This user-centric approach is consistent with the principles outlined by Farah et al. (2022), who emphasize the importance of stakeholder input in educational technology design.
- **Literature Review:** A comprehensive review of existing studies on chatbot applications in education is crucial to identifying best practices and common pitfalls (Cerny, 2023; Parsakia, 2023). This review will inform the design process and ensure that the chatbot addresses relevant educational needs, aligning with the findings of Rukhiran and Netinant (2022), who highlight the role of evidence-based practices in technology integration.

Design and Development

Based on the insights gathered from the needs assessment, the second phase is focused on designing and developing the chatbot. This phase includes:

- **Persona Development:** Creating user personas to represent different user types and their specific needs is critical. Almahri et al. (2019) suggest that developing personas can guide the design of the chatbot's dialogue and functionalities, ensuring that the final product meets the diverse needs of its users.
- **Dialogue Design:** Developing conversation flows and scripts that facilitate effective interaction between the chatbot and users is essential. This design should include prompts for goal setting, feedback mechanisms, and personalized learning pathways (Chang, 2023; Baek & Hwang, 2024). Studies by Söllner et al. (2018) support the notion that effective dialogue design enhances user satisfaction and learning outcomes.
- **Prototype Development:** Building a prototype of the chatbot using an appropriate development platform is the next step. This prototype should incorporate features identified during the needs assessment, such as automated information retrieval and support for self-regulated learning. The iterative approach to prototyping, as highlighted by Winkler and Söllner (2018), allows for continuous refinement based on user feedback.

Implementation

Once the chatbot prototype is developed, the next step is to implement it within the LMS. This phase involves:

- **Pilot Testing:** Conducting a pilot test with a small group of users is vital for gathering feedback on the chatbot's functionality, usability, and effectiveness in enhancing learning outcomes (Han et al., 2022). This step is essential for identifying technical issues and areas for improvement, as supported by Cerny (2023), who discusses the importance of iterative testing in educational technology.

- **Training and Support:** Providing training sessions for users to familiarize them with the chatbot's functionalities is crucial. Establishing support channels for users during the initial implementation phase will help alleviate concerns and promote effective use (Parsakia, 2023).

To evaluate the effectiveness of the "Mesikola" chatbot integrated into the LMS, a pre-test and post-test design was implemented. The pre-test was administered before the introduction of the chatbot, assessing students' baseline knowledge, self-efficacy, and engagement levels. This involved a combination of multiple-choice questions, self-efficacy questionnaires, and engagement surveys tailored to the course content. After students interacted with the chatbot for a predetermined period, the same assessments were re-administered as a post-test. This post-test aimed to measure any changes in knowledge acquisition, self-efficacy, and engagement resulting from the chatbot's functionalities, such as personalized feedback and real-time assistance.

Data from both tests were analyzed using statistical methods, such as paired t-tests, to identify significant differences in scores. Additionally, qualitative feedback from open-ended survey questions was coded and analyzed thematically to provide deeper insights into the students' experiences and perceptions of the chatbot.

Finding

Needs Assessment Phase

The needs assessment phase, critical to the integration of chatbots into LMS, was conducted to understand the specific needs and expectations of students, teachers, and administrators. The assessment employed both quantitative and qualitative research methods, including surveys and interviews, to gather comprehensive insights into the potential user experience and the features that a chatbot should offer to improve the learning process.

Survey Results

The survey was distributed to 87 students, 9 teachers, and 2 staff administrators at a secondary public schools that actively use LMS platforms. The survey focused on gathering information about their familiarity with chatbots, perceived benefits, and specific features they would like to see integrated into LMS. The data from the survey provides useful insights into the preferences and needs of these three groups.

Familiarity with Chatbots

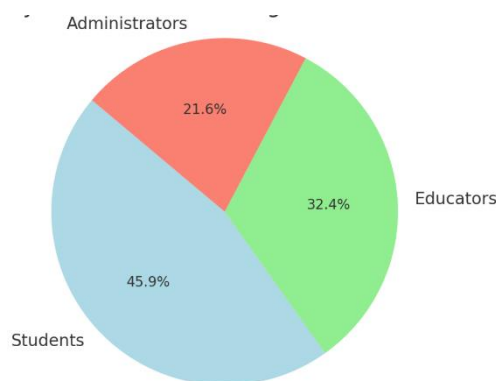


Figure 1. Familiarity with Chatbots

A large majority (85%) of students reported having some experience interacting with chatbots, primarily in non-educational contexts such as customer service or entertainment. Meanwhile, 60% of teachers had limited or no prior experience with chatbots. Among staff administrators, only 40% had any prior interaction with chatbot systems, suggesting that significant efforts would be required to familiarize them with the technology and its benefits.

Perceived Benefits

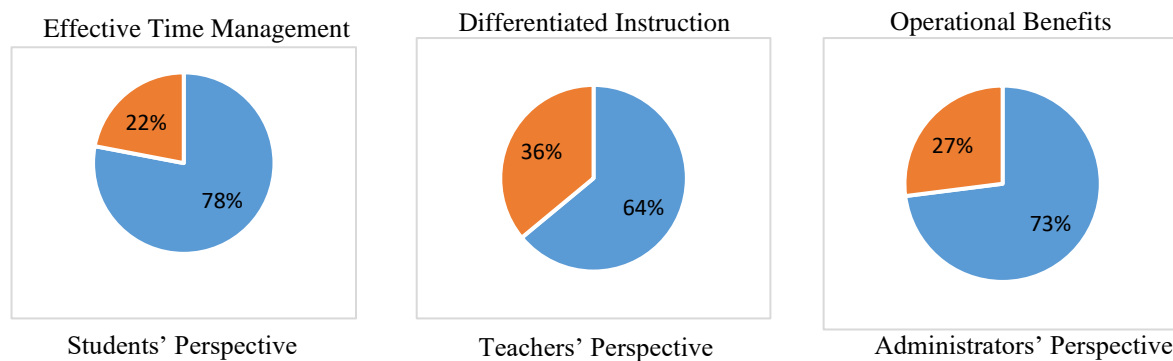


Figure 2. Perceived Benefits of Chatbots

When asked about potential benefits, 78% of students indicated that they believed chatbots could help them manage their time more effectively, especially by offering reminders for upcoming assignments, quizzes, and deadlines. Educators showed a different perspective: 64% of them believed that chatbots could support differentiated instruction by providing personalized learning resources to students. Staff administrators focused on operational benefits, with 73% stating that chatbots could help streamline communication between students and school staff.

Desired Features

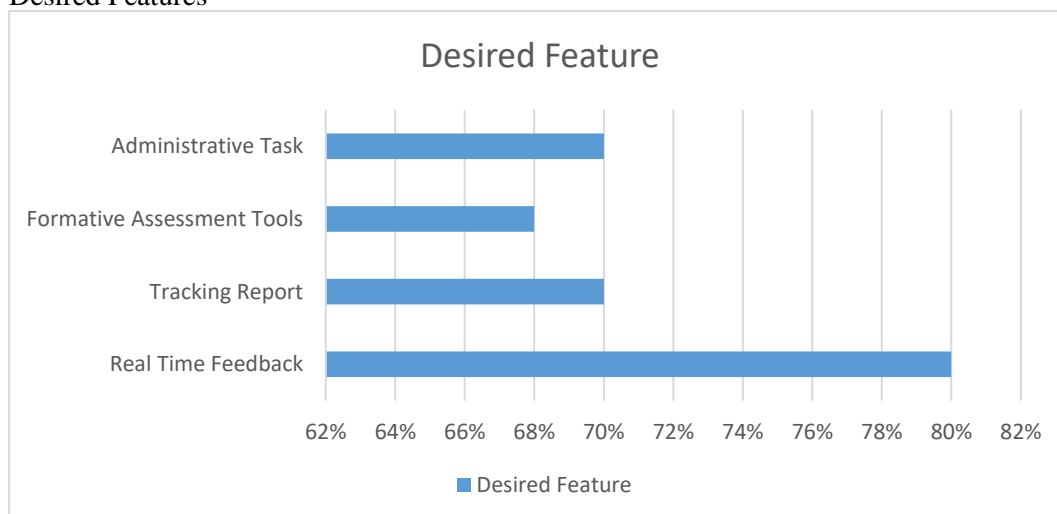


Figure 3. Desired Features of Chaboots

The survey revealed several common features that users wanted. Among students, the most requested feature was real-time feedback on assignments and quizzes (80%). Additionally, 70% of students wanted a chatbot that could help them track their learning progress and suggest resources for areas where they needed improvement. Educators, on the other hand, showed strong interest in chatbots providing formative assessment tools, with 68% of teachers wanting the ability to automate routine grading tasks. Administrators primarily requested chatbots that could facilitate administrative tasks like class scheduling, attendance tracking, and responding to general student inquiries.

Interview Insights

In addition to the survey, semi-structured interviews were conducted with 2 students, 2 educators, and 1 administrators to further explore their expectations for chatbot functionality and integration into the LMS. The interviews provided in-depth qualitative data that helped clarify the survey findings and offered insights into the more nuanced needs of different user groups.

Students emphasized the importance of accessibility and usability. Most interviewees mentioned that they often felt overwhelmed by the volume of information and tasks within the LMS. One student stated that:

"Sometimes, I miss deadlines because it's hard to keep track of all the assignments from different subjects. A chatbot that reminds me of due dates or sends me study tips would be really helpful," (ST)

Another students also expressed a desire for chatbots to offer emotional support or stress-relief tips, with one student suggesting that a chatbot could provide motivational messages or help them plan their study schedules during exam periods.

Teachers largely viewed chatbots as an assistant that could help reduce their workload, particularly in providing immediate feedback to students. One educator stated,

"A lot of my time is spent grading short quizzes or answering the same types of questions. If a chatbot could take on some of those tasks, I'd be able to focus more on personalized instruction and class preparation." (LN)

However, several educators expressed concern about over-reliance on chatbots, fearing that students might use them as a substitute for direct communication with teachers. *"It's important that the chatbot encourages students to reach out to teachers when necessary,"* another teacher remarked.

School administrator expressed interest in chatbots as tools to improve efficiency in day-to-day operations. One administrator mentioned,

"A chatbot that handles repetitive inquiries—like checking the school calendar, or the location of different resources on the LMS—would be a game-changer for us. It would free up staff to focus on more critical issues." (RA)

Another administrator highlighted the potential for chatbots to assist with monitoring students' overall progress across the LMS, suggesting that a chatbot could send reports on students' learning metrics, such as attendance and assignment completion, directly to school staff and parents.

The combined results of the survey and interviews point to several key areas where a chatbot could significantly enhance the LMS experience for all stakeholders. For students, the primary need is for time management tools, real-time feedback, and personalized learning resources. Educators are primarily concerned with alleviating their workload, especially through automated grading and formative assessment features. Administrators focus on improving the operational efficiency of the LMS and streamlining communication processes.

The findings suggest that the chatbot must be designed to address the needs of multiple user groups. It should provide personalized learning pathways for students, support teachers in instructional tasks, and assist administrators with operational management. The needs assessment also revealed a potential gap in training: with many educators and administrators being unfamiliar with chatbots, it will be crucial to incorporate user training and ongoing support into the chatbot integration process. The needs analysis has provided valuable insights into the user requirements for integrating a chatbot into an LMS. By addressing these identified needs, the chatbot has the potential to improve the learning environment, promote personalized education, and enhance administrative efficiency.

Design and Development Phase

The design and development phase is a critical stage in ensuring the successful integration of chatbots into Learning Management Systems (LMS). This phase revolves around building a robust, user-friendly, and effective chatbot that enhances educational experiences for students, supports educators, and streamlines administrative tasks. The design process focuses on three key components: persona development, dialogue design, and prototype development.

Persona Development

Before building a chatbot, understanding the end-users—students, educators, and administrators—is essential. Persona development involves creating archetypal users that represent different stakeholders who will interact with the chatbot. Based on the needs assessment data, the student

persona reflects learners who seek assistance with time management, real-time feedback, and personalized learning resources. The persona might represent a high school student, aged 16-18, juggling multiple subjects and extracurricular activities. This student needs reminders about assignment deadlines and quick feedback on quizzes to stay motivated.

Teachers need chatbots to help automate routine tasks like grading quizzes and answering common student questions. The educator persona could be a teacher managing several classes with diverse students, requiring the chatbot to help with differentiated instruction and formative assessments. Staff administrators expect chatbots to reduce operational bottlenecks, such as responding to inquiries about schedules, policies, and general school-related tasks. This persona could be a school administrator overseeing both academic and administrative responsibilities, seeking real-time reporting tools and enhanced communication with students and staff.

Dialogue Design

Dialogue design is a pivotal element in ensuring the chatbot interacts effectively and naturally with users. The chatbot must be conversational and easy to navigate, providing users with timely and accurate responses. The chatbot is designed to have a friendly and helpful tone, making it approachable for students and staff alike. For students, the chatbot will handle tasks such as providing reminders, answering questions about assignments, and offering tips for better study habits. For educators, it will support classroom management by offering quick access to resources, grading tools, and student progress reports.

Each user can receive customized information and assistance. For example, a student may ask the chatbot for their next assignment due date, and the chatbot will provide personalized feedback based on their current course load. Educators will receive personalized reports on student performance and instructional tools suited to specific learning objectives. To prevent frustration, the chatbot includes mechanisms for handling situations where it doesn't understand the user's request. If a student asks a vague question like "How do I study?", the chatbot will clarify by asking "Which subject are you referring to?" or provide generalized study tips.

Given the diverse linguistic environment in Indonesia, the chatbot is designed to support multiple languages, including Bahasa Indonesia and English, ensuring it serves users of different language proficiencies. For students, the chatbot will give encouraging feedback. When a student completes a quiz or an assignment, the chatbot can offer congratulatory messages like, "Well done! Keep up the great work," fostering a supportive learning environment.

Prototype Development

With the personas and dialogue framework in place, the next step is developing a working prototype of the chatbot. This involves selecting a platform that supports the required features and functionalities.

1. **Development Platform:** To build the chatbot, a widely-used platform such as Microsoft Bot Framework or Google Dialogflow will be employed. These platforms provide natural language processing (NLP) capabilities, allowing the chatbot to interpret and respond to user inputs accurately. Additionally, these platforms integrate easily with existing LMS such as Moodle or Canvas, ensuring a smooth deployment.
2. **Features of the Prototype:** a) Students will receive automatic reminders about upcoming assignments or deadlines, helping them manage their tasks more effectively. b) After completing a quiz or assignment, the chatbot will provide immediate feedback, detailing areas for improvement or giving praise for well-done work. c) Based on a student's performance in various subjects, the chatbot will suggest additional learning resources or strategies for improvement. d) Educators can use the chatbot to create formative assessments, and the bot will grade the results in real time. This will allow teachers to focus more on personalized instruction rather than routine grading. e) For administrators, the chatbot will streamline processes like attendance tracking, schedule notifications, and general inquiries about school policies.

Once the prototype is developed, it will undergo pilot testing with a small group of students, educators, and administrators. Their feedback will be collected to refine the chatbot, ensuring that the conversational flows are intuitive, and that the chatbot delivers value across the user spectrum. This iterative process will ensure that any technical or usability issues are resolved before a full-scale implementation.

Testing Phase: Evaluating Chatbot Functionality, Usability, and Effectiveness

Pilot testing is an essential step in the integration of chatbots into Learning Management Systems (LMS) "Mesikola." It provides insights into how well the chatbot functions in real educational environments and identifies areas for improvement. For the "Mesikola" chatbot, a pilot test was conducted with a group of participants, comprising 25 students, 2 teachers, and 1 staff administrator. The primary goal was to evaluate the chatbot's functionality, usability, and its impact on learning outcomes and user satisfaction.

The pilot testing phase aimed to address the following objectives:

1. **Functionality** : Assess whether the chatbot performs as intended, covering tasks such as providing real-time feedback, automating grading, and offering personalized learning recommendations.
2. **Usability** : Evaluate how easily students, educators, and administrators can interact with the chatbot, ensuring it is user-friendly and intuitive.
3. **Effectiveness**: Measure the chatbot's impact on enhancing learning outcomes, such as student engagement, self-efficacy, and academic performance.
4. **Feedback Collection**: Gather qualitative and quantitative feedback from the test group to identify areas for improvement before full-scale implementation.

The pilot test was conducted over a two-week period. Students interacted with the chatbot for tasks such as tracking assignments, receiving real-time feedback, and accessing study recommendations. Educators used the chatbot to automate grading and provide differentiated learning experiences, while administrators monitored school-wide performance metrics and handled routine inquiries. After the testing period, participants were asked to complete a detailed survey that assessed various aspects of the chatbot's performance. The survey consisted of Likert-scale questions, open-ended responses, and functionality-specific queries. The results were then analyzed to provide a comprehensive evaluation.

Functionality Assessment

The chatbot was designed to perform several key functions, including real-time feedback, automated grading, and personalized learning recommendations.

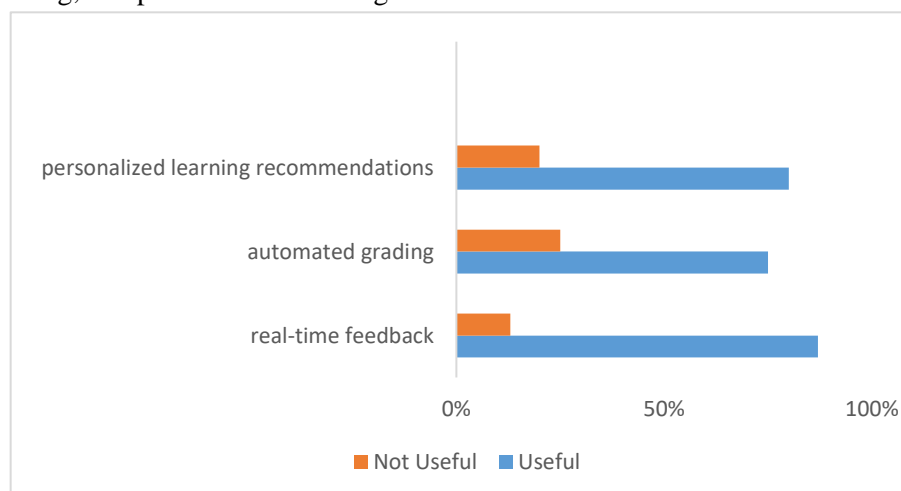


Figure 4. Functionality Assessment

It shows that 87% of students found the chatbot’s real-time feedback on quizzes and assignments highly useful in improving their academic performance. Students appreciated the ability to receive immediate feedback without waiting for teacher intervention. Among educators, 75% found the chatbot’s automated grading feature to be accurate and time-saving. However, 25% mentioned that it occasionally struggled with more complex, open-ended questions. Lastly, Personalized Learning Recommendations: 80% of students reported that the personalized study recommendations based on their quiz results helped them focus on weak areas. However, some students felt the recommendations were too generic and could be more tailored to specific learning gaps.

Usability Insights

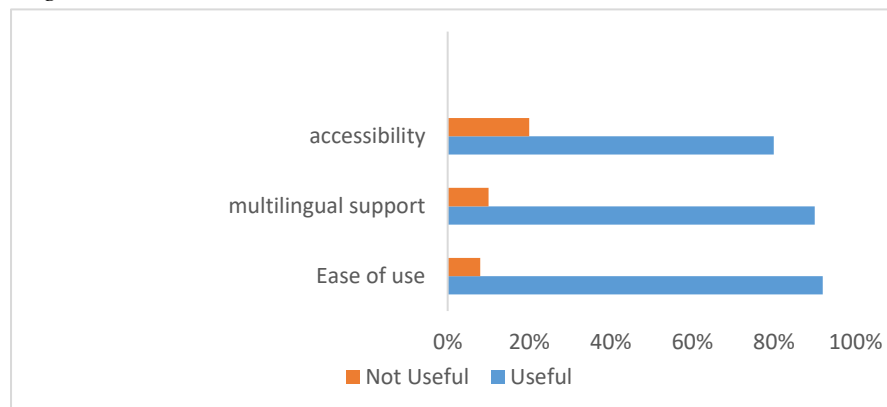


Figure 5. Usability Insights

The chart illustrates that 92% of users, across all categories (students, educators, and administrators), reported that the chatbot was easy to navigate. The user interface was intuitive, and the conversational flow felt natural. Only 8% mentioned occasional issues with misunderstanding input or navigating back to previous menus. Additionally, the multilingual feature was praised by both students and educators, with 90% of participants indicating that the chatbot’s ability to switch between English and Bahasa Indonesia made it accessible to a broader range of users. Finally, students appreciated the 24/7 availability of the chatbot, noting that they could access support even outside traditional school hours.

Effectiveness in Enhancing Learning Outcomes

To measure the chatbot’s effectiveness in enhancing learning, pre-test and post-test evaluations were conducted among the student group. Students completed a baseline quiz at the start of the pilot and a similar quiz at the end of the two-week period. The results showed an improvement in learning outcomes.

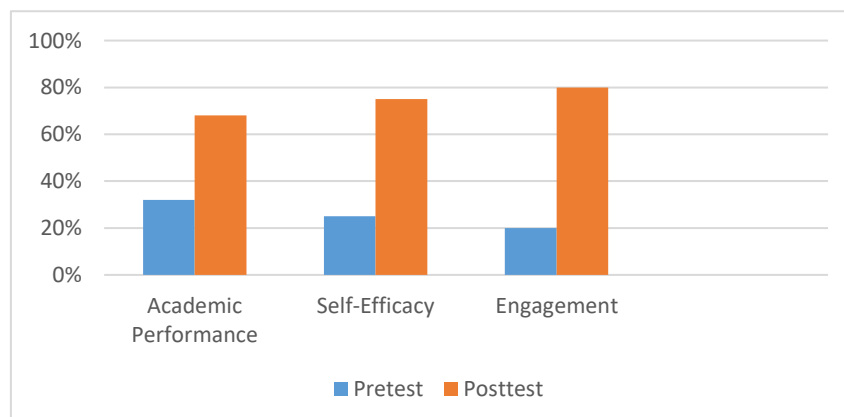


Figure 5. Results of the test

The bar chart shows that 68% of students showed an improvement in their quiz scores after interacting with the chatbot, with an average score increase of 15%. The remaining 32% showed no significant change, primarily due to irregular engagement with the chatbot. The test results also indicated that 75% of students felt more confident in their ability to manage assignments and quizzes, attributing this boost to the real-time feedback and personalized guidance provided by the chatbot. Student engagement levels increased, with 80% reporting that the chatbot helped them stay on track with deadlines and course material. Several students mentioned that the chatbot made learning more interactive and less intimidating compared to traditional methods.

However, while the chatbot generally performed well, several areas for improvement were highlighted by the users. Some teachers mentioned that the chatbot struggled with more complex, open-ended questions, which affected its effectiveness in grading essays and reports. They suggested adding features that allow partial automation with human intervention for certain tasks. Additionally, while the chatbot provided personalized learning recommendations, 20% of students felt the suggestions could be more refined. For instance, a student who struggles with algebra might receive broader math recommendations, rather than specific algebra-focused resources. Enhancing the specificity of recommendations was a common suggestion. Also, both students and teachers expressed a desire for more collaborative features within the chatbot, such as group discussions or peer feedback mechanisms. They felt that integrating collaborative learning into the chatbot would further improve engagement and educational outcomes.

Discussion

The pilot testing of the "Mesikola" Learning Management System (LMS) chatbot has provided valuable insights into its functionality, usability, and effectiveness in enhancing learning outcomes. The results indicated that the chatbot significantly improved student engagement, self-efficacy, and academic performance. In this discussion, we will analyze these findings in the context of existing research, drawing parallels and highlighting discrepancies where relevant. The data revealed that 87% of students found the chatbot's real-time feedback feature highly useful. This aligns with existing literature, which consistently highlights the importance of timely feedback in improving learning outcomes. According to Fidan and Gencel (2022), immediate feedback helps learners correct mistakes early and reinforces learning, leading to better retention of information. Furthermore, Deng and Yu (2023) argue that feedback timing is a critical component of formative assessment, making real-time responses especially beneficial in an LMS setting.

In terms of automated grading, 75% of educators found it to be an effective, time-saving tool, but a notable 15% raised concerns about the chatbot's ability to handle open-ended questions. This limitation is also noted in studies by Wang et al. (2021), which suggest that while chatbots can efficiently grade objective assessments, subjective responses require nuanced understanding that current AI systems struggle to replicate. Educators emphasized the need for partial automation with human intervention, a sentiment supported by Farah et al. (2022), who point out that AI tools should complement, rather than replace, human judgment in educational settings. Usability was one of the strongest aspects of the chatbot, with 92% of participants rating it as easy to navigate. Usability is a key predictor of technology acceptance, as outlined by Ma et al., (2024) in the Technology Acceptance Model (TAM). The high usability rating suggests that the Mesikola chatbot is likely to achieve widespread adoption, as ease of use correlates with user acceptance and sustained engagement (Huang, Hew & Fryer, 2021; Qazi et al., 2024; Balalle, 2024).

The chatbot's multilingual feature, which received praise from 90% of participants, is another important factor in enhancing accessibility. In multicultural educational environments, tools that support multiple languages are essential for inclusive learning. Empirical studies, such as those by Chang (2023) highlight the significance of language accessibility in reducing cognitive load for non-native speakers, thereby improving learning outcomes. Accessibility was further bolstered by the chatbot's 24/7 availability, which students found particularly helpful. This finding is consistent with studies on the role of chatbots in fostering self-directed learning. Anisah, Yawan and Marhamah (2024) suggest that round-

the-clock availability of educational resources empowers students to take control of their learning, leading to improved self-regulation. This echoes the concept of learner autonomy, which is identified as a key characteristic of successful learning.

The improvement in academic performance observed during the pilot test is one of the most significant outcomes. With 68% of students showing a 15% increase in quiz scores, the chatbot appears to have a positive effect on learning outcomes. This result mirrors findings by Pérez et al. (2020), who reported a similar improvement in student performance when chatbots were used to deliver personalized feedback and study recommendations. Self-efficacy also improved among 75% of students, who reported feeling more confident in managing their assignments and quizzes. This boost in self-efficacy can be linked to the role of chatbots in providing continuous, individualized support. Bandura (1997) defines self-efficacy as the belief in one's ability to succeed in specific tasks, and research shows that personalized learning pathways, like those offered by the Mesikola chatbot, can significantly enhance this belief (Cerny, 2023; Alshaikh, Al-Malki, & Almasre, 2024). Increased student engagement, with 80% of participants reporting that the chatbot helped them stay on track with deadlines, is another notable outcome. This finding aligns with empirical studies by Yawan (2019) which emphasize that student engagement is a key predictor of academic success. The chatbot's ability to remind students of deadlines and offer tailored study suggestions likely contributed to this increased engagement, supporting the claim that AI-driven tools can help combat procrastination and disengagement in online learning environments (Kamran, 2024; Halil et al. 2023).

Despite the overall positive feedback, some areas for improvement were highlighted. For instance, 20% of students felt that the chatbot's personalized study recommendations were too generic. This criticism is echoed by Tsivitanidou and Ioannou (2021) who argue that while chatbots can offer personalized feedback, their ability to tailor recommendations to individual learning needs is still limited by current AI capabilities. More advanced algorithms, such as those utilizing deep learning and neural networks, may be needed to refine the level of personalization (Ghahramani, 2020). Additionally, educators and students alike expressed a desire for more collaborative features within the chatbot, such as peer feedback and group discussions. The importance of collaboration in learning has been extensively documented in the literature (Zhang & Aslan, 2021; Essel et al., 2024), with studies showing that cooperative learning leads to higher achievement and more positive student attitudes. Jia et al. (2020) suggest that while chatbots can effectively support individual learning, incorporating features that promote peer interaction could further enhance motivation and engagement.

The feedback regarding the chatbot's limitations in handling complex tasks is also worth discussing. This challenge reflects broader concerns in the field of AI in education, as noted by Villegas-Ch et al. (2021), who argue that while AI can excel in repetitive tasks, it struggles with tasks requiring creativity, empathy, and higher-order thinking. To address this, future iterations of the Mesikola chatbot could incorporate hybrid models that combine AI-driven automation with human oversight (Söllner et al., 2018; Dwivedi et al., 2023).

Conclusion

In summary, the pilot testing of the Mesikola chatbot yielded promising results, demonstrating its potential to improve learning outcomes, increase student engagement, and enhance self-efficacy. These findings are consistent with existing empirical studies that highlight the value of AI-driven tools in education. However, the test also revealed areas for improvement, particularly in terms of handling complex tasks, refining personalization, and incorporating collaborative features. By addressing these issues, the Mesikola chatbot can become a more effective and comprehensive tool for supporting student learning in an LMS environment. Ultimately, the integration of chatbots like Mesikola into educational frameworks represents a significant step forward in the digital transformation of education, but continued refinement and research are needed to fully realize their potential.

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