.Published online on the journal's webpage: **http://journal.ittelkom-pwt.ac.id/index.php/dinda**

Journal of Dinda

Data Science, Information Technology, and Data Analytics

Vol. 5 No. 2 (2025) 176 - 189 E-ISSN: 2809-8064

Utilizing GPT-4o Mini in Designing a WhatsApp Chatbot to Support the New Student Admission Process at Telkom University

Muhammad Lutfi Ruhallah [1], Rahmat Pratami[2], Alfian Akbar Gozali[3]

[1,2,3*]Department of Application Software Engineering, Telkom University, Bandung, Indonesia

[1]mlrllahtfi@student.telkomuniversity.ac.id, [2]rachmad@student.telkomuniversity.ac.id, [3]alfian@telkomuniversity.ac.id

Abstract

The rapid adoption of Artificial Intelligence (AI) in higher education has revolutionized student support services, yet delivering scalable, real-time assistance through familiar platforms remains a challenge. This study presents the design, implementation, and evaluation of a WhatsApp-based chatbot powered by a fine-tuned GPT-4o Mini model to streamline the new student admission process at Telkom University. A specialized dataset comprising frequently asked questions and admission-related dialogues was curated and preprocessed for model fine-tuning over 288 epochs. The chatbot system integrates the WhatsApp Business API, a Webhook interface, and the n8n automation platform, all deployed on a Virtual Private Server (VPS) to ensure reliability and low-latency communication. Functional and performance testing involved manual scenario-based assessments and quantitative measurements of response accuracy and latency. Results indicate that the chatbot consistently delivers contextually relevant answers—achieving an average accuracy above 85%—and reduces average response time to under 3 seconds. User interaction studies with prospective and current students revealed high satisfaction levels, highlighting improvements in accessibility and reduction of administrative workload. Challenges identified include occasional misinterpretation of complex queries and the need for enhanced scalability under peak loads. Future work will focus on periodic dataset updates, advanced prompt engineering, scalability stress testing, and the integration of multimodal features such as voice and image recognition. By aligning AI-driven conversational interfaces with users' existing digital habits, this chatbot demonstrates a viable approach for enhancing admission services and operational efficiency in Indonesian higher education institutions.

Keywords: *GPT-4o Mini, WhatsApp chatbot, new student admission, fine-tuning, higher education AI.*

1. Introduction

The integration of Artificial Intelligence (AI) into educational systems has become an increasingly pivotal element in the digital transformation of higher education institutions [1]. From adaptive learning systems to intelligent tutoring and automated administrative support, AI technologies have reshaped conventional approaches to teaching, learning, and campus services [2]. Among these AI innovations, conversational agents especially chatbots have emerged as promising tools to address the growing need for personalized, real-time, and scalable interaction in educational settings [3].

Chatbots, particularly those built upon Large Language Models (LLMs) such as OpenAI's GPT-series, leverage natural language processing (NLP) and machine learning (ML) to simulate human-like conversations. Their ability to deliver instant and contextually relevant responses enables them to serve a wide range of academic and administrative functions, from answering FAQs to guiding students through registration procedures [4]. ChatGPT, as the most widely recognized example of such tools, has shown strong potential in education for supporting knowledge retrieval, providing structured explanations, and enhancing learner engagement [5].

In Indonesia, the relevance of such tools is amplified by the widespread use of mobile messaging platforms especially WhatsApp. According to the Digital 2023 report, over 112 million Indonesians actively use WhatsApp, with the highest usage rate among individuals aged 18 to 24 coinciding with the target demographic of university applicants [6]. This behavioral insight underscores the strategic advantage of delivering educational services through platforms that students already use extensively. WhatsApp-based chatbots powered by AI thus offer a compelling solution to bridge the gap between students' digital habits and the universities' communication strategies [7].

Received: 05-07-2025 | Accepted: 27-07-2025 | Published: 05-08-2025

Telkom University, a leading private institution known for its digital ecosystem and technology-focused programs, continues to seek innovative solutions to streamline the new student admission process. During peak enrollment periods, the university faces an influx of queries from prospective students, which often overwhelms its human resources. These inquiries range from admission timelines and required documents to program-specific details and payment procedures. Without an automated system in place, delays in response can affect the applicant's experience and decision-making process. Therefore, embedding an AI-based conversational interface within WhatsApp could improve service delivery, reduce staff workload, and enhance user satisfaction.

One of the most promising models for this purpose is GPT-4o mini, a lightweight and efficient version of OpenAI's GPT-4 designed for real-time deployment on resource-limited platforms. While retaining the multimodal and contextual strengths of its predecessor, GPT-4o mini offers faster response times and lower latency features that are essential for mobile-based chatbot interactions [8]. As demonstrated in previous research, GPT-powered chatbots significantly outperform traditional rule-based systems in terms of adaptability, user engagement, and linguistic coherence [9].

Moreover, flow-based chatbot design as employed by several Indonesian universities has proven effective in guiding users through hierarchical information retrieval processes. At UPN "Veteran" Jawa Timur, for example, flow-based chatbots were successfully used to deliver academic policy information, significantly increasing response accuracy and student trust in the information provided [7]. When combined with GPT-4o's language capabilities, such flow-based systems may evolve into conversational interfaces that can support multiple user intents with nuanced responses and adaptive logic [10].

Despite the promise of AI chatbots in higher education, their implementation still faces several challenges, including the need for ethical safeguards, data privacy, and system integration [8]. It is therefore necessary to develop these systems with a clear pedagogical and technical framework to ensure usability, transparency, and alignment with institutional goals. The rapid advancement of digital transformation has significantly influenced higher education institutions worldwide, urging them to adopt artificial intelligence (AI) technologies to improve the efficiency of both academic and administrative services [8]. In Indonesia, one of the most pressing challenges faced by universities—especially technology-focused institutions like Telkom University—is managing the increasing volume of student applicants. In 2023, Telkom University recorded a 15% increase in admission applications compared to the previous year, placing considerable strain on manual communication systems. The influx of inquiries often leads to delayed responses, fragmented information delivery, and applicant dissatisfaction, all of which may negatively impact the university's public image and student conversion rates [12].

To address this problem, many institutions have turned to AI-powered chatbots, particularly those based on Large Language Models (LLMs), to automate responses and manage repetitive queries [16]. Among the most promising developments is GPT-4o mini, a compact variant of OpenAI's GPT-4 model, which offers a balance between language understanding and computational efficiency. This makes it ideal for integration with widely used messaging platforms such as WhatsApp. With over 143 million active monthly users in Indonesia [25], WhatsApp serves as a strategic communication channel for universities aiming to provide real-time, accessible information services.

Prior research supports the growing role of AI in education. Studies by Kumar et al. and Al-Barrak have demonstrated how chatbots can simplify complex processes like student registration and admissions, while improving accuracy and speed [13], [11]. Cieliebak et al. found that the use of chatbots reduced staff workload by up to 35% and increased user satisfaction by 20% [14]. Additionally, a 2022 UNESCO report underscores the potential of AI technologies to increase access and efficiency in higher education systems globally [21]. However, there is a noticeable gap in localized research that applies LLMs specifically fine-tuned GPT-4o minito the unique context of Indonesian universities and the language behaviors of local users [17].

In the broader context of Indonesia's digital transformation agenda, integrating AI tools into public-facing educational services aligns with national initiatives to improve digital literacy and e-government efficiency. Universities play a central role in these efforts, not only as educational institutions but also as innovation drivers. By leveraging AI-based chatbot systems, universities can demonstrate leadership in adopting emerging technologies while also delivering concrete benefits to prospective students, particularly those from rural or underserved areas who may lack access to timely information through traditional means [18]. The deployment of a WhatsApp-integrated chatbot thus supports both institutional goals and national priorities in building a more inclusive and responsive education system.

Additionally, the success of such systems holds potential beyond the admissions context. Once established, the same chatbot infrastructure could be extended to support other university functions such as academic advising, course registration, tuition payment reminders, and alumni engagement [20]. This scalability underscores the strategic value of investing in a well-designed, adaptable AI communication system. In the long term, it could significantly reduce operational costs while enhancing the overall student experience throughout their academic journey. Thus, this research not only addresses a current communication bottleneck but also lays the foundation for broader digital service innovation in higher education [12].

Nevertheless, implementing a fine-tuned GPT-4o mini chatbot is not without technical challenges. One of the foremost concerns is ensuring that the chatbot operates reliably under high traffic conditions, particularly during peak admission periods. Moreover, the model must be trained to handle ambiguous, vague, or emotionally sensitive queries in a way that aligns with institutional standards and communication ethics. There is also a need for continuous evaluation and updating of the knowledge base to reflect changing admission policies and applicant needs [24]. These challenges demand a thoughtful system architecture and an agile development approach to ensure sustainability and relevance over time [16].

Ultimately, the significance of this research lies in its potential to bridge the gap between advanced AI capabilities and the real-world operational needs of higher education institutions in Indonesia. By providing empirical insights into chatbot design, performance metrics, and user experience, this study contributes both theoretically and practically to the emerging field of AI-assisted education services. The outcomes are expected to inform future AI integration strategies not only at Telkom University but also at other institutions seeking to enhance their digital service delivery through locally relevant, ethically sound, and technologically robust solutions [22].

This research is therefore driven by two main motivations: first, to overcome the operational inefficiencies caused by manual admission communication; and second, to explore the untapped potential of fine-tuned LLMs in improving institutional responsiveness through culturally and contextually relevant chatbot design [19], [20]. Generic language models, while powerful, often fail to understand domain-specific terminology, procedural nuances, and informal language patterns common in Indonesian student inquiries. Fine-tuning GPT-4o mini using a dataset composed of institutional FAQs, past admission logs, and policy documentation is essential to ensure the chatbot delivers precise, relevant, and trustworthy responses.

The primary objective of this study is to design, develop, and evaluate a WhatsApp-based chatbot powered by GPT-4o mini, which has been fine-tuned to support the student selection and admission process at Telkom University. Specifically, the research aims to assess the chatbot's performance across three key dimensions: response accuracy, response time, and user satisfaction [23]. By doing so, the study seeks to answer the following research questions:

1 How effective is a fine-tuned GPT-4o mini chatbot in handling admissions-related inquiries on WhatsApp?

2 How do prospective students perceive the chatbot's usefulness, clarity, and responsiveness?

3 To what extent can such a chatbot reduce the administrative workload during the admissions period?

Through this research, it is expected that the admission process will become more streamlined, accessible, and responsive delivering an improved experience for applicants while reducing the burden on administrative staff. Moreover, the outcomes of this study are intended to serve as a reference model for other higher education institutions in Indonesia and beyond that are exploring the integration of AI-powered chatbots into their academic service delivery systems.

This study aims to design and implement a WhatsApp-based chatbot supported by GPT-4o mini to assist the new student selection process at Telkom University. The objectives are to evaluate its usability, accuracy, and efficiency in delivering critical admission information to prospective students, while also exploring its potential impact on user satisfaction and operational efficiency. By leveraging conversational AI in a context-sensitive and culturally relevant platform like WhatsApp, this study contributes to the advancement of AI-driven educational services in the Indonesian higher education landscape.

2. Research Methods

This research method outlines in detail the stages and procedures involved in developing a WhatsApp chatbot powered by the GPT-4o mini Large Language Model (LLM) using a systematic fine-tuning approach. The process includes collecting and selecting conversational data and documents related to frequently asked questions (FAQ) about university admissions, which serve as the foundation for retraining the model to better understand

local context and the specific needs of prospective students. The next stage involves data preprocessing to ensure input quality and consistency throughout the training process. The fine-tuning aims to adapt the GPT-4o mini model to more accurately respond to administrative and general inquiries regarding the admissions process. The system implementation is carried out by integrating the model with the WhatsApp Business platform using an API, Webhook, and the n8n orchestrator, enabling real-time two-way interaction. This approach is designed to produce a chatbot that is responsive, efficient, and reliable in delivering automated answers to admissions-related FAQs quickly and accurately. An illustration of this overall workflow is presented in Figure 1, which depicts the flow diagram of the New Student Admissions Chatbot service.

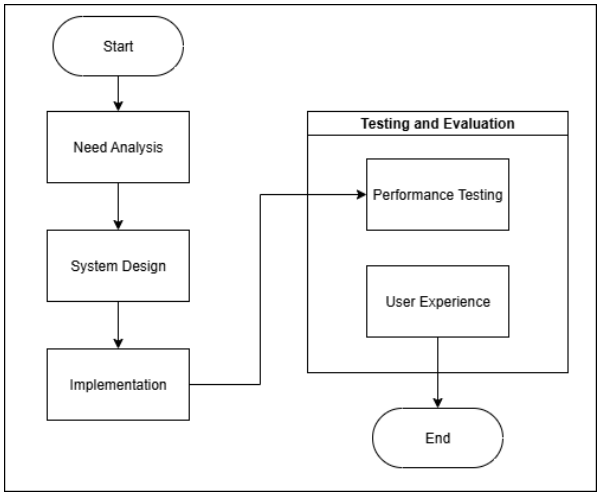

Figure 1. Flowchart of New Student Admission Service Chatbot

2.1 *Need Analysis*

This needs analysis was conducted to identify various challenges faced by prospective students during the registration process at Telkom University. Common issues include difficulties in obtaining accurate information, slow responses to frequently asked questions, and limited service availability restricted to office hours. These factors often cause confusion and dissatisfaction among applicants, especially during busy admission periods.

To ensure the developed chatbot meets user needs and expectations within the university environment, interviews were conducted with active students, prospective students, members of the general public and staff from the admissions office. The purpose of these interviews was to gather insights into the typical questions asked by prospective students, their preferred communication platforms, and their expectations regarding the speed and clarity of responses.

This study is a Research and Development (R&D) project that combines quantitative and qualitative methods harmoniously to create an effective and responsive WhatsApp chatbot based on the GPT-4o Mini model. The quantitative method was applied by objectively measuring the chatbot's performance using indicators such as response accuracy and system response time, ensuring the chatbot delivers precise and reliable answers in the context of new student admission.

On the other hand, the qualitative method was used to understand user needs and preferences through interviews, observations, and in-depth feedback collection about their experiences interacting with the chatbot. The results of this qualitative analysis served as the basis for content validation and feature adjustments to improve the quality of interactions and the relevance of information provided, enabling the chatbot to optimally meet user expectations during the university's admission process.

As part of this study, a set of evaluation questions was designed to capture user experiences and perceptions of the WhatsApp chatbot. Respondents consisted of prospective and active students who provided diverse perspectives on the system. They assessed aspects such as ease of use, chatbot response speed compared to conventional admission services, and the potential for misunderstandings in the chatbot's replies.

Table 1 Survey questions for diverse respondents

No	Question	Respondent
1	Do you find this chatbot engaging and easy to use for obtaining information about the new student admission?	Prospective Student , Parents of prospective students & Active Student
2	How easy is it for you to understand how to use this chatbot to inquire about the registration and selection procedures?	Prospective Student & Parents of prospective students
3	Does the chatbot provide quick and clear answers regarding the requirements and stages of the new student admission?	Prospective Student & Parents of prospective students
4	Do you feel that this chatbot can be trusted to deliver official information related to the admission announcements?	Student Affairs Staff, Prospective Student, Active Student

5	Does using this chatbot make you feel more comfortable and pleased when obtaining information about new student admission?	Prospective Student & Parents of prospective students

2.2 *System Design*

The following explains the flow of how the WhatsApp chatbot powered by GPT-4o mini processes user messages and generates responses. Each step highlights a key part of the system to ensure effective communication between users and the chatbot.

1. Webhook (Initial Trigger)
    - The lightning icon marks the starting trigger.
    - The webhook receives an HTTP POST request from the WhatsApp Business API when a user sends a message.
2. When a Chat Message is Received
    - This node reads and handles the incoming message content from the webhook.
    - The message data is then sent for further AI processing.
3. AI Agent (Tools Agent)
    - This node represents the AI agent, namely the GPT model (GPT-4o mini).
    - It processes the user's input and generates a relevant response based on context.
4. OpenAI Chat Model
    - This symbol indicates the use of an OpenAI GPT model by the AI agent.
    - The model automatically produces replies to user questions.
5. Respond to Webhook
    - After the AI generates a response, this node sends the reply back to the user via the webhook.
    - This ensures smooth, two-way communication between the chatbot and the user on WhatsApp.

Figure 2 provides a visual representation of the chatbot system design and is referenced in the text

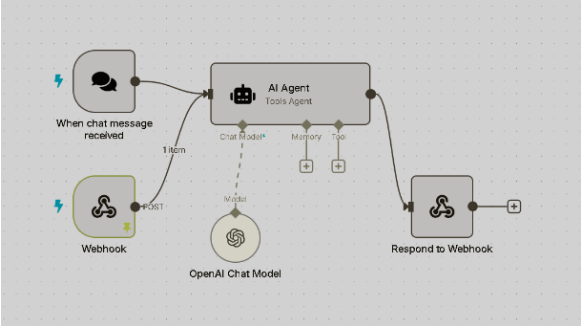

Figure 2 Design of the Chatbot System

2.3 *Implementation*

The backend system of this application is developed with a focus on scalability and efficient integration to support the new student admission process at Telkom University. The GPT-4o Mini model serves as the core component for natural language understanding and generating fast, relevant responses. Every interaction between users both questions and chatbot replies is stored in a database hosted on a VPS for performance monitoring and further analysis.

On the frontend side, the chatbot leverages the WhatsApp Business API, allowing prospective students to interact directly through the WhatsApp application. Incoming messages are received by a webhook running on the VPS and then forwarded to the GPT-4o Mini model for further processing.

Workflow automation and coordination are handled using the n8n platform, which manages communication between the WhatsApp Business API, webhook, and the GPT model. Additionally, n8n plays a role in logging activities and efficiently managing backend processes.

Through this architecture, the chatbot can deliver interactive, real-time services via WhatsApp, supported by a stable and flexible backend powered by the VPS and automated workflows from n8n. This enables prospective students to obtain admission information in a practical, fast, and accurate manner.

Figure 3 provides a visual representation of the user interface design, illustrating how prospective students interact with the chatbot through WhatsApp to access admission-related information.

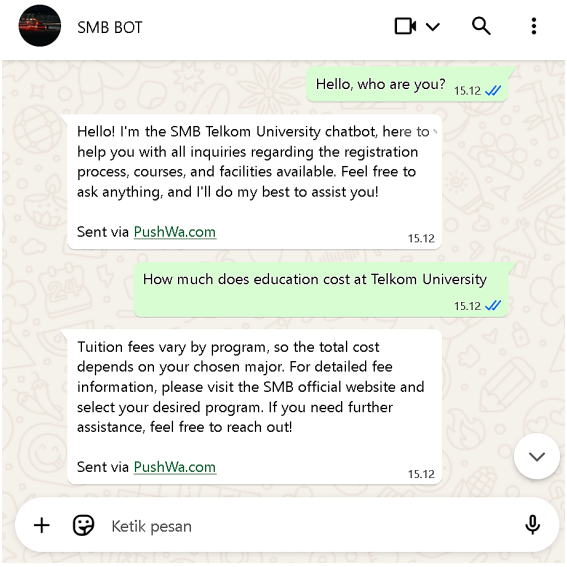

Figure 3 User Interface Design

2.4 *Testing and Evaluation*

To ensure the chatbot met its intended objectives, a series of tests were carried out focusing on functionality, system performance, and user interaction—specifically within the scope of assisting prospective students during the admission process at Telkom University. The evaluation process included the following components:

- Functionality
  Both manual and automated testing were performed to verify that the chatbot could handle typical admission-related inquiries. These included questions about registration procedures, document submission, and selection timelines.
- Performance
  The system's efficiency was measured by monitoring API response times and evaluating the relevance and accuracy of the chatbot's answers when presented with a variety of prompts tailored to admission topics.
- User Interaction Evaluation
  Prospective and current students were involved in testing to gather insights into the chatbot's usability. Aspects such as clarity of the conversation, ease of interaction, and the usefulness of the information provided were assessed to understand how well the chatbot supports users in navigating the admission process.

3. Results and Discussion

This study successfully developed a WhatsApp-based chatbot powered by the GPT-4o mini model, which was refined through a fine-tuning process using a specially prepared dataset. The dataset consists of frequently asked questions and conversations related to the new student admission process at Telkom University, covering topics such as admission pathways, registration schedules, document requirements, re-registration procedures, and tuition fee information.

The fine-tuning process enabled the chatbot to understand the context and terminology commonly used during the admission process, allowing it to provide accurate, relevant, and easy-to-understand responses for prospective students. With these capabilities, the chatbot serves as a virtual assistant that can automatically deliver information quickly and efficiently in response to inquiries about student admissions.

3.1 *System Overview*

This study developed a WhatsApp-based chatbot powered by the GPT-4o mini language model. The chatbot is designed to assist prospective students by answering frequently asked questions related to the new student admission process at Telkom University. Topics covered include registration procedures, admission pathways, document requirements, important schedules, and tuition fee information.

The system architecture consists of several key components:

- WhatsApp Business, serving as the primary interface between users and the chatbot.
- n8n, functioning as the workflow automation tool and middleware that manages message routing and request formatting.
- GPT-4o mini, the natural language processing engine fine-tuned to understand and respond to admission-related inquiries.
- Virtual Private Server (VPS), which hosts the backend infrastructure to run the chatbot and handle data processing.

Users interact with the chatbot via WhatsApp. When a prospective student sends a message, it is forwarded to the backend server, processed by the fine-tuned GPT-4o mini model, and the generated response is delivered automatically and in real time

3.2 *Comparison of New Student Admission Information Systems: Manual vs. LLM Chatbot*

Before the implementation of conversation agent solutions (chatbots) leveraging large language models (LLMs) such as GPT-4o Mini, information management related to new student admission at Telkom University was conventionally handled through manual or traditional rule-based systems. These preceding systems

often involved reliance on administrative staff intervention, printed guides, and static information repositories (FAQs) that necessitated manual search efforts from users. The adoption of this chatbot technology represents a substantial paradigm shift, providing significant enhancements in operational efficiency, information accessibility, and the quality of user interaction.

Table 2 Results of Comparison for New Student Admission Information Systems: Manual vs. Chatbot

No	Feature/ Aspect	Manual Rule-Based System (Previous)	New Student Admission Chatbot	Chatbot Advantage
1	Accessibility & Availability	Limited to staff operating hours or physical accessibility	Available outside manual staff operating hours and operates without breaks (e.g., lunch breaks), via the user-familiar WhatsApp platform.	Optimal Accessibility: Provides information anytime outside manual working hours, without rest interruptions, offering significant flexibility for prospective students.
2	Response Speed	Varies, depending on staff availability, question volume, or user's manual search speed.	Instant. Answers are provided within seconds after a question is asked.	Fast Response: Drastically reduces user waiting time, enhancing instant experience.
3	Answer Consistency	Can vary among staff or depend on individual interpretation of rules/FAQs.	Highly consistent. Answers are generated based on a centralized database	Uniform Information: Ensures every user receives standard and consistent answers
4	Question Coverage & Flexibility	Limited to anticipated and explicitly recorded questions. Questions outside the template are difficult to handle.	Capable of understanding and responding to various question variations, including those not precisely in the FAQ	Contextual Understanding: More adaptive to user language styles and able to infer intent behind questions.
5	Interaction	Rigid, non-interactive, or requires direct	Natural, more dynamic, and	Natural & Comfortable Interaction: Increases user
	Experience	human interaction which can sometimes feel formal.	responsive conversation. Users feel like they are interacting with a virtual assistant.	comfort, making the information search process feel more personal and efficient.
6	Resource Efficiency	Requires many staff members to handle repetitive questions, especially during peak new student admission periods.	Reduces staff workload, allowing them to focus on complex cases requiring human intervention.	Operational Cost Savings: Optimizes human resource allocation and operational costs in the long run.
7	Scalability	Difficult to scale; increased question volume requires significant staff additions or infrastructure.	Easily scalable to handle surges in questions without significant performance degradation.	High Capacity: Efficient in serving thousands of questions simultaneously without bottlenecks.
8	Improvement Potential	Requires manual updates to documents/ staff training periodically.	Capable of learning and being improved through model fine-tuning, data addition, and algorithm updates.	Continuous Learning: Chatbot adaptation and capability improvements can be done more systematically and automatically.

3.3 *Analysis of Scenario Testing Results*

In chatbot development, it is crucial to identify scenarios where the chatbot might fail to provide adequate or accurate responses. These failures often occur when user questions are outside the scope of the available training data (FAQ), or when the questions are ambiguous, too specific, or assume information that the chatbot does not possess. This analysis of failure cases is essential to identify the limitations of the chatbot's capabilities and areas that require further development. Below are several failure scenarios that can occur, along with examples of questions that can be categorized as ambiguous or leading to response failure. Table 3 shows the results from the chatbot scenario testing.

Table 3 results from the chatbot scenario testing

No	Question Scenario	Scenario Description	Example Question	Failure Analysis
1	Questions exactly in the FAQ	Questions whose information is explicitly available or can be directly synthesized from the data in the knowledge base (FAQ file).	"What are the initial steps to register at Telkom University as a new student?"	The chatbot is able to provide accurate, relevant, and satisfactory responses based on the available data
			"What is the difference between the Excellence Scholarship and the Smart Scholarship?"	
2	Questions not in the FAQ	Questions whose topics are outside the scope of the information in the FAQ knowledge base, and there is no relevant data to answer them.	"Does Telkom University provide dormitory facilities or accommodation for new students?"	The chatbot can provide a response but gives an answer that is not consistent with the FAQ new student admission data Here is the answer provided by the chatbot: "Yes, Telkom University provides dormitories. Further details can be found on the Dormitory Facilities page on the official new student admission Telkom website." "This study program offers a balanced understanding of technology and management, collaborating closely with the business world. Supporting courses include Business Research & Analysis, Data-Based Analysis, Managerial Information Systems, and Project Management. Further details are available via the official new student admission link."
			"What are the main courses focused on in the S1 Information Systems study program?"	
3	Questions similar to FAQ but yielding different results (Failure Scenario)	Questions that at first glance seem relevant or as if they can be answered by the FAQ, but in reality, the requested information is too specific, unavailable, dynamic, or contradicts existing policies in the data. This is a potential area of chatbot failure.	"What is the minimum average report card score required to be accepted into the Industrial Engineering major at Telkom University?"	The chatbot can provide a response but gives an answer that is not consistent with the FAQ new student admission data Here is the answer provided by the chatbot: "Those criteria vary by division and major: Business: 70 Science: 75 Engineering: 80 Other: 60." "Independent pathway dates are unannounced. Please check the official new student admission Telkom University website for updates."
			"Can I apply for a deferral of education fees due to financial constraints?"	

3.4 *Results of Fine-Tuning Testing*

The fine-tuning process of the GPT-4o mini model on a specialized dataset for new student admissions was conducted over 288 epochs. The training results are presented through two main graphs: the loss graph and the accuracy graph. In the loss graph, there is a noticeable decline in loss values from the beginning to the end of training. The initially high loss values indicate large errors made by the model at the start of learning, but as epochs progress, the loss generally decreases and stabilizes at a low level. This reflects the model's improving ability to predict outputs that align well with the training data.

Meanwhile, the accuracy graph shows the model's performance improvement in terms of prediction correctness. At the start, accuracy ranged around 40–50%, then gradually increased with some fluctuations, eventually reaching near or above 85% by the end of the fine-tuning process. Despite the fluctuations, the overall trend suggests that the model effectively learns to recognize patterns in the dataset and produces increasingly accurate predictions.

To further evaluate the model's performance, a confusion matrix was utilized as the primary metric for measuring accuracy. The confusion matrix allows detailed analysis by comparing the chatbot's predicted answers with the actual correct answers (ground truth). It categorizes the outcomes into True Positives (correctly predicted correct answers), False Positives (incorrect answers predicted as correct), False Negatives (missed correct answers), and True Negatives (correctly identified incorrect answers).

In our testing, the confusion matrix values were: True Positive (TP) = 85, representing chatbot answers that were correct and aligned with ground truth; False Positive (FP) = 7, representing incorrect chatbot answers mistakenly considered correct; False Negative (FN) = 8, representing missed correct answers by the chatbot; and True Negative (TN) = 10, representing correctly identified wrong answers.

Figure 4 provides a visual representation of the confusion matrix generated during the performance evaluation of the fine-tuned GPT-4o mini model. It clearly illustrates the number of correct and incorrect predictions made by the chatbot when tested against a dataset of new student admission queries. The figure shows 85 true positives, 7 false positives, 8 false negatives, and 10 true negatives, where the color intensity corresponds to the frequency of each outcome. This visualization supports the quantitative results discussed previously, confirming that the model achieved an accuracy of approximately 86.36% and demonstrates reliable performance in classifying relevant and accurate responses.

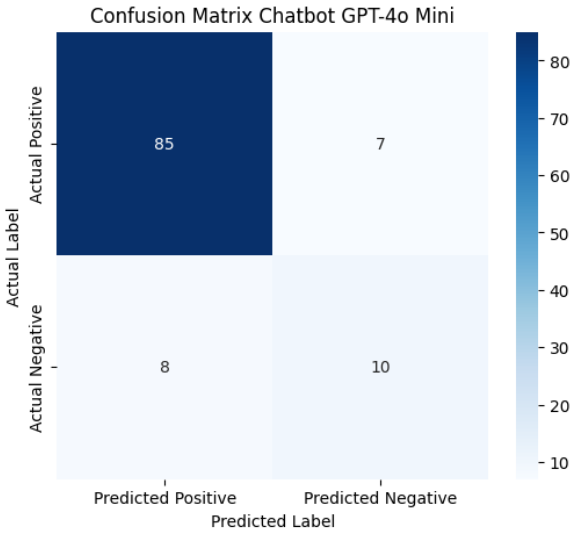

Figure 4 Confusion Matrix of the Fine-Tuned GPT-4o Mini Chatbot

Overall, these results demonstrate that the fine-tuning procedure successfully enhanced the GPT-4o mini model's capability to adapt to the new student admissions domain at Telkom University. The fine-tuned model is expected to deliver more relevant and accurate responses when deployed in the WhatsApp chatbot.

Figure 5 provides a visual representation of the decreasing loss values and increasing accuracy throughout the model fine-tuning process.

Figure 5 Visualization of Decreasing Loss and Increasing Accuracy During Fine-Tuning

3.5 *Analysis of Prompting Strategies*

In developing the new student admission Telkom University chatbot, prompting strategies play a vital role in shaping the quality of interactions between users and the system. Prompting refers to the technique of providing instructions or context to a Large Language

Model to enable it to generate responses that are appropriate, accurate, and relevant to user needs.

In this chatbot implementation, several prompting strategies were analyzed based on conversation patterns and common question types posed by prospective students. Four main strategies were identified.

Table 4 Key Prompting Strategies in the new student admission Telkom University Chatbot

No	Prompting Strategy Type	Brief Explanation	User Prompt (Input)	Example Usage (Chatbot Response)
1	Instruction-based Prompting	Explicitly sets chatbot instructions or role to communicate in a specific style and purpose.	"Hello, who are you?"	"Hi, I'm the new student admission Telkom University Chatbot. Nice to meet you. How can I assist you?"
2	Role-based Prompting	Establishes the chatbot persona or identity to ensure consistent responses in line with its role.	"What's your role here?"	"I'm the official chatbot of new student admission Telkom University. I'm here to assist you with registration and admission inquiries."
3	Knowledge-grounded Prompting	Utilizes pre-existing data or information to accurately answer factual questions.	"What documents are required for registration?"	"For registration through the new student admission pathway, please visit the new student admission pathway information link available on the new student admission Tel-U website. The required documents vary depending on the selection pathway you choose."
4	Contextual/Conversational Prompting	Uses previous conversation context to provide relevant and natural responses.	"What is the tuition fee at Telkom University?"	"Tuition fees are listed per study program. You can find detailed information on the profile page of your chosen program..."
5	Contextual/Conversational Prompting	Uses previous conversation context to provide relevant and natural responses.	"Does Telkom University offer KIP selection pathway?"	"Yes, new student admission Telkom University opens the KIP selection pathway for prospective students from low-income families. Detailed information can be accessed..."

3.6 *Result Training Dataset*

the WhatsApp chatbot training dataset designed to support the New Student Admission process at Telkom University contains a total of 96 data rows. After a cleaning and validation process, it was identified that there are 76 unique and valid Question and Answer pairs that can be used as training data. The remaining 20 rows are duplicates or empty rows irrelevant for training purposes.

From the 76 valid QA pairs, the questions can be categorized into 14 primary intent types. These intents represent various topics and information needs most frequently sought by prospective students during the PMB process.

Table 5 below presents a breakdown of the intent types along with the number of QA pairs associated with each intent:

Table 5 Training Dataset Intent Types

No.	Intent Type (Question Intent)	Number of QA Pairs
1.	Registration Procedure	5
2.	Forgot Registration Account Password	4
3.	Registration PIN Payment	5
4.	Study Program Accreditation	5

5.	Education Fees	4
6.	Definition of Fees (UP3, SDP2, BPP)	5
7.	Withdrawal Procedure	1
8.	Specific Study Program Requirements	6
9.	Document Upload Provisions (Report Card)	4
10.	Registration Data Changes (Report Card/Study Program)	7
11.	Selection & Scholarship Information	9
12.	Exam Schedule & Technicalities, and Admission Announcement	10
13.	Payment & Document Verification Issues	6
14.	Other General Questions (e.g., blacklist)	5

3.7 *Functional Testing*

Functional testing is conducted to ensure that the chatbot performs all of its core features properly and aligns with the intended objectives. This testing focuses on user interactions with the chatbot, including message reception, input processing by the model, and the delivery of responses through the WhatsApp platform.

1. Testing Objectives

The purpose of this testing is to evaluate whether the chatbot is capable of:

- Answering general questions related to new student admissions.
- Responding accurately to greetings and identity-related queries.
- Delivering information concerning institutional policies, such as the KIP scholarship program.
- Maintaining a consistent persona as the official representative of new student admission Telkom University.

2. Testing Methodology

The testing was carried out manually by simulating direct conversations through WhatsApp. Each scenario was tested individually, and the chatbot's responses were analyzed based on the following criteria:

- The relevance of the response to the user's question.
- The clarity and completeness of the information provided.
- The consistency of language style according to the chatbot's identity.

Table 6 below presents a summary of the testing results from several important interaction scenarios.

Table 6 Functional Testing

No	Testing Scenario	Result	Notes
1	Responding to user greetings	Successful	The chatbot introduced itself appropriately
2	Responding to "What is the admission path?"	Successful	Providing a clear explanation of what a selection pathway is
3	Question about tuition fees	Successful	Redirected to the program profile webpage
4	Question about KIP selection path	Successful	Delivered policy-based information accurately

3.8 *User Experience Test*

In the development of chatbots that directly interact with prospective students, such as the Telkom University new student admission support chatbot, data ethics and privacy aspects become fundamental considerations. Given the conversational nature which may contain personal and sensitive information, it is crucial to affirm a commitment to responsible data collection, processing, and storage practices. In this context, it should be emphasized that explicit consent has been obtained from students regarding the processing of their personal data, ensuring compliance with privacy principles.

Subsequently, to evaluate how well the WhatsApp chatbot, powered by the GPT-4o Mini model, meets the needs and expectations of prospective and current students during the new student admission process at Telkom University, User Experience (UX) testing was conducted. This testing aims to measure aspects such as ease of use, clarity of information, response speed, trustworthiness, and overall satisfaction with the chatbot interaction.

A total of 10 respondents participated in this UX testing. These respondents were selected using a purposive sampling technique to represent diverse profiles, consisting of prospective students and active students of Telkom University, members of the general public, and staff from the admissions office. The sample included individuals from various academic backgrounds and various admission stages (e.g., early inquiry, registration, document submission).

The following 10 questions were used to collect feedback from users:

1. Do you find the chatbot easy to use for obtaining information about the new student admission?
2. How clear and easy to understand are the answers provided by the chatbot to your questions?
3. Does the chatbot respond quickly when you ask a question?
4. To what extent do you trust this chatbot as an official information source from Telkom University?
5. Does the chatbot help you save time compared to searching for information manually?
6. How comfortable are you interacting with the chatbot compared to human information services?
7. Do you feel the chatbot can handle various types of questions you asked during the admission process?
8. How satisfied are you with the consistency of the chatbot's language style and tone during interactions?
9. Did you experience any difficulties or confusion while using the chatbot? If yes, please explain.
10. How likely are you to recommend this chatbot to other prospective students?

The survey questions aimed to assess the effectiveness of the GPT-4o Mini-powered WhatsApp chatbot in delivering admission information, the ease of use experienced by users, and their overall satisfaction. The results of the survey are presented in Figure 6.

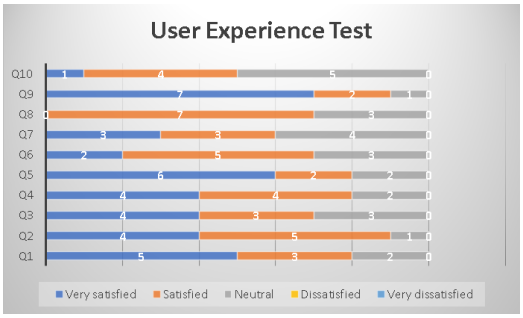

Figure 6 User Experience Test

3.9 *Iterative Improvement*

Feedback from prospective students indicated that the chatbot was sufficiently responsive and easy to use in delivering information related to the admission process. However, some limitations were found in accurately interpreting user intent in certain cases, highlighting the need to improve the model's contextual understanding. The implementation of caching helped reduce response times, although system stability under high user load remains a challenge that needs further optimization. Since the chatbot operates through the WhatsApp platform, which is already familiar to users, the user interface was not identified as a concern and does not require further enhancement. Overall, the chatbot has performed well in supporting the new student admission process, though continuous refinement is still needed to improve accuracy and reliability.

4. Conclusion

The WhatsApp chatbot based on GPT-4o Mini, which has undergone a specialized fine-tuning process, was successfully developed to support the new student admission process at Telkom University. This chatbot enhances the accuracy and relevance of responses in answering various inquiries from prospective students, thus facilitating a smoother admission information service. The system is integrated with the WhatsApp Business API, Webhook, and the n8n automation platform, and is hosted on a VPS to ensure stable and efficient communication.

By automating interactions and providing fast and consistent responses, the chatbot helps reduce the workload of the Telkom University new student admission staff while increasing user satisfaction. Further development is still needed through periodic dataset updates, response optimization to minimize latency, and scalability testing to maintain optimal performance under various usage conditions.

With these improvements, the chatbot is expected to become an adaptive and effective tool in supporting Telkom University's new student admission process.

References

[1] I. K. Bakti, A. Yarun, and H. Syafaq, "The Role of Artificial Intelligence in Education: A Systematic Literature Review," *J. Iqra' Kaji. Ilmu Pendidik.*, vol. 8, no. 2, pp. 182–197, 2023.

[2] M. N. Syuhra, N. E. Chandra, and E. Rosalina, "Artificial Intelligence in English Language Teaching : A Systematic Literature Review of Tools , Impact , and Challenges," *Voices English Lang. Educ. Soc.*, vol. 9, no. 1, pp. 193–205, 2025.

[3] C. W. Okonkwo and A. Ade-ibijola, "Computers and Education : Artificial Intelligence Chatbots applications in education : A systematic review," *Comput. Educ. Artif. Intell.*, vol. 2, no. 100033, pp. 1–10, 2021, doi:

10.1016/j.caeai.2021.100033.

[4] W. Yee, W. Lai, and J. S. Lee, “Computers and Education : Artificial Intelligence A systematic review of conversational AI tools in ELT : Publication trends , tools , research methods , learning outcomes , and antecedents,” *Comput. Educ. Artif. Intell.*, vol. 7, no. August, p. 100291, 2024, doi: 10.1016/j.caeai.2024.100291.

[5] Y. Albadarin, M. Saqr, N. Pope, and M. Tukiainen, “A systematic literature review of empirical research on ChatGPT in education,” *Discov. Educ.*, vol. 3, no. 60, pp. 1–26, 2024, doi: 10.1007/s44217-024-00138-2.

[6] DataReportal. "Digital 2023 global overview report" DataReportal.com (We Are Social & Meltwater), 2023. [Online]. Available: https://datareportal.com/reports/digital-2023-global-overview-report

[7] A. A. Arifiyanti, I. F. Daniar, R. Permatasari, A. Rezha, and E. Najaf, “Designing Flow-Based Chatbot as Student Information Service Center,” *Int. Semin. Res. Mon. 2023*, vol. 2024, no. 8, pp. 123–130, 2024, doi: 10.11594/nstp.2024.4121.

[8] A. M. Bettayeb, M. A. Talib, A. Z. S. Altayasinah, and F. Dakalbab, “Exploring the impact of ChatGPT : conversational AI in education,” *Frontiers (Boulder).*, vol. 4, no. July, pp. 1–16, 2024, doi: 10.3389/feduc.2024.1379796.

[9] R. D. Aryanti and M. H. Santosa, “A Systematic Review on Artificial Intelligence Applications for Enhancing EFL Students ’ Pronunciation Skill,” *Art Teach. English as a Foreign Lang.*, vol. 5, no. 1, pp. 102–113, 2024.

[10] A. DROBNJAKa, I. BOTICKI, P. SEOWb, and K. KAHN, “Learning with Conversational AI and Personas : A Systematic Literature Review,” *Proc. 31st Int. Conf. Comput. Educ.*, pp. 1003–1008, 2023. [11] A. Al-Barrak, "The role of AI chatbots in higher education," *Computers & Education*, vol. 165, 2021, Art. no. 104140, doi: 10.1016/j.compedu.2021.104140.

[12] D. Al-Mallah, I. A. Aljazaery, H. T. H. S. ALRikabi, and H. A. Mutar, "Cloud computing and its impact on online education," *IOP Conference Series: Materials Science and Engineering*, vol. 1094, no. 1, 2021, Art. no. 012024, doi: 10.1088/1757-899x/1094/1/012024.

[13] M. Cieliebak, N. Tchalakova, and R. Mohamad, "AI chatbots in education: Reducing workload and increasing satisfaction," *Journal of Educational Technology & Society*, vol. 24, no. 1, pp. 45–59, 2021.

[14] A. Y. Eskaluspita, "ISO 27001:2013 for Laboratory Management Information System at School of Applied Science Telkom University," *IOP Conference Series: Materials Science and Engineering*, vol. 879, no. 1, 2020, Art. no. 012074, doi: 10.1088/1757-899x/879/1/012074.

[15] A. Hsain and H. E. Housni, "Large language model-powered chatbots for internationalizing student support in higher education," *arXiv preprint arXiv:2403.14702*, 2024, doi: 10.48550/arxiv.2403.14702.

[16] F. Koto, N. Aisyah, H. Li, and T. Baldwin, "Large language models only pass primary school exams in Indonesia: A comprehensive test on IndoMMLU," *arXiv preprint arXiv:2310.04928*, 2023, doi: 10.48550/arxiv.2310.04928.

[17] R. Kumar, A. Gupta, and S. Singh, "Implementing AI chatbots for student support services," *International Journal of Educational Management*, vol. 36, no. 3, pp. 450–468, 2022, doi: 10.1108/IJEM-06-2021-0229.

[18] N. R. Moşteanu, "Building a sustainable future: How intelligent automation is transforming higher education’s sustainability efforts," *E3S Web of Conferences*, vol. 420, 2023, Art. no. 10009, doi: 10.1051/e3sconf/202342010009.

[19] A. Nurshatayeva, L. C. Page, C. C. White, and H. Gehlbach, "Proactive student support using artificially intelligent conversational chatbots: The importance of targeting the technology," *EdWorkingPapers.Com*, 2020. [Online]. Available: https://edworkingpapers.com/ai20-208

[20] J. Odede and I. Frommholz, "JayBot – Aiding university students and admission with an LLM-based chatbot," in *Proc. 2024 ACM Conf. Intelligent User Interfaces*, 2024, p. 391, doi: 10.1145/3627508.3638293.

[21] P. F. Oliveira and P. Matos, "Introducing a chatbot to the web portal of a higher education institution to enhance student interaction," in *Proc. 2023 International Conference on Applied Sciences, Engineering and Computing*, 2023, p. 128, doi: 10.3390/asec2023-16621.

[22] H.-Y. Park, "Application of ChatGPT for an English learning platform," *STEM Journal*, vol. 24, no. 3, pp. 30–38, 2023, doi: 10.16875/stem.2023.24.3.30.

[23] H. P. Tiwari, "Artificial intelligence in the classroom: Revolutionizing English language teaching," *Journal of English Teaching and Linguistics Studies (JET Li)*, vol. 6, no. 1, pp. 42–51, 2024, doi: 10.55215/jetli.v6i1.9757.

[24] UNESCO. "Artificial intelligence in education: Challenges and opportunities for sustainable development", (Education Sector Policy Paper). Paris: UNESCO Publishing, 2022. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000380602

[25] Z. Wang, N. Keyes, T. L. Crawford, and J. D. Choi, "InterviewBot: Real-time end-to-end dialogue system to interview students for college admission," *arXiv preprint arXiv:2303.15049*, 2023, doi: 10.48550/arxiv.2303.15049.