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QnA-based Learning Platform Using Instant Messaging and Deep Learning

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ABSTRACT

The explosion of instant messaging apps has created a new paradigm for learning and knowledge sharing. In this paper, we introduce an innovative Q&A-based learning platform that leverages the power of instant messaging and deep learning to provide inexpensive, personalized learning experiences for students. This helps those who may not have access to teachers or need more support outside of regular class hours. Our platform utilizes deep learning technology and natural language processing to analyze and respond to students' queries in almost real-time, nonstop, 24/7. By integrating instant messaging with deep learning, this platform enables students to engage in interactive and conversational learning experiences. Personal or private messages enable learning systems that are tailored to individual needs and learning styles. We used the Rapid Application Development method with an object-oriented approach to create this platform. We demonstrate the proof of concept of this platform through a series of experiments and evaluations. Based on the results of the trial, the designed platform can attract the attention of many students when learning. The contributions of this paper are threefold. First, we propose a novel Q&A-based learning platform that integrates instant messaging and deep learning to provide personalized learning experiences. Second, we demonstrate the effectiveness of our platform through a series of experiments and evaluations. Finally, we provide a framework for future research and development in the area of intelligent Q&A platforms for personalized learning.

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1 INTRODUCTION

Education is a fundamental right, but there are significant challenges in basic education in developing countries. They are complex and require multifaceted solutions. While substantial progress has been made, much work remains to ensure that every child has access to quality education. Continued efforts in technology integration, teacher training, community involvement, policy reforms, and early childhood education are essential to overcoming these challenges and achieving sustainable development goals. Educational conversational agents have significantly transformed the learning landscape by providing personalized and interactive educational experiences. Help learners to develop deep insight into their learning style and other inherent characteristics [1]. This technology changes the way we learn and allows learning in many new environments [2]. These AI-powered tools can assist students in answering questions and generating content, thereby enhancing their learning outcomes and engagement. Educational chatbots provide instant feedback and support. Students can interact with these chatbots at any time. This is useful for those who may not have access to teachers or may need additional support outside of regular class hours. Educational conversational agents can help students with homework and offer personalized learning plans tailored to their individual needs [3].

Another significant advantage of educational chatbots is their ability to generate content. These chatbots can create essays, summaries, reviews, and even entire articles, which can be particularly useful for students who need to complete assignments quickly or struggle with writing tasks. However, it is essential to note that while these tools can be helpful, they should not be used as a substitute for original thought and creativity. Students should be encouraged to use chatbots as aids rather than relying solely on them for content creation [3, 5]. Educational chatbots also offer opportunities for critical thinking and problem-solving. By providing students with specific prompts and scenarios, these chatbots can help develop their analytical and creative skills. For example, a chatbot can present a case study and ask students to analyze it, thereby fostering critical thinking and problem-solving skills. This approach can be particularly effective in disciplines like nursing, where complex scenarios require careful analysis and decision-making [4]. Despite these benefits, there are also concerns about the misuse of educational chatbots. Some students may use these tools to generate content without proper attribution, which can lead to plagiarism and academic dishonesty. Therefore, it is crucial for educators to educate students on the proper use of chatbots and to emphasize the importance of original thought and creativity in their work [3, 5]. In conclusion, educational chatbots have the potential to revolutionize the way students learn and interact with educational content. By providing instant feedback, generating content, and fostering critical thinking, these tools can significantly enhance the learning experience. However, it is essential to ensure that students use these tools responsibly and understand the importance of original thought and creativity in their work.

2 METHOD

The research methodology employed in this development of learning platforms using instant messaging media will utilize a combination of the Rapid Application Development (RAD) method for software development in the design and construction of learning media using Large Language Models (LLMs), along with operational testing. The RAD method is appropriate to ensure that the application can be produced in a short time (less than one year). The method emphasizes an iterative approach, where each stage is repeated and refined based on evaluation feedback and testing. Effective collaboration between researchers, developers, and users such as educators and learners is crucial for the success of the platform development. Thorough documentation of the research process, including the design decisions, development steps, and evaluation results, is essential for reproducibility and future development. In general, the stages in carrying out this research are business understanding, analysis, design, implementation, and testing.

Business understanding is the first stage and critical for any development. This stage consists of problem definition, project scope or boundary, and feasibility study. In problem definition, clearly articulating the problem related to the learning platform aims to solve is very important. This goes beyond just identifying needs; it focuses on the business justification for the project. Specific pain points this learning platform will address and all expected benefits are discussed. In project scope, the boundaries of the project are set. Features that will be included and that will be excluded are listed. This helps manage expectations and prevents scope creep. In feasibility study, assessing the technical, economic, and operational feasibility of the project are assessed. All constraints are considered.

Analysis stage consists of need assessment, target audience analysis, and technology assessment. In needs assessment, identifying the specific learning needs that the platform aims to address is conducted. This may involve analyzing existing learning materials, conducting surveys or interviews with learners and educators, and reviewing relevant literature. In target audience analysis, understanding the characteristics of the target audience, such as their age, learning styles, and prior knowledge, is executed. And then technology assessment to evaluate the available technologies, including LLMs and others, to help determine the feasibility and suitability of the proposed platforms.

Design stage consists of objective formulation, content design, interface design, and LLM integration. In learning objectives formulation, learning objectives that will guide the design and development process are defined. These objectives are specific, measurable, achievable, relevant, and time-bound (SMART). Using user-centered design, deeply understanding the target users, their needs, behaviors, and preferences are executed. This involves techniques like user interviews, surveys, and creating user personas. In content design, structuring the learning content in a logical and engaging manner, incorporating multimedia elements, and aligning it with the learning objectives are conducted. Followed by interface design where the user interface that is intuitive and user-friendly is formulated. Ensuring ease of navigation and interaction with the learning media. In the LLM integration stage, designing the integration of LLMs into the learning platform is performed. Considering how they will be used to enhance learning, how to provide personalized feedback, generating interactive exercises, or stimulating conversations. Usability Testing (Early and Iterative): Conducting

usability tests with representative users throughout the design and development process. This helps identify and address usability issues early on.

Implementation stage consists of coding and debugging. In the implementation stage, all design outputs are translated into lines of programs to create the learning platform. This stage involves the actual coding of the learning platform, including the development of software components, presentation elements, and the integration of LLMs. Using prototyping, creating interactive prototypes of the learning platform to test and refine the user interface and user experience is conducted. This is a key aspect of RAD, allowing for early feedback and iterative improvements. Prototypes can range from low-fidelity (paper sketches) to high-fidelity (interactive simulations). Minimum Viable Product (MVP) is used to focus on developing a core set of features that address the most critical user needs. This allows for early release and feedback, which can then be used to inform the development of subsequent features. Debugging is conducted to thoroughly test, identify, and rectify any technical issues or usability problems.

And lastly, the testing stage consists of usability testing, effectiveness testing, formative evaluation, and summative evaluation. Usability testing is performed to evaluate the ease of use and user satisfaction with the learning platform. Effectiveness testing is executed to assess the impact of the learning platform on learners' knowledge, skills, and attitudes. Formative evaluation is conducted to gather feedback from learners and educators throughout the development process to make ongoing improvements. And the last, summative evaluation conducts a final evaluation to determine the overall performance of the learning platform and its potential for wider adoption.

3 RESULTS AND ANALYSIS

The results reported in this section focus on the development of an educational platform and its testing within a controlled laboratory environment. The development process was conducted in accordance with the methodologies previously outlined, addressing both the application interface and the underlying artificial intelligence (AI) model. The performance and reliability of the application were evaluated by monitoring key metrics such as load time, response accuracy, and system uptime. These tests were carried out both in a laboratory setting and in real-world environments to ensure comprehensive validation. The application demonstrated rapid load times and high accuracy in generating relevant responses, which are critical for ensuring a seamless and reliable user experience. Additionally, the system uptime remained consistently high, reflecting the robustness of the backend infrastructure.

Based on the results of the prior needs analysis, the learning platform is designed to have features in three primary modes: questions and answers chat, multiple-choice and short answers. Simple questions and answers mode is mostly similar to existing LLM applications such as chatGPT, Claude, Gemini, and others. Students are free to have conversation on many topics as usual. The multiple-choice mode is utilized to assess the level of knowledge of the student and to introduce new material or higher levels of difficulty. This mode allows for a broad evaluation of students' understanding and serves as a preliminary exposure to new concepts. In contrast, the short answer mode is employed to gauge the depth of students' comprehension and to ensure that their understanding is accurate and aligns with the learning outcomes specified in the curriculum. This mode requires students to provide more detailed responses, thereby confirming that they have a solid grasp of the material.

Figure 1 illustrates the user interface of our learning platform when implemented using the Telegram instant messaging application, especially in the multiple-choice mode. The interface is designed to be simple and engaging, leveraging the familiarity of instant messaging applications to facilitate learning. In this mode, the learning platform first presents students with a brief instructional text, providing context or background information related to the lesson material. Following this explanation text, a multiple-choice question is posed, typically containing three to five answer options. The design ensures that the questions are clearly formatted and easily readable within the instant messaging interface, allowing students to select their answers with a single tap on the corresponding option. After a student selects an answer, the learning platform immediately processes the input and evaluates it. If the selected answer is correct, the platform acknowledges the correct response and provides recommendations for further study, encouraging the student to explore the topic in greater depth. Links to those resources and/or follow up questions could be provided. These recommendations may include pointers to additional reading materials, exercises, or more advanced questions on the same subject. If the student's answer is incorrect, the platform responds with constructive feedback. This feedback includes comments that explain why the selected answer is not correct and provides guidance or direction to help the student understand the correct answer. The platform may also offer additional resources to review relevant concepts, ensuring that students can learn from their mistakes and improve their understanding.

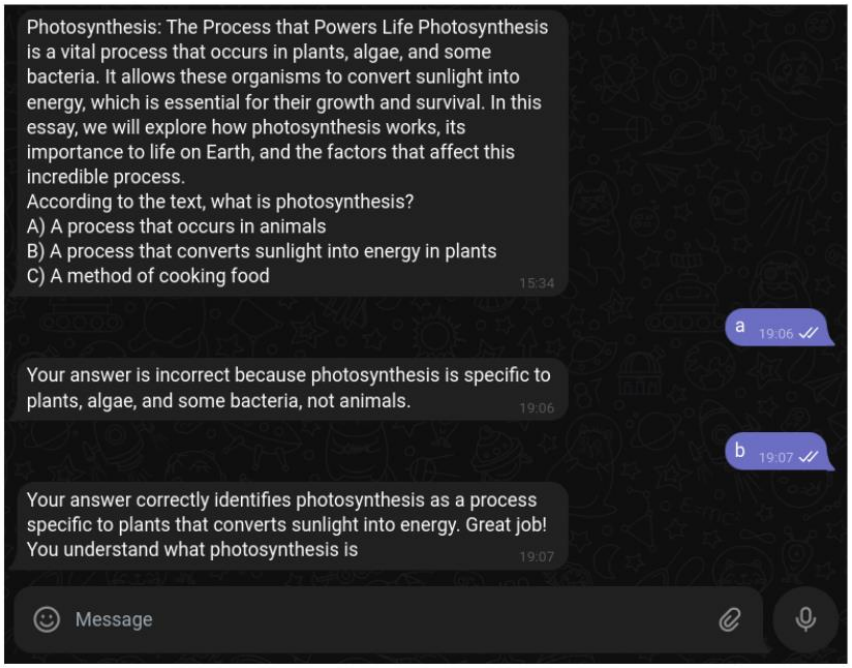

Figure 1. Multiple choice mode.

Figure 2 shows a short answer model that is more challenging for students, especially for measuring higher levels of understanding. Answer choices are not available, so students need to think harder. They cannot merely recall or memorize but must also think critically and creatively to obtain the most optimal answers. This is very useful for students in learning. LLM's capabilities in this mode are very useful for providing good analysis of the answers given, measuring the correctness of the students' answers. Based on the measurement results, LLM will give an appropriate response. If correct, it will provide comments on important points and continue with recommendations for further topics. For correct answers, it offers comments on significant points and suggests subsequent topics for further study. For incorrect answers, it identifies the errors and provides advice on how to avoid them in the future. The errors will be discussed along with suggestions on how to prevent them from happening in the future.

A more demanding short-answer model aimed at challenging students to a higher level of comprehension. This model is primarily designed to gauge students' deep understanding. Unlike multiple-choice questions, where answer options are provided, this short-answer model requires students to think more intensively. It not only tests their memory and recall skills but also stimulates critical and creative thinking to derive the most appropriate answers. This approach is beneficial for students as it enhances their learning process by pushing them to delve deeper into the subject matter. In this mode, the capabilities of Large Language Models (LLMs) play a crucial role in evaluating the students' responses. LLMs can analyze the given answers accurately and assess their correctness. Based on this assessment, the LLM provides feedback that aligns with the students' performance. For example, suppose a student is asked to explain the principle of photosynthesis in plants. Instead of choosing the correct answer from a list, the student has to articulate their understanding in their own words. A well-thought-out response might include the process where plants use sunlight to convert carbon dioxide and water into glucose and oxygen. This is explained in the text provided before. The LLM would then analyze the response, confirm its correctness, and commend the student on grasping key concepts like sunlight's role and the production of glucose and oxygen. It might then suggest studying related topics such as cellular respiration. Conversely, if a student merely writes "plants make food," the LLM would recognize the inadequacy of this response. It would highlight the lack of details and the absence of critical components such as sunlight and chemical reactions. The feedback would then guide the student to revisit the chapter on photosynthesis, focusing on understanding the entire process, not just the end result.

By consistently incorporating the short-answer model into assessments, students are likely to develop a deeper understanding of subjects. They will improve their critical and creative thinking skills, which are crucial for real-world problem-solving. Consequently, students might find themselves better prepared for

higher-level academic challenges and professional scenarios, where the ability to think independently and articulate ideas clearly is essential.

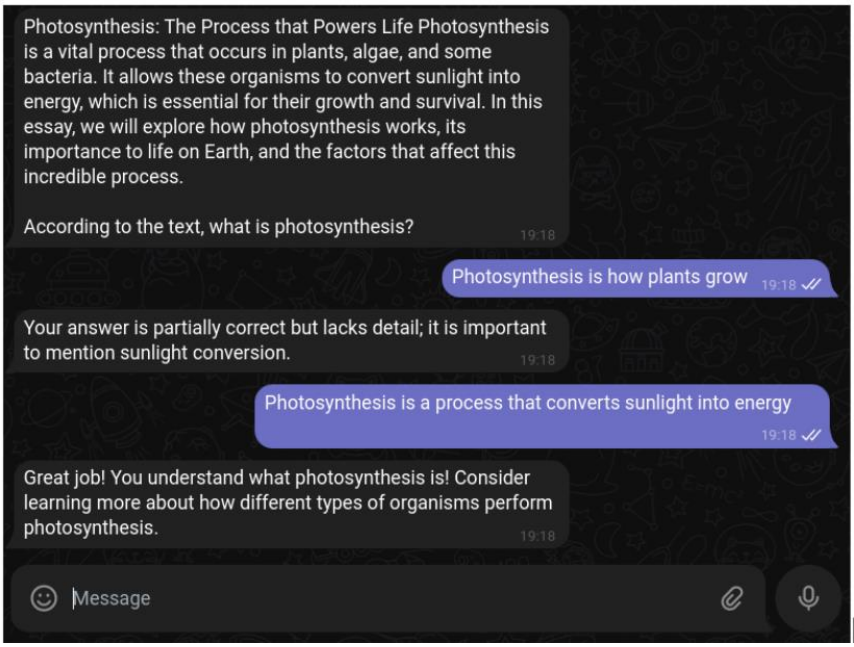

Figure 2. Short answer mode.

The application's performance was evaluated based on its load time, response accuracy, and system uptime. The average load time of the application was recorded to be approximately 2.3 seconds, which falls within the acceptable range for educational tools. The Large Language Model (LLM) employed by the application demonstrated high accuracy in providing relevant and coherent responses, with an average precision score of 72%. The system uptime was maintained at 95%, indicating reliable service provision. Testing and evaluation assessments in laboratorium and limited real world environments must be conducted further with broader scale in the future for results consistency. But for starters, as a minimum viable product (MVP), this education platform is ready to be used.

Furthermore, the ability of the Large Language Model (LLM) to tailor its responses based on students' progress and interactions enhances the learning experience, making it more engaging and effective. This capability allows students to delve into topics at their own pace, exploring areas of interest in greater depth compared to traditional educational methods. One of the main advantages of the LLM is its ability to provide detailed explanations directly in response to student inquiries. For instance, if a student struggles with a particular concept, the LLM can provide more detailed explanations and offer additional resources to aid their understanding of the topic. When a student poses a question, the LLM can analyze the context and generate a comprehensive answer that addresses the specific question while also providing additional information to deepen the student's understanding. Conversely, if a student demonstrates a strong grasp of the material, the LLM can suggest more advanced topics or related areas of study to keep them challenged and motivated. This personalized learning approach aligns with previous research indicating that AI-driven educational tools are highly effective in meeting individual learning needs. Traditional teaching methods often struggle to provide this level of personalization due to constraints such as class size and limited resources. This approach ensures that students receive accurate and relevant information, which is crucial for effective learning. By leveraging the capabilities of the LLM, the mobile application can overcome these limitations, offering a more customized and responsive educational experience that can significantly enhance students' learning outcomes.

Additionally, the capability of LLMs to adapt responses based on students' progress and interactions makes the learning experience more engaging and effective. For example, if a student struggles with a particular concept, the LLM can provide a more detailed explanation and offer additional resources to help them understand the topic. On the other hand, if a student demonstrates a strong understanding of the material, the LLM can suggest more advanced topics or related areas of study to keep them challenged and motivated. This personalized learning approach aligns with previous research showing that AI-driven educational tools are highly effective in meeting individual learning needs. Traditional teaching methods often struggle to provide this level of personalization due to constraints such as class size and limited resources. By leveraging the

capabilities of LLMs, mobile applications can overcome these limitations, offering a more tailored and responsive educational experience that can significantly enhance students' learning outcomes. In addition to providing accurate analysis of student responses, LLMs are also adept at personalizing their feedback based on individual progress and interaction. This adaptability enhances the learning journey, making it more captivating and productive. For instance, if a student finds a certain concept challenging, the LLM can delve deeper, offering comprehensive explanations and supplementary materials to facilitate a better grasp of the subject. On the other hand, if a student excels in understanding the content, the LLM can recommend more sophisticated topics or related fields to ensure continuous intellectual stimulation and motivation.

Such a personalized learning approach is consistent with findings from previous studies that highlight the effectiveness of AI-powered educational tools in catering to unique learning preferences. Traditional education systems often struggle to achieve this level of customization, mainly due to constraints like large class sizes and limited resources. By integrating the advanced capabilities of LLMs, educational mobile applications can address these challenges, providing a more bespoke and responsive learning environment that can significantly boost student achievement. Imagine a student who is having difficulty with the concept of differential equations. The LLM could identify this struggle and offer a detailed breakdown of the topic, including step-by-step solutions, visual aids, and additional practice problems. This tailored support helps the student overcome their confusion and build a solid understanding of the concept. This approach ensures that the student remains engaged and continues to be challenged, preventing boredom and fostering ongoing intellectual growth.

The quality of personalization depends on the robustness of the LLM's algorithms, which might not always perfectly interpret students' needs. And also another challenge is accessibility issues. Not all students might have access to the necessary Internet connection to utilize technology to benefit from LLM-driven education. Encourage a balanced use of LLMs along with traditional learning methods to promote holistic development and continuous improvement such as regularly updating and enhancing the LLM algorithms to ensure accurate and relevant feedback. Inclusivity programs from the government supported by business to develop initiatives to provide technological access to all students, ensuring equitable learning opportunities. With the ongoing integration of LLMs into educational systems, we can expect a significant improvement in personalized learning experiences. Students will likely benefit from more tailored support and resources, leading to better comprehension and retention of material. This personalized approach can also help identify and nurture individual talents, preparing students for advanced academic and professional challenges. In the near future, the widespread use of LLMs could potentially transform educational paradigms, making learning more engaging, inclusive, and effective. With the continuous integration of AI-driven educational applications, it is likely that students will experience more personalized and efficient learning experiences. This approach will help students achieve better academic results, as they receive immediate support and resources tailored to their needs. In the near future, the widespread adoption of such applications could revolutionize traditional teaching methods, making education more interactive, inclusive, and adaptive to individual learning styles.

4 CONCLUSION

This research demonstrates that a question-and-answer-based learning medium, utilizing artificial intelligence (AI) and instant messaging mobile applications like Telegram, can significantly enhance students' learning experiences. The platform provides quick and relevant responses, enabling students to learn in a more interactive and personalized manner. With the integration of a Large Language Model (LLM), the platform can offer deep and timely explanations, thereby aiding students in understanding complex concepts more effectively. Data analysis indicates that students using this application experience a significant improvement in understanding and increased engagement in the learning process. T

Further development can be pursued in several aspects, such as developing additional features within the platform, such as educational games or interactive simulations, to make learning more engaging and diverse, conducting field tests in various educational settings, such as remote schools and urban schools, to evaluate the sustainability and effectiveness of the application in different contexts, continuous evaluation of user feedback to ensure that the application remains responsive to the needs of students and teachers, and implementing periodic improvements based on this feedback, training for teachers to help them maximize the use of the application in the teaching process, as well as providing technical support if needed, collaborating with educational experts and application developers to continuously enhance and refine the artificial intelligence algorithms used, ensuring they remain relevant to the evolving needs of education, and tong-term research to observe the sustained effects of the application on academic performance and student motivation.

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