MALAYSIAN JOURNAL OF COMPUTING AND APPLIED MATHEMATICS (2026) 9 (1) 50-62

DOI: *https://doi.org/10.37231/myjcam.2026.9.1.168*

Article: Received 12.07.2025; Accepted 31.12.2025; Published 31.03.2026

AI CHATBOT INTEGRATION ON THE NEW STUDENT ADMISSIONS INFORMATION LANDING PAGE OF MUHAMMADIYAH UNIVERSITY OF TASIKMALAYA TO IMPROVE SERVICE EFFICIENCY

Syahid Jundulloh[1,✉], Muhammad Taufiq[1], Alfadl Habibie[1], Sulidar Fitri[1], Taofik Muhammad[1], Milah Nurkamilah[1], Yana Mulyana[1], Siti Dhalila Mohd Satar[2]

[1]Faculty of Information Technology Education, Muhammadiyah University of Tasikmalaya, Tasikmalaya, Indonesia
[2]Faculty of Informatics and Computing, Universiti Sultan Zainal Abidin, Besut Campus, Besut 22200, Malaysia
[✉]educraftofficial@gmail.com

Abstract: In the context of increasing digital service demands in higher education, providing fast, accurate, and easily accessible information has become essential to support an effective admission process. This study aims to improve the efficiency of new student admission (PMB) information services by integrating an AI-based chatbot into the PMB landing page of Universitas Muhammadiyah Tasikmalaya. The research follows the ADDIE development model through five stages: Analysis, Design, Development, Implementation, and Evaluation. Data were collected through observation, interviews, documentation, and questionnaires. The system was evaluated using the PIECES framework and a Likert scale to assess system performance, user satisfaction, and service efficiency. The results showed a significant improvement in response time and user engagement after the chatbot implementation. This AI-based chatbot proved to be an effective solution to modernize PMB services, reduce staff workload, and provide 24/7 access to accurate and structured information.

Keywords: AI, landing page, new student admission, service efficiency, higher education

1. INTRODUCTION

In the era of rapid digital transformation, higher education institutions are increasingly required to provide fast, accurate, and accessible information services to meet the expectations of prospective students [1]-[2]. Efficient information delivery is not only essential for operational effectiveness but also plays a crucial role in shaping institutional credibility and user satisfaction [3]. During university admission periods, the need for timely responses becomes even more critical, as delays or inconsistent information can create uncertainty among applicants and negatively affect the institution's reputation [4].

At Universitas Muhammadiyah Tasikmalaya (UMTAS), information services for new student admissions (PMB) are primarily delivered through two channels: in-person consultations at the Information Center Building and online communication handled by administrative staff [5]-[6]. Although these methods have been effective in certain situations, they are limited by staff availability and working hours. Queries submitted outside operational periods often experience delays, and during peak registration times, the volume of inquiries exceeds staff capacity, resulting in long response times and reduced service quality [7]-[8].

These challenges highlight the need for an innovative solution capable of operating continuously and addressing repetitive inquiries efficiently [9]-[10]. One such solution widely adopted in recent years is the integration of artificial intelligence (AI)-powered chatbots into academic service systems. Previous studies have shown that AI chatbots can provide real-time automated responses, reduce human workload, and improve user engagement in various educational contexts [11]-[15]. Research conducted in university admission environments also demonstrates that chatbots enhance accessibility and consistency of information, contributing to a more streamlined decision-making process for prospective students [16]-[18].

Building upon these findings, this study aims to implement an AI-based chatbot on the PMB landing page of UMTAS to address the limitations of the existing service system. The chatbot is expected to handle frequently asked questions related to admission schedules, program requirements, tuition fees, and registration procedures. By offering 24/7 availability, the system enables prospective students to access information anytime, thus reducing dependency on staff presence and improving overall service responsiveness.

Furthermore, the development of the chatbot follows the ADDIE model—comprising the stages of Analysis, Design, Development, Implementation, and Evaluation—to ensure a systematic and user-centered creation process. To assess the chatbot's impact, this study applies the PIECES framework, focusing on performance and efficiency, accompanied by a Likert-scale evaluation to capture user perceptions. This structured approach ensures that both technical functionality and user experience are comprehensively evaluated.

Through this research, the integration of AI chatbot technology is expected to serve as a model for modernizing academic information services in higher education institutions. The findings also contribute to the growing body of literature on intelligent service systems and provide practical insights for universities seeking to enhance operational efficiency and service quality through digital innovation.

2. METHODOLOGY

This study uses a Research and Development (R&D) approach aimed at building and evaluating an AI-based chatbot integrated into the New Student Admission (PMB) landing page at Universitas Muhammadiyah Tasikmalaya. The development process follows the ADDIE model, which consists of five structured phases: Analysis, Design, Development, Implementation, and Evaluation. The overall development framework used in this research is illustrated in Figure 1, which presents the sequential steps of the ADDIE model.

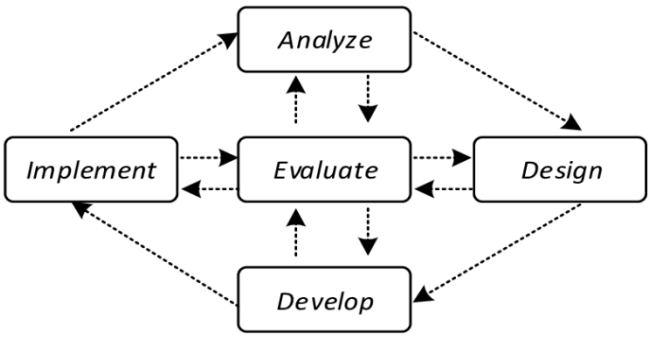

Figure 1: Step of ADDIE model

2.1 Analysis Phase

The Analysis phase aims to identify the core problems and user needs in the existing PMB information service. Methods used in this phase include observation, documentation review, and analysis of communication logs between prospective students and PMB administrators. To structure the assessment, the study adopts two components from the PIECES framework: Performance and Efficiency.

The list of Performance indicators adopted in this research is presented in Table 1. Performance component aspects. These indicators include response time, processing time, throughput, system load, availability, utilization, and scalability. They serve as the main parameters for evaluating how well the service system supports real-time interactions.

Table 1: Performance component aspects

No	Indicator	Observed Data
1	Response Time	Time between message receipt and first reply
2	Processing Time	Time from start of answer to completion of answer
3	Throughput	Number of questions answered in an hour
4	System Load	Number of concurrent users compared to maximum capacity
5	Availability	Ratio of service uptime to expected operational time
6	Utilization	Number of active staff compared to total available staff
7	Scalability	Comparison of throughput during peak hours versus normal hours

Similarly, the Efficiency indicators used in this research are summarized in Table 2. Efficiency component aspects. This table contains indicators such as resource utilization, time per transaction, labor efficiency, device usage, and cost per output. These parameters help assess whether the service system utilizes resources optimally and minimizes operational effort.

Table 2: Efficiency component aspects

No	Indicator	Observed Data
1	Resource Utilization	Percentage of effective staff, equipment, and work time utilization
2	Time per Transaction	Average time to complete a service transaction
3	Labor Efficiency	Number of transactions completed by one staff member
4	Device Usage	Number of transactions completed by one device
5	Cost per Output	Service cost per transaction based on total operational costs

Additionally, the methodology incorporates a set of Likert-scale scoring categories used during user evaluation (See Table 3). Although the table has no formal title in the manuscript, it provides the score–description mapping, such as “5 = Very Good” and “1 = Very Poor.” This table defines the scoring rubric used later in the Implementation and Evaluation phases.

Table 3: Likert-scale scoring categories

Score	Description
5	Very Good
4	Good
3	Fairly Good
2	Poor
1	Very Poor

Findings from this analysis indicate that the manual PMB service system suffers from slow response rates, limited operational hours, high staff workload, and inconsistent efficiency—highlighting the need for an automated and scalable solution like an AI chatbot.

The final system feasibility was determined using the following formula:

$$AS = \frac{TSS}{TNQ} \tag{1}$$

Equation (1) is used to determine how feasible the system is based on the total score received from all respondents divided by the number of questionnaire entries. The result is then interpreted using predetermined feasibility categories.

2.2 Design Phase

The Design phase focuses on developing the system architecture and interaction flow required for the chatbot. This includes structuring the dataset of PMB-related information, drafting question–answer mappings, outlining conversation scenarios, and defining system behaviors across various user inputs. Although the diagrams are not displayed here, the design stage ensures that the chatbot can effectively simulate human-like interactions and provide accurate information based on institutional data.

The outputs of this phase act as the blueprint for the development stage, ensuring system components, user interactions, and information pathways are aligned with user needs and institutional objectives identified in the Analysis phase.

2.3 Development Phase

The Development phase transforms the design specifications into an operational product. The PMB landing page is created using WordPress CMS, while the AI chatbot is developed on the FastBots.ai platform. Several technical steps are executed, including:

- constructing structured datasets based on PMB documents and FAQs,
- developing conversational flows and automated response models,
- configuring fallback mechanisms for queries beyond the chatbot's knowledge scope,
- embedding the chatbot script into the landing page interface.

Through this process, the landing page and chatbot system become fully functional, allowing real-time, automated, and contextually relevant interactions.

2.4 Implementation Phase

The Implementation phase verifies whether the developed system functions correctly under real-world conditions. The study uses Black-Box Testing, which assesses input–output behavior without examining internal program logic. Test cases include accessing landing page sections, navigating faculty pages, triggering chatbot responses, and evaluating responsiveness across devices.

In addition to system functionality testing, a feasibility assessment is conducted involving two respondent groups: PMB administrative staff and prospective students. The score rubric defined in the earlier Likert-scale table (no title) is used here to evaluate performance, efficiency, and user experience. The results confirm that the system performs reliably and is suitable for practical use.

2.5 Evaluation Phase

The Evaluation phase measures improvements after the chatbot implementation by revisiting the same Performance and Efficiency indicators defined previously in Table 1 and Table 2. This ensures consistency between pre- and post-implementation assessments. Parameters such as response time, processing time, throughput, workload distribution, and resource utilization are compared with the manual service baseline.

The evaluation results show substantial improvements in all key indicators, validating the effectiveness of the AI chatbot in enhancing service speed, scalability, and accessibility. The findings demonstrate that the developed system successfully supports PMB information services and addresses the limitations identified in the Analysis phase.

3. RESULTS AND DISCUSSION

This section presents the implementation process and outcomes of developing an AI-based chatbot on the Universitas Muhammadiyah Tasikmalaya (UMTAS) admission landing page, based on the ADDIE development model. It also discusses the results of the system testing and user evaluation.

3.1 *Analysis Phase*

The analysis phase aimed to obtain a comprehensive understanding of the actual condition of the information service system for new student admissions (PMB) at Universitas Muhammadiyah Tasikmalaya prior to implementing the AI-based chatbot. The analysis utilized the PIECES framework, focusing specifically on the Performance and Efficiency components. Data was gathered through direct observation of manual service activities (primarily through WhatsApp) and documentation of communication between prospective students and PMB administrators.

1. Performance Component
   Performance analysis measured system responsiveness and operational capability. Based on the observations, the following metrics can be seen in Table 4.

Table 4: Observation Results – Performance Component

No	Indicator	Result
1	Response Time	47 minutes 54 seconds/msg
2	Processing Time	1 hour 41 minutes 4 seconds/msg
3	Throughput	0.59 messages/hour
4	System Load	71% (Not overloaded)
5	Availability	86%
6	Utilization	HR: 100%, Devices: 70%
7	Scalability	>80% of normal load, but performance drops

From Table 4, it was evident that the current manual service system had a slow response time, high processing time, and low throughput. Although system load remained within safe limits (71%), availability and device utilization did not reach optimal values. Moreover, despite human resource utilization reaching 100%, the inability to maintain response speed during peak demand indicated the need for technological intervention.

2. Efficiency Component
   Efficiency analysis measured the optimal use of time, labor, and cost in delivering PMB services. The observation results for efficiency component can be seen in Table 5.

Table 5: Observation Results – Efficiency Component

No	Indicator	Result
1	Resource Utilization	HR: 100%, Device: 70%, Time: 86%
2	Time per Transaction	1.684 hours/message
3	Labor Efficiency	25 messages/staff
4	Device Usage	10.71 messages/device
5	Cost per Output	Rp 1,032.86/transaction

Table 5 reveal inefficiencies in transaction speed and cost. Despite full human resource engagement, the time required per interaction was still long, and the message-handling capacity per device and staff member was limited. This contributed to a relatively high service cost per transaction, reflecting an inefficient system incapable of sustaining peak-period workloads.

Based on performance and efficiency findings, the existing PMB service system heavily relied on manual methods, lacked responsiveness, and incurred high operational costs. Repeated questions and limited staff capacity further burdened the process.

As a result, a digital service innovation was deemed essential. The integration of an AI-based chatbot into the PMB landing page is expected to:

- Reduce response time
- Provide 24/7 service
- Minimize repetitive tasks for staff
- Increase access and scalability
- Enhance overall service efficiency

3.2. *Design Phase*

The design phase serves as the foundation for building the AI-based chatbot system by modeling its functionality, behavior, and structure. This stage uses Unified Modeling Language (UML) to visually represent the interaction, process flow, and data structure of the system. The objective is to provide a clear architectural blueprint that aligns with user needs and system requirements identified in the analysis phase. The following diagrams were developed:

1. Use Case Diagram
   The Use Case Diagram provides a high-level overview of the interactions between users and the system. It identifies the actors involved and the various functionalities they can perform within the AI Chatbot and Landing Page environment for PMB services at Universitas Muhammadiyah Tasikmalaya. The Figure 2 is a use case of the system to be designed.

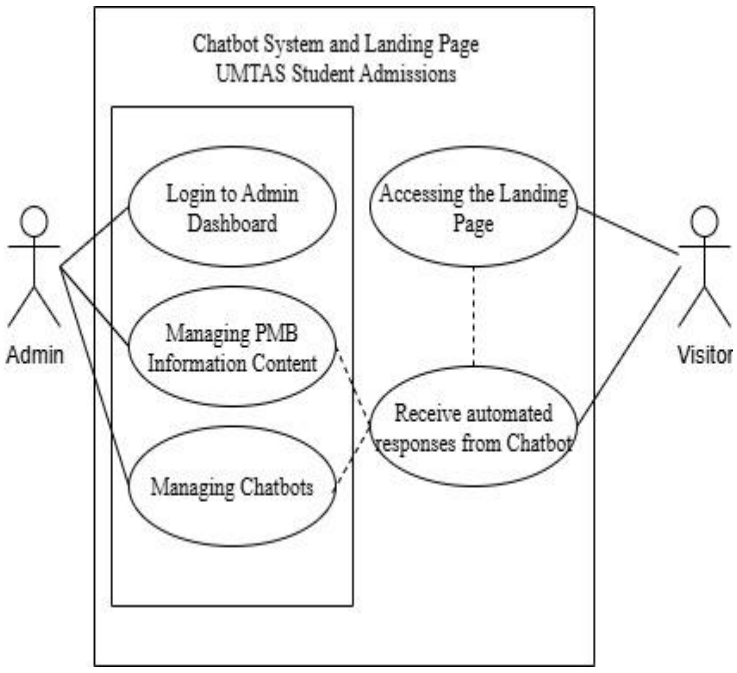

Figure 2: Use Case Diagram of AI chatbot integration on landing page

The use case diagram above shows the interaction between Admin and Visitor in the AI Chatbot system and the UMTAS PMB Landing Page. The Admin manages the system, from logging in and managing content to composing chatbot responses. Visitors access the landing page to search for PMB information and receive automated responses from the chatbot. This diagram illustrates the efficient flow of information services through chatbot integration.

2. Activity Diagram

The activity diagram in this study illustrates the workflow of the PMB information service system integrated with an AI chatbot on the UMTAS landing page. Figure 3 shows the stages of user interaction, from accessing the landing page, submitting a question via the chatbot, to receiving the required information.

The activity diagram above illustrates the user interaction flow with the chatbot system on the UMTAS New Student Admissions (PMB) landing page. Users access the page and browse information such as schedules, requirements, and fees. If they need further assistance, they can open the chatbot feature and type a question. The system processes the input and attempts to provide an automated response. If the question cannot be answered, the system sends a notification to PMB staff for manual follow-up. The user then waits for a follow-up response, and the process ends once the information is received. This diagram illustrates the combination of automated and manual services to improve the efficiency of PMB information services.

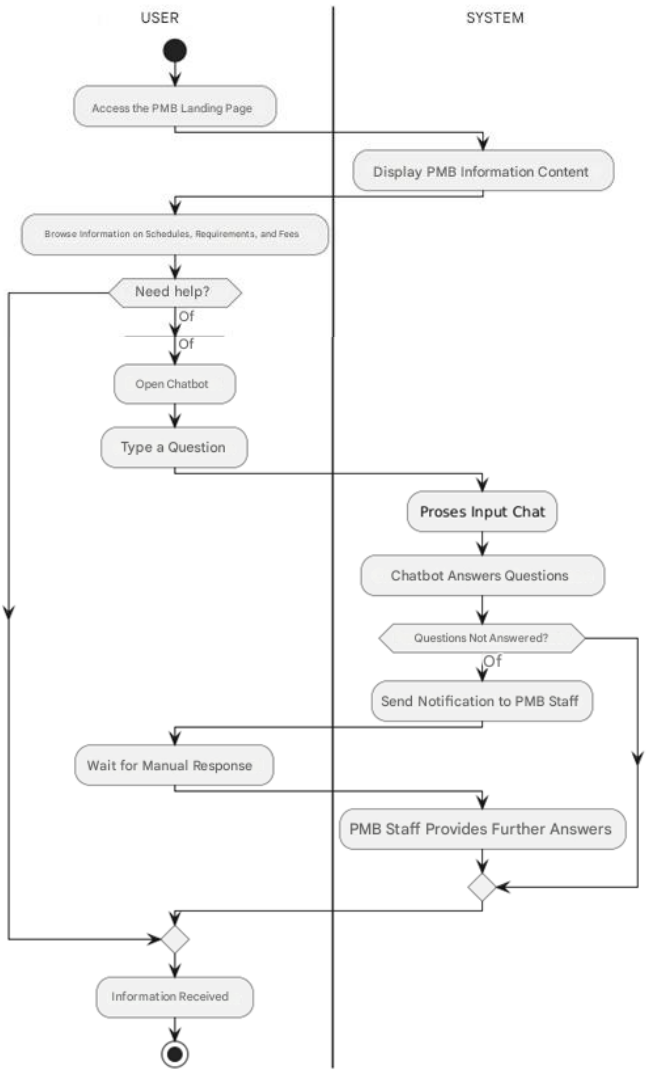

Figure 3: Activity Diagram of AI chatbot integration on landing page

3. Class Diagram

The class diagram for the UMTAS PMB AI Chatbot and Landing Page system has two main actors: Admin and Visitor. Admins have a one-to-many relationship with the Post, Page, Tag, and Category entities because they are responsible for managing all chatbot content and configuration.

The Post entity has a many-to-many relationship with the Tag and Category entities, because a single post can have multiple tags or categories, and vice versa. The system also includes Chatbot and Landing Page entities that interact with visitors to automatically provide information. The Figure 4 is the class diagram for the UMTAS PMB AI Chatbot and Landing Page system.

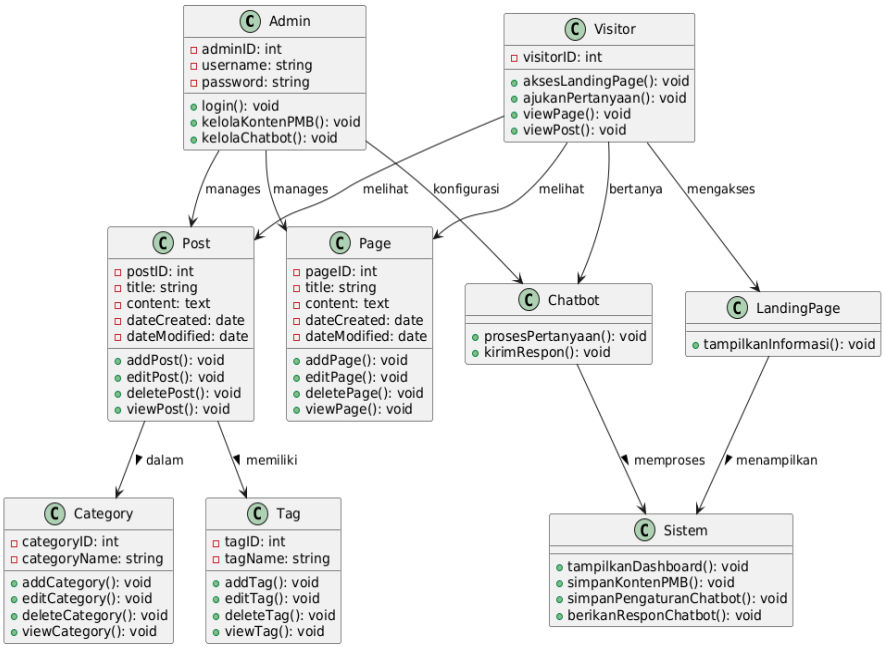

Figure 4: Class Diagram of AI chatbot integration on landing page

4. Entity Relationship Diagram (ERD)
The ERD in the AI Chatbot and Landing Page integration system for PMB UMTAS represents the relationships between entities that support information content management. Admins manage Posts, Categories, Tags, Pages, and the chatbot knowledge base. Posts have a many-to-many relationship with Categories and Tags through the connecting entity. Visitors can only access content and interact with the chatbot. This structure supports a responsive, structured, and accessible information system. The Figure 5 shows the system's ERD.

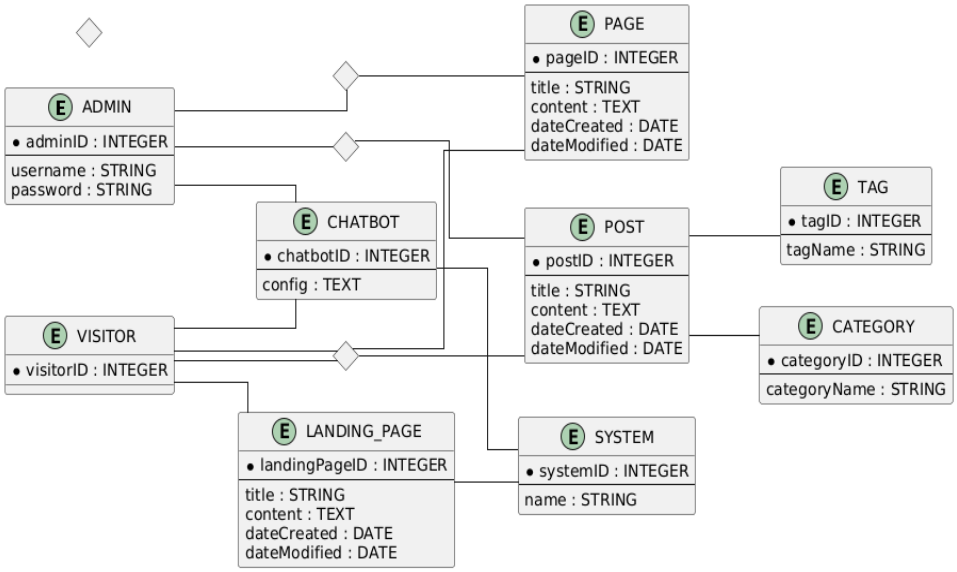

Figure 5: ERD of AI chatbot integration on landing page

3.3. *Development Phase*

The development phase focused on building and integrating an AI-based chatbot with the existing landing page for New Student Admission (PMB) at Universitas Muhammadiyah Tasikmalaya. This stage involved the technical realization of the system's design, with the objective of enabling automated, responsive, and continuous access to admission-related information.

The landing page was developed using the WordPress Content Management System (CMS), which allowed for the flexible arrangement of content and user navigation. Simultaneously, the AI chatbot was developed using the FastBots.ai platform, trained with official data and documents related to PMB to ensure accurate and contextually relevant responses.

Integration was achieved by embedding the chatbot script directly into the homepage and configuring automatic response flows based on predefined conversation scenarios. This ensured that users could interact with the system seamlessly, even outside of regular operational hours. The integrated landing page view with AI chatbot can be seen in Figure 6.

Figure 6: integrated landing page view with AI chatbot

The main components of the landing page include:

a. Homepage (Home), serving as the central hub of navigation and key information;
b. Header section, displaying the university's identity, promotional visuals, and an accessible chatbot trigger;
c. Informational sections, presenting UMTAS's academic advantages, admission tracks, and faculty/program offerings;
d. Call-to-Action (CTA) areas and alumni testimonials, designed to enhance user engagement and build trust;
e. Footer, which provides official contact details, social media links, and a direct link to join the university's discussion group.

This structure was designed to create an intuitive and efficient user experience. The integration of the chatbot AI ensures real-time service delivery, reduces the workload on administrative staff, and improves the accessibility of information for prospective students, especially during peak admission periods.

Meanwhile, the chatbot is then embedded into the landing page using a script provided by the platform, enabling seamless interaction from within the homepage. The chatbot interface provides a natural-language experience for users seeking information such as:

a. Registration requirements;
b. Tuition and program fees;
c. Study programs offered;
d. Deadlines and selection schedules.

A dedicated Chatbot AI Interface was made accessible directly from the homepage. This interface allows users to initiate conversations with the chatbot in real time. The Chatbot AI Interface can be seen in Figure 7.

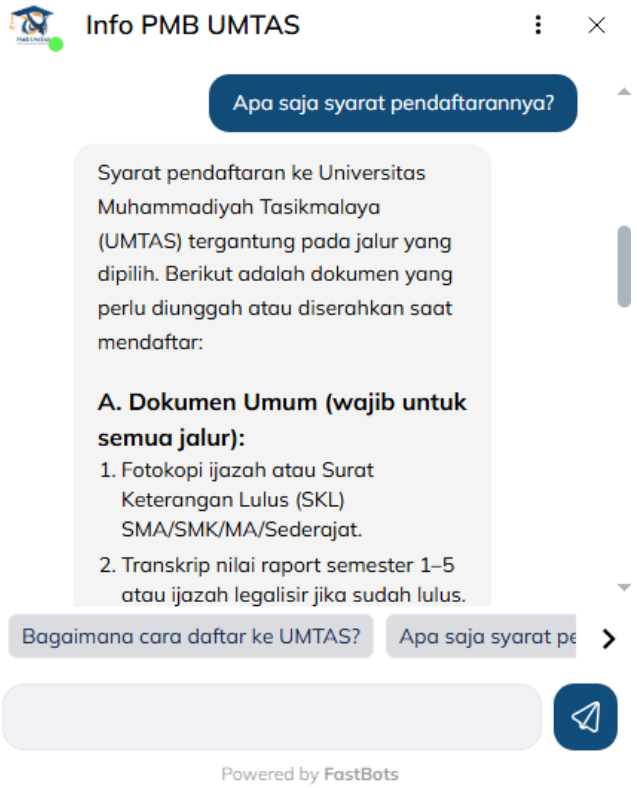

Figure 7: Chatbot AI Interface

The chatbot responds automatically based on predefined conversational flows and a trained knowledge base. For inquiries outside the scope of its training, the system can redirect the message to human staff for follow-up.

3.4. *Implementation Phase*

The implementation phase focused on testing the developed system to ensure that the integrated AI chatbot and landing page for New Student Admission (PMB) at Universitas Muhammadiyah Tasikmalaya functioned correctly and reliably. This phase included both functional testing using Black-Box methods and feasibility assessments from stakeholders and users.

1. System Functionality Testing (Black-Box Testing)
   Functional testing was carried out using the Black-Box testing method, which focuses on validating outputs against expected results without examining the internal code structure. The goal was to ensure that all components of the systemoperated according to predefined scenarios.

The tests involved common user interactions such as navigating through the homepage, accessing faculty pages, and interacting with the chatbot. The Table 6 show the all-tested buttons, icons, and features functioned correctly across multiple devices and browsers.

Table 6: Internal System Testing Results

No	Test Item	Result Summary	Valid
1	Homepage	Successfully displays homepage; all icons and navigation function correctly.	✓
2	Faculty of Health Sciences Page	Page loads correctly; icons and navigation respond as expected.	✓
3	Faculty of Education Page	Page loads correctly; all features function as intended.	✓
4	Faculty of Engineering Page	All content and features load without issue; navigation is functional.	✓
5	RPL Program Page	Displays correctly with full feature usability.	✓
6	Chatbot Interface	Chatbot loads automatically, displays a clean interface, responds accurately and consistently.	✓

2. Feasibility Assessment Results

To evaluate the feasibility and usability of the developed system, structured feedback was collected using Likert-scale questionnaires based on Performance and Efficiency criteria. The assessment was conducted in two groups: PMB Staff and End Users (prospective students, current students, and the general public).

a. Evaluation by PMB Administrative Staff

Staff members evaluated the system's performance, efficiency, and user interface experience. A total of 70 respondents participated in the user testing phase. Participants assessed the same aspects evaluated by the staff, and the results are presented in Table 7.

Table 7: Staff Feasibility Test Results

No	Assessment Category	Question Numbers	Total Score
1	System Performance	1–7	35
2	Efficiency	8–13	30
3	UI/UX Experience	14–15	10
Maximum Score			**75**
Average Score			**5.00**
Feasibility Criteria			**Highly Feasible**

b. Evaluation by Users (Prospective Students and Public)

A total of 70 respondents participated in the user testing phase. The participants evaluated the same aspects as the staff, and the results are presented in Table 8.

Table 8: User Feasibility Test Results

No	Assessment Category	Question Numbers	Total Score
1	System Performance	1–7	2.195
2	Efficiency	8–13	1.86
3	UI/UX Experience	14–15	617
Maximum Score			**5,250**
Total Score Obtained			**4,672**
Average Score			**4.45**
Feasibility Criteria			**Highly Feasible**

3.5. *Evaluation Phase*

The evaluation phase was conducted to assess the effectiveness of the AI-powered chatbot system implemented on the PMB landing page of Universitas Muhammadiyah Tasikmalaya, with particular

emphasis on performance and efficiency improvements. A comparative observation was carried out before and after system implementation to examine its practical impact on the delivery of information services.

This comparison emphasizes two key components: Performance and Efficiency. Each metric is analyzed to identify improvements in system responsiveness and operational optimization.

Table 9: Comparison Before and After Implementation

No	Indicator	Before Implementation	After Implementation
		Performance Component	
1	Response Time	47 minutes 54 seconds / message	10.29 seconds / message
2	Processing Time	1 hour 41 minutes 4 seconds / message	2 minutes 58 seconds
3	Throughput	0.59 messages / hour	20.19 messages / hour
4	System Load	71% (Not overloaded)	36%
5	Availability	86%	100%
6	Utilization	Human: 100%, Device: 70%	Human: 33.33%, Device: 70%
7	Scalability	Up to 80% traffic spike tolerated	>136% increase in throughput
		Efficiency Component	
1	Resource Utilization	Human: 100%, Device: 70%, Time: 86%	Human: 33.33%, Chatbot: 100%, Time: 100%
2	Time per Transaction	1.684 hours / message	2.97 seconds / message
3	Labor Efficiency	25 messages / staff	35 messages / staff
4	Device Usage	10.71 messages / device	35 messages / device
5	Cost per Output	Rp. 1,032.86 / transaction	Rp. 1,306.78 / transaction

Table 9 demonstrates that AI-integrated chatbots significantly improve service performance and efficiency within the PMB information system. Key improvements include faster response times, optimized staff workloads, increased scalability, and improved transaction processing, making the system more sustainable and user-friendly for future applicants.

4. CONCLUSION

Based on the research findings and discussion, it can be concluded that the development of an AI-based chatbot integrated into the New Student Admission (PMB) landing page of Universitas Muhammadiyah Tasikmalaya provides an effective solution to the limitations of conventional information services, particularly those related to operational time constraints. The chatbot was designed to automatically and interactively respond to inquiries regarding admission schedules, requirements, academic programs, tuition fees, and registration procedures. The system was developed using the ADDIE model, beginning with a needs analysis supported by the PIECES Framework, followed by system design through UML modeling, development using the FastBots.ai platform and WordPress CMS, and implementation validated through Black-Box testing.

The evaluation showed significant positive results. The chatbot drastically reduced response time compared to the previous manual system, improved device and time efficiency, and ensured 24/7 service availability without continuous staff involvement. Feasibility tests conducted with PMB staff yielded a perfect score of 75 out of 75 (average 5.00), while general users gave 4,672 out of 5,250 (average 4.45), with both categorized as “highly feasible.” Therefore, the AI-powered chatbot successfully delivers fast, accurate, and time-independent PMB information services while improving institutional operational efficiency. For future development, it is recommended that the chatbot’s knowledge base be continuously expanded to handle more complex queries, integrated more deeply with the PMB system, and further evaluated using the PIECES framework to enable broader comparisons with manual services.

REFERENCES

[1] Aditya, R. Q., & Suranto, S. (2024). The role of educational transformation in the digital era in improving student quality. *Al Qalam: Jurnal Ilmiah Keagamaan dan Kemasyarakatan*, *18*(3), 1756-1772.

[2] Joseph, O. B., Onwuzulike, O. C., & Shitu, K. (2024). Digital transformation in education: Strategies for effective implementation. *World Journal of Advanced Research and Reviews*, *23*(2), 2785-2799.

[3] Håkansson Lindqvist, M., Mozelius, P., Jaldemark, J., & Cleveland Innes, M. (2024). Higher education transformation towards lifelong learning in a digital era–a scoping literature review. *International Journal of Lifelong Education*, *43*(1), 24-38.

[4] AlAli, R., & Wardat, Y. (2024). Empowering education through digital transformation: Confronting educational wastage in basic education schools in Jordan. *International Journal of Innovative Research and Scientific Studies*, *7*(3), 1148-1162.

[5] Nurmahmudah, E., & Nuryuniarti, R. (2020, March). Google forms utilization for student satisfaction survey towards quality of service at Universitas Muhammadiyah Tasikmalaya. In *Journal of Physics: Conference Series* (Vol. 1477, No. 2, p. 022003). IOP Publishing.

[6] Mukarom, Z., Darmawan, D., Agustin, M., Dwijantie, J. S., & Samadi, M. R. (2024). Islamic education curriculum innovation in the digital era: Challenges and opportunities. *International Education Trend Issues*, *2*(2), 317-328.

[7] Håkansson Lindqvist, M., Mozelius, P., Jaldemark, J., & Cleveland Innes, M. (2024). Higher education transformation towards lifelong learning in a digital era–a scoping literature review. *International Journal of Lifelong Education*, *43*(1), 24-38.

[8] Rêgo, B. S., Lourenço, D., Moreira, F., & Pereira, C. S. (2024). Digital transformation, skills and education: A systematic literature review. *Industry and higher education*, *38*(4), 336-349.

[9] Engreini, S., Amini, R., & Alfana, Y. D. (2025). Effectiveness of Using Artificial Intelligence Chatbox Integrated Case Method on Science Learning Outcomes of Basic Education Students. *Jurnal Penelitian Pendidikan IPA*, *11*(1), 1206-1214.

[10] Bennett, L., & Abusalem, A. (2024). Artificial Intelligence (AI) and Its Potential Impact on the Future of Higher Education. *Athens Journal of Education*, *11*(3), 195-212.

[11] Sambas, A., Zhang, X., Moghrabi, I. A., Vaidyanathan, S., Benkouider, K., Alçın, M., ... & Johansyah, M. D. (2024). ANN-based chaotic PRNG in the novel jerk chaotic system and its application for the image encryption via 2-D Hilbert curve. *Scientific Reports*, *14*(1), 29602.

[12] Sambas, A., Vaidyanathan, S., & Aziz, A. A. (2024). Guest Editorial Machine Learning Technology for Biomedical Signal Processing. *IEEE Journal of Biomedical and Health Informatics*, *28*(10), 5661-5666.

[13] Kedi, W. E., Ejimuda, C., Idemudia, C., & Ijomah, T. I. (2024). AI Chatbot integration in SME marketing platforms: Improving customer interaction and service efficiency. *International Journal of Management & Entrepreneurship Research*, *6*(7), 2332-2341.

[14] Wangsa, K., Karim, S., Gide, E., & Elkhodr, M. (2024). A systematic review and comprehensive analysis of pioneering AI Chatbot models from education to healthcare: ChatGPT, Bard, Llama, Ernie and Grok. *Future Internet*, *16*(7), 219.

[15] Shahzad, M. F., Xu, S., An, X., & Javed, I. (2024). Assessing the impact of AI-chatbot service quality on user e-brand loyalty through chatbot user trust, experience and electronic word of mouth. *Journal of Retailing and Consumer Services*, *79*, 103867.

[16] Awal, M. R., & Haque, M. E. (2025). Revisiting university students' intention to accept AI-powered chatbot with an integration between TAM and SCT: a South Asian perspective. *Journal of Applied Research in Higher Education*, *17*(2), 594-608.

[17] Kingchang, T., Chatwattana, P., & Wannapiroon, P. (2024). Artificial intelligence chatbot platform: AI chatbot platform for educational recommendations in higher education. *International Journal of Information and Education Technology*, *14*(1), 34-41.

[18] Dužević, I., Baković, T., & Surman, V. (2025). Understanding artificial intelligence chatbot quality and experience: A higher education student perspective. *Entrepreneurial Business and Economics Review*, *13*(3), 151-170.