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The Use of AI-based Virtual Assistant to Support Islamic Religious Education and Digital Literacy in Labschool Elementary School

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ABSTRACT

This study aimed to assess the implementation of an artificial intelligence-based virtual assistant to support Islamic religious education and enhance digital literacy at Labschool Elementary School. The research employed a comprehensive approach, including literature review, system design, virtual assistant development, simulation implementation, and evaluation. The virtual assistant, named SchoolPal, was meticulously developed and integrated with the advanced GPT-4-32K model on the Telegram platform. The evaluation of SchoolPal's performance revealed its remarkable ability to deliver accurate and relevant responses across a wide range of questions. Moreover, students at Labschool Elementary School demonstrated a noticeable improvement in their understanding after engaging with SchoolPal. The findings highlight the tremendous potential of this artificial intelligence-based virtual assistant in effectively supporting and enriching the learning experience at Labschool Elementary School.

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1. INTRODUCTION

Developing a well-educated workforce through high-quality educational processes is a crucial goal. However, the current education system faces some challenges, including the slow pace of learning and an overemphasis on rote memorization (Tabroni, 2021). To address these issues, innovative approaches leveraging advances in technology and pedagogy warrant exploration.

As we find ourselves in the midst of the transformative Fourth Industrial Revolution, characterized by rapid technological change and the integration of digital technologies across many societal domains, including education (Lestari & Lingga, 2024). This era presents new opportunities to reimagine and redesign the learning experience. Emerging technologies like automation, artificial intelligence, and the Internet of Things can enhance the effectiveness and efficiency of education.

Within this context, educational technology emerges as a powerful tool for driving educational reform and learner-centered approaches. By systematically applying relevant resources, educational technology aims to optimize student performance and enrich the quality of teaching (Mesra et al., 2023).It enables educators to develop dynamic, interactive learning environments that cultivate skills like critical thinking, problem-solving, and creativity. Through integrated technology and effective teaching methods, learners can engage with content in beyond the traditional constraints of time and place.

One promising application of technology is the use of virtual assistants. These intelligent programs, powered by artificial intelligence algorithms, can interact with learners through chat interfaces to provide real-time support and guidance. By simulating human conversation, virtual assistants can address individual needs, offer personalized feedback, and deliver targeted resources. They serve as digital companions empowering self-directed, interactive exploration and acquisition of knowledge.

By leveraging virtual assistants as alternative learning media, educators can harness automation, artificial intelligence, and opportunities of this revolutionary era to foster more efficient, engaging learning experiences. These technologies allow learners flexible access to educational resources anytime and anywhere on their own schedule. Moreover, virtual assistants can help connect theoretical and applied knowledge, facilitating more profound comprehension and real-world contexts. An institution like UPI Laboratory School could greatly benefit from such an approach, particularly Labschool Elementary School of UPI Purwakarta. While UPI Laboratory School provides an ideal education for Indonesia's best students overall, with modern facilities, superior programs, and professional teachers, learning at Labschool Elementary School of UPI Purwakarta specifically is semi-conventional (Sekolah Laboratorium - UPI, 2023). Introducing a virtual learning assistant targeted towards the students could therefore be integral in helping them keep pace with technology's evolving role in education and information discovery. A virtual assistant could better engage these students and harness new technologies for more personalized learning experiences at their institution.

2. METHODS

Prior to data collection, a comprehensive literature review was conducted to explore existing works related to virtual assistants. Academic databases including Google Scholar were searched using the keywords "Virtual assistant" to identify relevant articles published between 2021-2023. Additional searches combined this keyword with terms like "Islam" to

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expand the scope of findings. After screening the results, two research questions were formulated to guide the study:

1) RQ1: What domains or industries have seen applications of virtual assistants?
2) RQ2: What platforms do end-users typically access virtual assistants through?

The implementation method of this activity is divided into 3 stages, namely the preparation stage, implementation stage and evaluation stage (Agung et al., 2023). The explanations of these stages are as follows:

2.1. Preparation Stage

The initial phase focused on establishing the theoretical and practical foundations for an effective research process. This began with a comprehensive literature review to explore previous work related to artificial intelligence-based virtual assistants and module design approaches.

Concurrently, the research team engaged in consultations with Labschool Elementary School administrative staff. The target population was identified as 4th, 5th and 6th grade students. From these cohorts, a representative sample of 30 students was recruited, with 10 from each grade level to control for variability in competencies.

Logistical arrangements were also addressed during the preparation phase. Venue selection and technical requirements for minimizing disruptions were evaluated. Provisions for refreshments and ensuring participant comfort during sessions were likewise coordinated.

Completing these front-end activities around conceptual grounding, population scoping, and operational planning established robust groundwork to structure subsequent implementation and evaluation phases. The preparation phase created an optimized environment for the research to achieve its aim of assessing SchoolPal's educational viability.

2.2. Implementation Stage

Our research team conducted a small-scale study to evaluate the potential impact of interactions with SchoolPal. Thirty 4th-6th grade students from Labschool Elementary participated. Students were then introduced to SchoolPal through a structured lesson incorporating three methods:

1) Presentation method: Presentations provided fundamental background on AI, virtual assistants and SchoolPal's application.
2) Question and answer method: An interactive question and answer session allowed students to actively clarify concepts.
3) Simulation method: Hands-on simulations provided practical experience applying SchoolPal to explore an educational topic.

2.3. Evaluation Stage

At this stage, the research team will conduct a comprehensive assessment of all activities implemented during the previous phase. Participants will complete questionnaires to collect feedback on their experiences. Questions will evaluate respondents' understanding of materials presented and ability to apply concepts through simulations. The questionnaires aim to gather data on participants' insights gained as well as the extent to which interactions increased comprehension.

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Responses will be analyzed both quantitatively and qualitatively. This will provide an objective measure of variations in outcomes, as well as nuanced perspectives from open-ended questions. The overall goal of evaluation is to analyze both the implementation process and its impacts based on participant reports. This will help determine the effectiveness of methods used and identify areas for future improvement. Outcomes can then inform further development and delivery of educational training with SchoolPal.

3. RESULTS AND DISCUSSION

This research use literature review with any references. This literature riview can be seen **table 1**.

Table 1. Results of the literature review.

No	References	RQ1	RQ2
1.	Lestari & Lingga (2024). Implementasi Fitur Assistance Virtual Sebagai Media Pembelajaran Interaktif. *Jurnal RESTIKOM: Riset Teknik Informatika dan Komputer*, *5*(1), 46-54.	Education.	Website
2.	Adi et al. (2022). *Virtual assistant* Pusat Informasi Mahasiswa Berbasis Android Menggunakan Flutter. *Research in Technical and Vocational Education and Training*, *1*(2), 79-90.	Virtual assistant designed for student information center demonstrates education application.	Website
3.	Khanifudin et al. (2023). AVIBOT: Assistant Virtual Pengelolaan Persediaan Obat pada Apotek Mitra Sehat Purwokerto. In *Prosiding Seminar Nasional Penelitian dan Pengabdian Kepada Masyarakat* (Vol. 1, No. 1, pp. 163-167).	Healthcare industry, specifically to assist in medicine inventory management at pharmacies.	Google Dialogflow
4.	Bariyah & Imania (2022). Pengembangan *Virtual assistant* Chatbot Berbasis Whatsapp Pada Pusat Layanan Informasi Mahasiswa Institut Pendidikan Indonesia-Garut. *Jurnal Pendidikan Teknologi Informasi Dan Komunikasi*, *8*(1), 66-79.	Virtual assistant showcases educational application through student information center design.	WhatsApp
5.	Kamaruddin (2023). Systematic literature review on development of Biology learning module through bot telegram application for Matriculation students: Kajian literatur bersistematik ke atas pembangunan modul pembelajaran Biologi melalui aplikasi telegram bot bagi pelajar Matrikulasi. Jurnal Pendidikan Sains Dan Matematik Malaysia, 12(2), 39–50. https://doi.org/10.37134/jpsmm.vol12.2.3.2022	Education.	Telegram
6.	Winarti et al. (2023). Pengenalan aplikasi chatbot berbasis teknologi artificial intelligence menggunakan aplikasi ChatGPT pada MAN 1 Kota Tangerang Selatan. Abdi Jurnal Publikasi, 1(6), 644-649. https://jurnal.portalpublikasi.id/index.php/AJP/index	Learning medium in education.	LINE, Facebook Messenger, Slack, Skype, and other messaging platforms

Based on the results of the literature review, it is evident that artificial intelligence-based virtual assistants have been implemented in the fields of education and health, as demonstrated by the studies conducted by (Adi et al., 2022; Bariyah & Imania, 2022; Kamaruddin, 2023; Khanifudin et al., 2023; Lestari & Lingga, 2024). These studies highlight

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the utilization of virtual assistants in various contexts such as interactive learning, student information centers, medicine inventory management, and module development.

In the realm of education, the literature review reveals that virtual assistants have been predominantly accessed through websites requiring user accounts for login, as mentioned by (Adi et al., 2022; Kamaruddin, 2023). However, it is worth noting that Telegram has emerged as a promising platform for integrating virtual assistants in the education sector. Kamaruddin (2023) emphasize the advantages of using Telegram over WhatsApp, citing better safety features and comprehensive bot creation, maintenance, and usage updates.

Building upon the existing literature, the authors and research team aim to contribute to the field by developing an innovative artificial intelligence-based virtual assistant. This virtual assistant will be integrated with GPT-4-32K and Telegram, leveraging the platform's superior features and enhanced security measures for an optimized learning experience in the education domain.

By combining the insights from the literature review with the proposed research direction, this study aims to advance the field of virtual assistants in education and provide a novel solution that harnesses the potential of artificial intelligence and Telegram to facilitate seamless and secure learning interactions.

3.1 Development Planning for an AI-Powered Virtual Assistant

3.1.1 Needs Assessment for SchoolPal Development

The development of SchoolPal began with a needs analysis phase. This involved consultations with education experts and school administrators to understand user requirements. Meetings were held with Mr. Dea Ariana Vamitrianto, Principal of SMK Pertiwi Kuningan Vocational School and founder of the technology-based tutoring service for early childhood, kindergarten and elementary schools called BimJar Al-Nabil. His experience developing elementary curriculum, especially technology-integrated lessons, provided valuable insight.

We also consulted Mr. Mochamad Kosim, Principal of MTS Pertiwi Kuningan. The goal was to gain perspective on challenges faced by Labschool elementary students in comprehending subject materials. Discussions with Mr. Dea Ariana Vamitrianto focused on the elementary curriculum, learning objectives and difficulties encountered. His views informed determination of features needed for SchoolPal to better facilitate understanding.

Input from Mr. Mochamad Kosim also aided identification of opportunities for an AI tutor to supplement learning. Continued collaboration will help ensure SchoolPal appropriately caters to student needs based on the curriculum. This front-end assessment established a solid foundation for subsequent development based directly on requirements.

3.1.2 Evaluating Potential Messaging Platforms

Prior to selecting Telegram as the platform for SchoolPal's user interface, we conducted user research among 30 students from Labschool Elementary School on October 12, 2023 from 8:00 AM to 8:30 AM. The target audience was 10 representative students each from the 4th, 5th and 6th grade classes, totaling 30 students. Through a Google Form survey with two questions, we gathered data on which messaging platforms the students currently used and preferred for interacting with an educational bot. The questions were:

1) If an educational bot was available on both WhatsApp and Telegram, which messaging app would you want to use to access the bot?

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2) What is the main factor that would influence your choice of messaging app to access an educational bot?

We found that 28 of the 30 students already had the Telegram app installed on their phones and used it regularly. 29 students voted for Telegram rather than WhatsApp. Most answered that they chose Telegram due to how easy it is to use or add a bot, rather than WhatsApp which is harder because they have to save the bot's number. Based on this research data, Telegram was selected as the platform for SchoolPal's user interface.

3.1.3 System Design

During this stage, we defined the overall system architecture and technical design that will be implemented in SchoolPal. The system architecture includes the following components:

1) User Interface:
   SchoolPal utilized Telegram as its user interface platform based on research among 30 4th-5th-6th grade students at Labschool Elementary School, which found that 28 already used Telegram regularly on their phones and 29 students preferred it to WhatsApp for accessing an educational bot due to Telegram allowing direct access and interaction without needing to save contact numbers first, providing a more seamless experience than WhatsApp. By leveraging Telegram's existing popularity and straightforward integration capabilities for accessing bots through searches and direct messaging, as well as its readily available APIs, SchoolPal aims to maximize student engagement with its chatbot services through an intuitive interface built on a familiar platform.
2) Library:
   SchoolPal is built using several Python libraries, including Telebot, Requests, JSON, OS, and Datetime. The core library is Telebot, which serves as a wrapper for the Telegram Application Programming Interface (API). Telebot allows developers to interface with Telegram's API and control interactions between users and SchoolPal. By enabling communication with the Telegram API, Telebot is integral in powering SchoolPal's chat functionality and conversational abilities within the Telegram messaging platform.
3) GPT-4-32K Model:
   SchoolPal leverages OpenAI's GPT-4-32K language model. As the latest iteration of OpenAI's GPT technology, the GPT-4-32K features 32,000 tokens, allowing it to more effectively reason about context and provide high-quality responses. With its enhanced capabilities for natural language understanding and generation compared to prior GPT versions, the GPT-4-32K powers SchoolPal's human-like conversational abilities and helps ensure intelligible, appropriate interactions for assisting students with their academic needs.
4) Utils Module:
   The utils.py module plays an important supporting role in SchoolPal's development and functionality. This module contains various utility functions that are integral to the application's back-end operations. Key among these are functions for sending messages via the Telegram API, managing authorization tokens, and other infrastructure-level tasks. By handling lower-level processing needs, the utils.py module allows SchoolPal's core conversational abilities and student-assistance functions to run seamlessly. It provides a foundation of utility support that is crucial for powering SchoolPal's interactions on the Telegram platform.

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5) API Integration:
   SchoolPal is integrated with the Proxy and Telegram APIs. The Proxy API serves an important role by replacing SchoolPal's OpenAI API key. This allows the application to leverage OpenAI's GPT-4-32K model through the Proxy API from various locations while still protecting the sensitive API key. Using the Proxy API in this manner enables free and open access to the powerful GPT-4-32K model for assisting users. SchoolPal also interfaces with the Telegram API via the Telebot Python library, allowing it to communicate with users through this popular messaging platform. These backend API integrations are crucial as they connect SchoolPal to the computational modeling and user interfaces necessary to deliver an engaging and helpful educational assistant.

3.2 Implementation of the SchoolPal Virtual Assistant

At this stage, SchoolPal was developed by connecting it to GPT-4-32K using the Proxy API and integrating it with the Telegram platform for user interactions. The main steps taken were:

3.2.1 Library Selection

To build the core functionalities of SchoolPal, we evaluated several Python libraries that would support integrating with messaging platforms and storing user data. The key selection criteria included compatibility with the Telegram API, easing HTTP requests, and facilitating data processing and storage. After reviewing options, we selected the following libraries:

1) Telebot: As the primary integration library, Telebot allows us to easily send/receive messages, manage commands, and handle inline requests directly through the Telegram API.
2) Requests: Used alongside Telebot, Requests simplifies making HTTP calls to Telegram's API endpoints for authentication and exchanging data.
3) JSON: Given the need to store chat histories locally on the server, JSON provides a straightforward way to serialize user data into structured files
4) OS: For basic filesystem operations such as creating directories, OS handles system-level tasks related to data storage.
5) Datetime: To time-stamp chat records as they are processed, Datetime supplies methods for retrieving timestamps in a standardized format.

3.2.2 Registering the SchoolPal Bot

To enable interaction with users via Telegram, we need to register a bot account:

1) Using the Telegram client, we initiated a conversation with BotFather, Telegram's official bot for managing other bots.
2) BotFather provides instructions for registering a new bot, which involves specifying a bot name and username. We chose names reflective of the SchoolPal purpose and brand, which is “schoolpal_bot”.
3) registering, BotFather immediately provided us with an authentication token unique to our new SchoolPal bot.
4) We securely stored the authentication token for later use in authorizing requests from our Python code to the Telegram API on behalf of the SchoolPal bot.

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5) Having obtained our authentication token through the Telegram registration process with BotFather, we were now ready to begin programming the bot's core functionality using the token for API identification.

This stage established our SchoolPal bot's identity on Telegram and secured the authorization we needed to control it programmatically and allow users to interact with it for chat assistance purposes.

3.2.3 Setting Up the Development Environment

Now that we had registered our SchoolPal bot, the next step was to build out the Python codebase:

1) We initialized a new Python project to contain the SchoolPal application code. This would serve as the foundation and organization for our development work.
2) Using pip, Python's package management system, we installed the required third-party libraries identified during system design. This included Telebot for Telegram integration, Requests for HTTP functionality, and JSON, OS, and Datetime for core application needs.
3) We took care to pin the exact library versions used to ensure a reproducible and stable development environment.

With our development environment and dependencies now in place, we were ready to begin implementing the core bot functionality using our authenticated SchoolPal identity on Telegram's platforms. This stage set us up for structured and organized development.

3.2.4 Integrating the Large Language Model Through a Proxy API

To power SchoolPal's conversational abilities, we chose to leverage the latest pre-trained GPT-4-32K model via a proxy API service.

1) We selected a reputable proxy provider considering factors like performance, security and availability, in this case, we used FakeOpen.
2) After obtaining authentication credentials from the provider, we configured our Requests calls to direct to the proxy's endpoint URL instead of OpenAI's public URL.
3) This abstracted away the underlying model and provided a consistent interface to leverage the capabilities of GPT-4-32K through the proxy service.

By utilizing a proxy API, we gained programmatic access to state-of-the-art language models while avoiding direct access issues or resource constraints of interfacing with OpenAI directly. This was a key enabler of our conversational tutoring goals.

3.2.5 Developing the SchoolPal Codebase

We began implementing the core application code across multiple Python modules:

1) A main.py file served as the application entrypoint and housed initialization logic.
2) Utility functions were defined in utils.py for common tasks like parsing Telegram updates.
3) The core Telegram bot logic and handlers were defined in init.py.
4) We imported our configured third-party libraries across all modules
5) Within utils.py, we instantiated our Telebot object using the authentication token.
6) Command handlers were defined following Telegram best practices to respond to bot commands like /start, /history and /reset.
7) Role prompts and inline handlers were implemented to handle main bot conversations.
8) After that, we integrated the handlers with the GPT-4-32K functions.

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3.2.6 Managing Conversation History

To maintain context across user sessions, we implemented local conversation history storage:

1) Each user is assigned a locally stored folder named after their Telegram ID
2) Within each user's folder sits a history.json file storing conversations in JSON format.
3) Conversation data takes the form of an array of objects, where each object represents a turn.
4) Turn objects contain the sender's role and conversation text.
5) Our core conversation handler writes each new turn to history.json as an object in the array.
6) It also reads the stored history array when resuming a conversation.
7) Together, these steps neatly package history by user and serialize structured turn
8) Users can export their conversation context via the /history command.

This stores not just individual messages but full context threads. By integrating history management into our core bot workflows, SchoolPal is able to provide a persistent, conversational experience that progresses naturally across user sessions.

2.2.7 Configuring for the Target User Profile

Given SchoolPal's focus on delivering age-appropriate Islamic education content, several configurations were made to tailor the experience:

1) Ethos Setting: A "system" conversation role was defined to outline appropriate discussion guidelines focused on ethics, relevance and avoiding sensitive/adult topics unsuitable for young learners.
2) Temperature: The language model temperature was calibrated to promote responses focused more on relevancy versus uniqueness, by steering away from obscure, ambiguous or overly creative replies.
3) Vocabulary Filter: A positivity filter replaced words like "cannot" with more encouraging alternatives like "not yet able to" in order to nurture students' growth mindsets.

These special settings helped establish educational norms for discussions while still allowing open-ended questions. Model calibration aimed conversations at the target comprehension level and topics of Elementary-level Islamic instruction. Overall, the interface and underlying configurations regarding content, complexity and tone of voice were designed specifically for young students exploring their faith within a guided yet flexible learning experience.

2.2.8 Launching The SchoolPal Bot

With development complete, we were ready to deploy our chat bot:

1) Within the main application file, we called the start_polling() method on our Telegram bot object.
2) This kicked off an asynchronous polling process to continuously check Telegram's servers for any new updates like messages, commands or other events targeted at our bot.
3) Once started, SchoolPal would remain running indefinitely to handle conversations in real-time as users engaged with it on Telegram.

By activating the core polling mechanism, we transformed SchoolPal from a codebase into an actively functioning cloud service available to our target audience. This marked the

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completion of our conversational Islamic tutoring assistant. Next, functional testing of SchoolPal was conducted by evaluating user interactions. The key steps undertaken were:

2.2.9 Validating Core Features

To ensure proper operation, we conducted rigorous testing of SchoolPal's key capabilities:

1) Command Testing: The /start command was invoked to validate the welcome flow and messaging.
2) History Retrieval: By issuing /history requests, we confirmed the bot could access stored conversation context from previous sessions.
3) Session Reset: The /reset path was exercised to verify it cleared discussion history and reset the user experience seamlessly
4) Conversation Testing: Sample user messages were sent to verify the bot engaged helpfully and on-topic via its natural language conversation abilities.
5) Inline Interactions: We triggered inline queries to SchoolPal to check it could respond appropriately without requiring direct outreach from users.

2.2.10 Validating Language Model Responses

A key focus of our testing was evaluating the response quality from GPT-4-32K:

1) Accuracy Validation: We conducted methodical conversations to verify responses directly answered users' questions, statements or dialogue prompts accurately.
2) Diversity Evaluation: Testing explored the range and variation in responses produced across an extensive set of diverse conversation pathways and stimuli.
3) Difficult Question Handling: To challenge the model, we engaged it with deliberately obscure, nuanced or complex subject matter to gauge its limits and observe how gracefully it handles uncertainty.

2.2.11 Evaluating Boundary Management for Elementary School Students

1) Assessing Content Filters: Edge cases involving restricted words, topics, media or other potentially objectionable stimuli were exposed to check proper moderation by SchoolPal's filters and configurations for elementary school audiences.
2) Ensuring Ethical Stewardship: We deliberately prompted the bot with unadvisable questions, statements or conversational directions to validate its ability to remain courteous while steering discussions firmly back within alignment of its ethical and topical mandates for elementary school students.

Any detected filter or handler shortcomings were remedied to guarantee elementary school students would consistently receive guidance reflecting educational wisdom and safety. This evaluative process around complex special situations helped shore up SchoolPal's defenses to avoid unintended exposure to inappropriate influences outside its remit of elementary Islamic scholarship for young learners.

2.2.12 Conducting Performance Validation

1) Response Time Benchmarking: Automated tools measured average response latencies under varying simulated user loads to ensure interactions remained smoothly interactive.

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2) Load Capacity Evaluation: Strenuous load testing exposed SchoolPal to intensive concurrent usage patterns modeling burst event scenarios, validating it could maintain expected service levels even under heavy demand.
3) Error Monitoring: Telemetry was analyzed for errors or failed requests to identify and remediate any bottlenecks impeding SchoolPal's ability to serve students dependably.

This phase helped optimize performance, substantiate SchoolPal could scale to growing requirements over time, and maintain consistent satisfactory user experiences.

By thoroughly characterizing SchoolPal's response profile, we delivered assurance it was fit to robustly serve students for the long term.

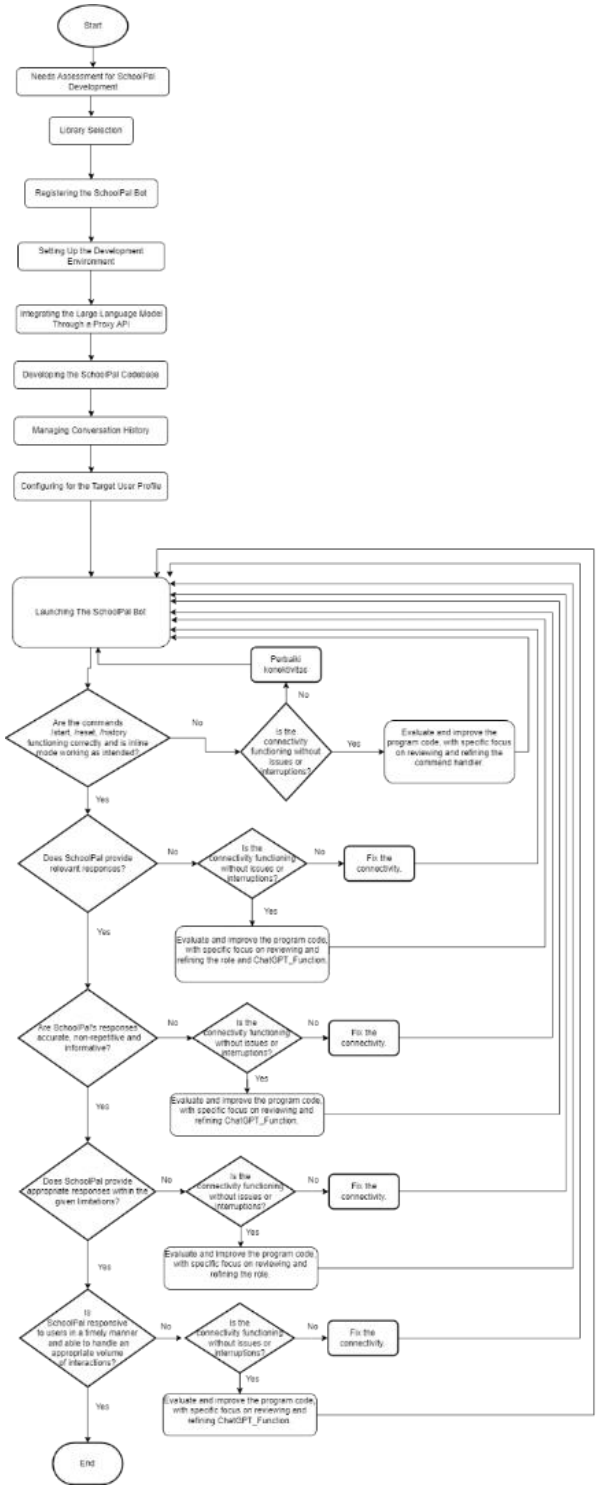

Figure 1. Flowchart of developing schoolpal

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3.3 How SchoolPal Works

The following is how SchoolPal, an artificial intelligence-based virtual assistant, works:

3.3.1 Utilizing Essential Software Libraries

The initial step in how SchoolPal functions is leveraging key Python libraries to enable its operations.

1) Telebot library allows SchoolPal to communicate with users via the Telegram messaging platform.
2) Requests library powers the interface with the API proxy for accessing the underlying language model.
3) JSON library facilitates serialization of conversational sessions and data into standardized storage format.
4) OS library offers file handling capabilities for data input/output operations.
5) Datetime library provides functionality for time-related tasks like timestamping events.

3.3.2 Connecting to GPT-4-32K Through Proxy API

A critical function of how SchoolPal operates is interacting with the natural language capabilities underlying its conversational abilities:

1) Proxy API Connection: SchoolPal leverages an API proxy to interface with OpenAI's GPT-4-32K model in a managed manner.

3.3.3 Message Handling

1) Message Reception: Users can initiate interactions by sending messages to SchoolPal within Telegram.
2) Event-driven Routing: SchoolPal utilizes handler functions to examine message contents and route each event to the appropriate workflow.
3) Command Parsing: Specific handlers detect commands like "/start" and designated keywords to trigger predefined actions.
4) When SchoolPal receives a message, it checks the message type and directs the message to the appropriate handler for processing.
5) SchoolPal receives messages from users then directs them to the handler.
6) The handler handles messages and SchoolPal's role functions.

3.3.4 Processing Messages with GPT-4-32K

A core function of SchoolPal is leveraging generative dialogue through GPT-4-32K:

1) Model Integration: Via the Proxy API, student messages are forwarded to the language model for context-aware response formulation.
2) Request Parsing: Messages conform to the API standard and include relevant session details to maintain coherence.
3) Response Generation: GPT-4-32K processes the text to produce a respectful, on-topic reply drawing from its vast language knowledge
4) Response Retrieval: SchoolPal fetches the formulated response from the completion provided by the Proxy API.
5) Delivery Management: The response is formatted as needed before SchoolPal returns it to the student via Telegram, closing the conversational loop.

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This integration of a powerful language model allows SchoolPal to demonstrate human-level discussion abilities while maintaining a consistent learning-focused interaction. Student engagement and comprehension are thereby enhanced.

3.3.5 Storing Dialogue Context

To facilitate coherent, seamless discussions over time, SchoolPal preserves conversational exchanges:

1) Data Schema: Using JSON format, interactive sessions are recorded programmatically.
2) Object Modeling: Each new message/response pair is encoded as an individual object within the collection.
3) History Aggregation: These objects accumulate over time into a complete log representing the linear dialogue.
4) Context Preservation: Stored exchanges inform future interactions by providing GPT-4-32K awareness of discussion topics, questions asked/answered, and interactive references made.
5) Resilience: The history facilitates picking up seamlessly from where users left off regardless of time elapsed or access channel used.

By systematically archiving dialogue content and progression, SchoolPal maintains an informative basis for consistent, thoughtful responses attuned to individuals' specific learning characteristics and needs, see **figure 1**.

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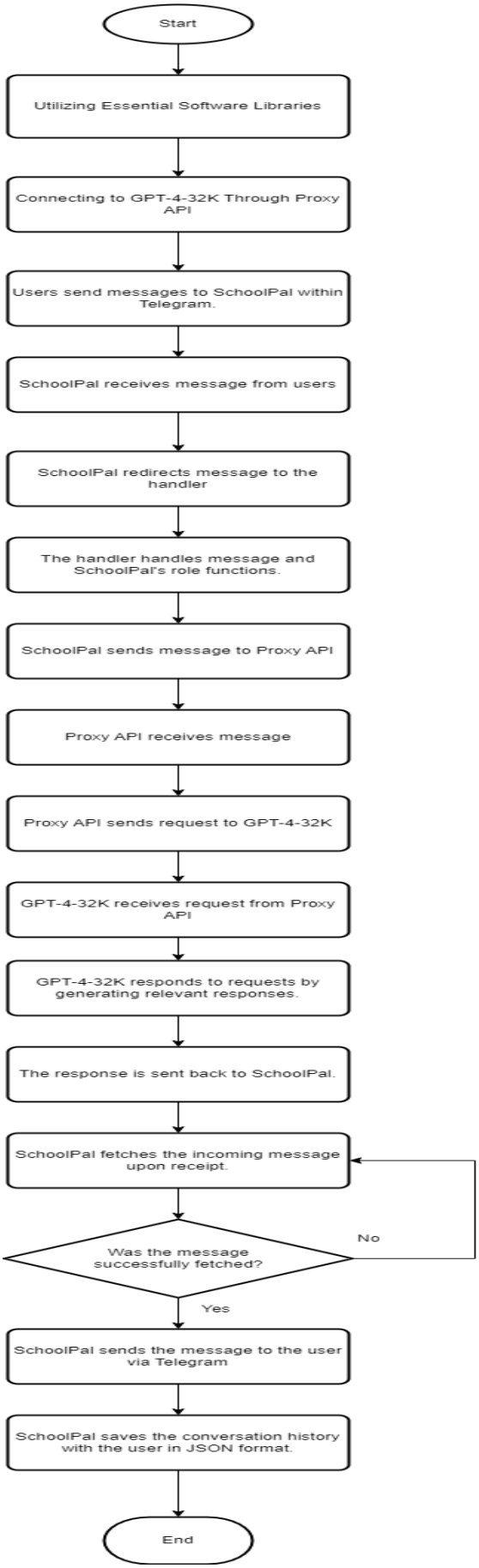

Figure 2. Flowchart of how schoolpal works.

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3.4 mplementation and Trial Run of the Artificial Intelligence-Based Virtual Assistant

This research study was conducted on October 16, 2023 from 1:00 PM to 3:00 PM at Labschool Elementary School. Thirty students from grades 4, 5 and 6 participated - with 10 students from each grade level. The participants were joined by one supervising teacher.

The session began with an introductory remark from a Labschool faculty member providing context on the goals of exploring an AI-based virtual assistant's applications. Next, the master of ceremonies formally opened the proceedings.

Participants were then engaged in an informational briefing about the basic concepts of virtual assistants and artificial intelligence. This set the foundation for subsequent hands-on experiences.

Following the didactic portion, a simulation project was undertaken. Here, the research team administered three distinct evaluation exercises to assess the virtual assistant's performance:

1) Equivalence Testing: Examining responses to identical questions across subjects, such as "What is Badar War?", whether the same answer will come out from each participants.
2) Variability Testing: Comparing answers to semantically similar inquiries stated differently, such as "What animals can be used as sacrificial (Qurban) animals?" with "Mention the animals that are permitted for sacrifice on Eid al-Adha?" whether answers with the same meaning will come out.
3) Open-Response Testing: Evaluating comprehension of spontaneous, unprompted queries.

With this multi-pronged approach, insights were gathered around the virtual assistant's consistency, nuanced understanding, and ability to engage naturally. The results of implementing and systematically analyzing these test conditions will yield valuable data to continue refining the technology's pedagogical usefulness.

3.5 Evaluation of Student Interactions with an Artificial Intelligence-Based Virtual Assistant

Upon completion of the simulation activities, the research team distributed assessment questionnaires utilizing a Google Form to gather feedback. The results indicated improved student comprehension, as demonstrated by scoring. Responses were captured using a 5-point Likert scale (with higher scores signifying greater levels of agreement). Out of the 30 students in attendance, 26 participants completed the evaluation form from the Google Form. The following details the key findings from the student assessments administered at Labschool Elementary School, can be seen figure 3:

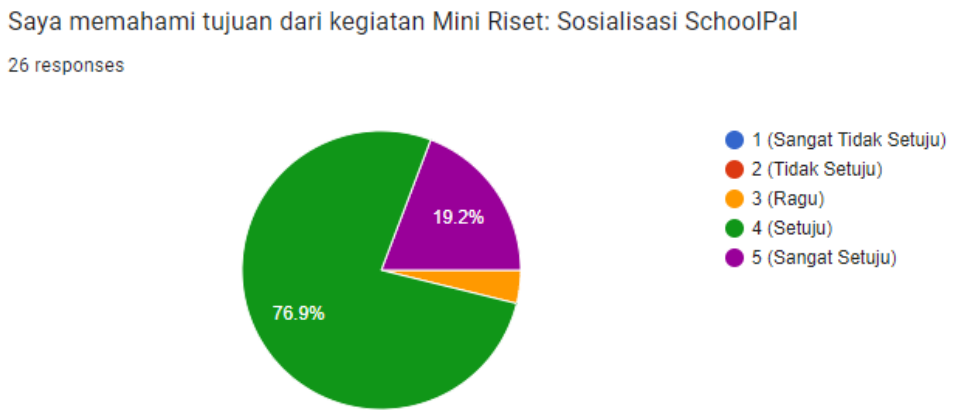

Figure 3. Student feedback on comprehension of the mini-research objective

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Figure 3 shows that 96,1% of students agreed and strongly agreed in understanding the objective of the mini-research activity. The student feedback can be seen figure 4.

Figure 4. Student feedback on the mini-research methodology

As shown in Figure 4, 88,4% of students agreed and strongly agreed that the mini-research used an appropriate methodological approach.

Figure 5. Student feedback on presentation of content.

As shown in Figure 5, 92,3% of students agreed and strongly agreed that the material was presented in an engaging and effective manner. An benefit of mini research can be seen figure 6.

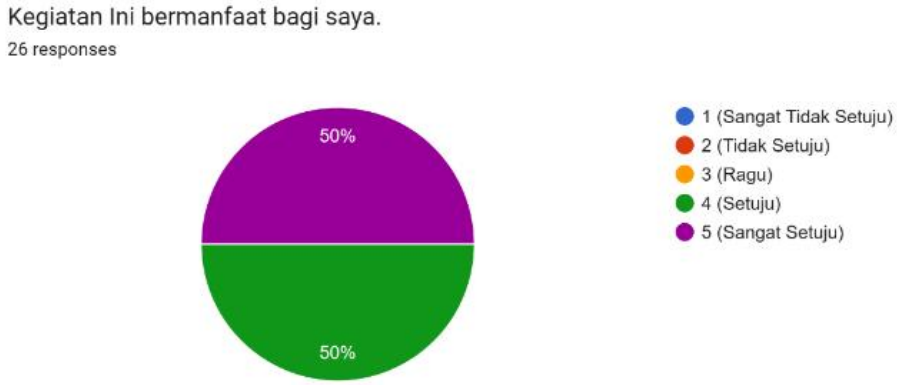

Figure 6. Student feedback on benefit of the mini research.

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As illustrated in Figure 6, all students agreed and strongly agreed that the activity provided valuable benefits for participants. Student feedback on support received from mentors can be seen figure 7.

Figure 7. Student feedback on support received from mentors.

As shown in Figure 7, 92,3% of students agreed and strongly agreed that the mentors provided assistance to those facing challenges. Student feedback on answers from schoolpal can be seen figure 8.

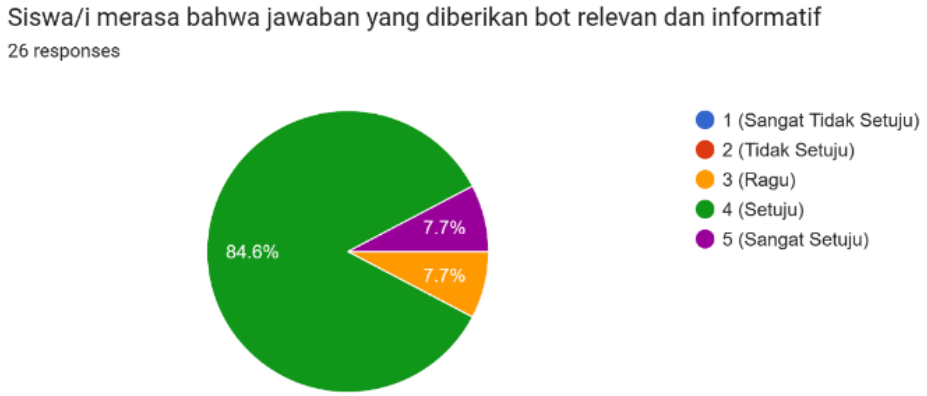

Figure 8. Student feedback on answers from schoolpal.

As seen in Figure 8, 92,3% of students agreed and strongly agreed that SchoolPal's responses were pertinent and helpful. Student feedback on relevance of schoolpal vs chatgpt responses can be seen figure 9.

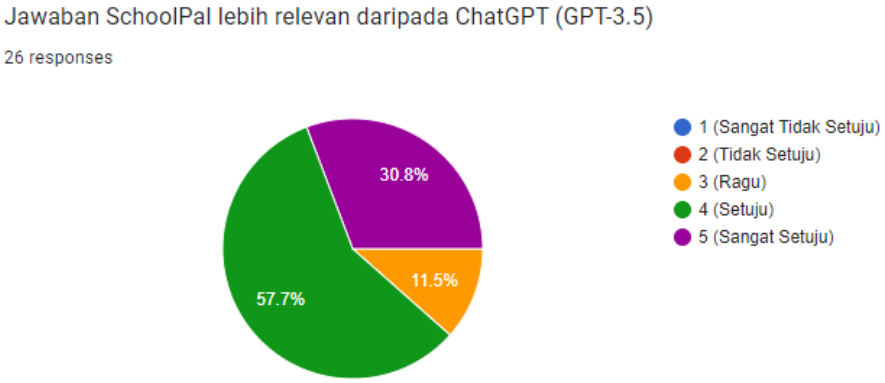

Figure 9. Student feedback on relevance of schoolpal vs chatgpt responses.

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As shown in Figure 9, 88,4% of students agreed and strongly agreed that SchoolPal provided more pertinent responses compared to ChatGPT (GPT-3.5). Student feedback on the impact of schoolpal can be seen figure 10.

Figure 10. Student feedback on the impact of schoolpal.

As shown in Figure 10, 96,2% of students agreed and strongly agreed that SchoolPal enhanced and supported their learning experience. Student feedback on ease of use of schoolpal compared to search engines can be seen figure 11.

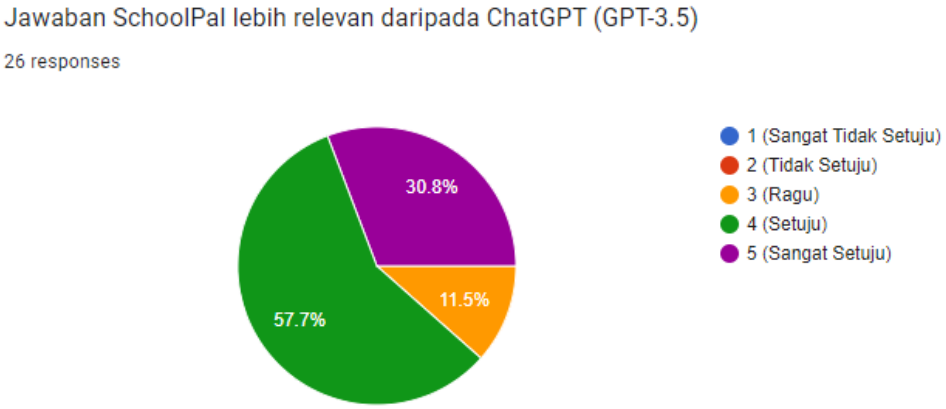

Figure 11. Student feedback on ease of use of schoolpal compared to search engines.

As shown in Figure 11, 88,4% of students agreed and strongly agreed that SchoolPal was more user-friendly than search engines.

To further evaluate the virtual assistant prototype, open-response questions were included to gather qualitative user input. Participants were asked to provide typed responses to the prompts:

1) "My Interest in Applications of an AI-Based Virtual Learning Assistant"
2) "Suggestions and Input"

Valuable insights were extracted from two reflective answers that held potential for informing future development efforts.

One response expressed a hope that SchoolPal's capabilities could be expanded to include additional features like Figure and document processing. This input may guide roadmap planning for gradually enhancing multi-modal interactions.

The other answer proposed opening the system for wider public use while continuing customized support for student users. Taking the product to a broader user base after refinement could expand its learning impact.

The development team will incorporate ongoing daily evaluations to iteratively improve the user experience based on feedback. Continued research efforts and agile development approach aim to ensure smooth progress towards effectively meeting education needs through innovative AI technology.

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4. CONCLUSION

This study focused on the implementation of SchoolPal, an advanced AI-based virtual assistant, to support Islamic religious education and enhance digital literacy at Labschool Elementary School. The evaluation revealed SchoolPal's outstanding performance, consistently providing accurate and relevant responses across a wide range of questions. Students at Labschool Elementary School experienced a noticeable improvement in their understanding and engagement as a result of interacting with SchoolPal. These remarkable findings highlight the transformative potential of SchoolPal as an innovative and effective learning tool, enriching the educational experience at Labschool Elementary School.

AI-powered virtual assistants like SchoolPal demonstrate promise to address current educational challenges through technology-enhanced personalized learning. By blending AI, real-time support, and interactive feedback, SchoolPal nurtures critical skills while transcending barriers of time and place. It fosters dynamic, individualized learning environments empowering students. Fulfilling this potential requires continuous advancement through expanded AI capabilities, knowledge bases, and accessibility across adaptive platforms tailored for each learner. Assessments evaluating long-term impacts could sustainably drive innovation through collaboration, ethical guidelines, and realizing AI's benefits of optimized virtual assistants transforming education into engaging digital experiences that promote literacy for all. Further work unlocking AI's educational potential merits ongoing progress toward revolutionizing learning.

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