Question Generation Based On Performance Analysis

Ms. S. Poornima[1], Darius Jonathan D[2], Karthikeya Vishwa N[3], Prem Kumar D[4], Ramesh V[5]

[1,2,3,4,5]Coimbatore Institute of Technology, Coimbatore, India

Emails: *poornima.s@cit.edu.in[1], dannymano1234@gmail.com[2], karthikeyavishwa.n@gmail.com[3], prem.mdj18vk@gmail.com[4], rameshvelkumar0321@gmail.com[5]*

Abstract

The development of an application that generates questions across various levels of Bloom's Taxonomy, such as remembrance, understanding, analysis, and creation, represents a significant advancement in the field of education and assessment. The primary goal of this application is to provide a comprehensive platform for assessing and enhancing individual performance in a specific topic. At the core of this innovative project lies the utilization of Google's state-of-the-art LLM, PaLM 2's text-bison-001, which is a powerful language model known for its natural language processing capabilities. This model is harnessed to generate questions that span the cognitive domains of Bloom's Taxonomy, ensuring a well-rounded assessment of learners' knowledge and skills based on their past performances on respective domains. There are four main modules used in the project: Providing resources, Conducting test, Performance Analysis, Question Generation. In summary, this project aspires to revolutionize education by offering personalized, comprehensive, and evolving assessments that enhance individual performance and understanding of a specific topic. Through the synergy of advanced technology and educational theory, it paves the way for a more effective and efficient learning experience.
Keywords: *Bloom's Taxonony; PaLM; Revolutionize*

1. Introduction

In the ever-evolving landscape of education, the quest for innovative approaches to assessment has become paramount. Recognizing the need for a comprehensive and personalized tool, our project endeavors to revolutionize the assessment process through the integration of Bloom's Taxonomy with cutting-edge natural language processing technology. This amalgamation not only promises to offer a more profound understanding of learners' knowledge and skills but also aims to provide a tailored learning experience that caters to individual needs and fosters continuous improvement. At the heart of this endeavor lies Google's PaLM 2 model, renowned for its prowess in natural language processing, serving as the cornerstone for generating questions across various cognitive levels. Through a modular design encompassing resource provision, [7] test administration, performance analysis, and question generation, our project aims to redefine education, offering a synergistic blend of advanced technology and pedagogical theory to enhance learning outcomes and promote a culture of lifelong learning.

1.1 Test conduction

The primary functionality begins with the conduction of the test which acts as the basis of further assessment. It provides a general structure to create MCQ forms and retrieve the user results [6]

1.2 Analysis of user's performance

The application provides an extensive analysis report the user's performance on the current test as well as a complete report on their overall performance which acts as the key for the subsequent modules.

1.3 Providing resource

On retrieving the user answers the application prompts the user with resources that helps them to review the incorrectly answered questions using a custom search engine [1]

1.4 Question generation

Questions are generated on the basis of the parameters extracted from the tests and the model is fine-tuned based on the parameters to generate unique questions

2. Method

Dynamic Question Generation Module: The dynamic

question generation module leverages Google's generative AI to create multiple-choice questions (MCQs) based on specified parameters such as topic, difficulty, and type of questions. It begins by configuring the Palm API with the necessary API key and endpoint settings. The selection of the model is crucial; here, the model used is the "Bison" model, chosen from the available models that support text generation. The module categorizes questions into four cognitive levels: knowledge, understanding, application, and analysis. To identify the major concept of a given question, the module generates a relevant prompt and processes the response to extract the topic. [5] It can generate a specified number of MCQs or a single MCQ with four options based on provided parameters. The prompts are crafted to ensure that each question is formatted as a Python dictionary with keys for the question, options, and correct answer. To ensure proper JSON formatting, a utility function replaces single quotes around keys and values. Additionally, a formatting function converts the result string into a list of dictionaries, making the questions ready for use. This module facilitates automated and scalable question creation, catering to diverse educational needs by utilizing advanced AI models for text generation. The project uses the Flask framework to build a dynamic web application for studying through quizzes. The application uses template rendering to generate HTML pages dynamically, allowing users to navigate through different sections like quizzes, results, and resources. User-specific data is stored in sessions, enabling personalized interactions such as tracking questions and scores. A MySQL database is integrated for storing and retrieving subjects, taxonomy levels, questions, and user responses. Dynamic question generation is implemented, adapting to the user's performance and difficulty levels. Additional resources for incorrect answers are fetched using web scraping techniques. The user's performance is visualized using charts generated by Matplotlib, which are saved as static images and displayed on result pages. The application handles form submissions to collect user inputs for starting quizzes and recording answers. [8] This comprehensive approach combines web development, database management, dynamic content generation, and data visualization to create an effective study tool. Figure 1 shows the Process of AI Model. [2]
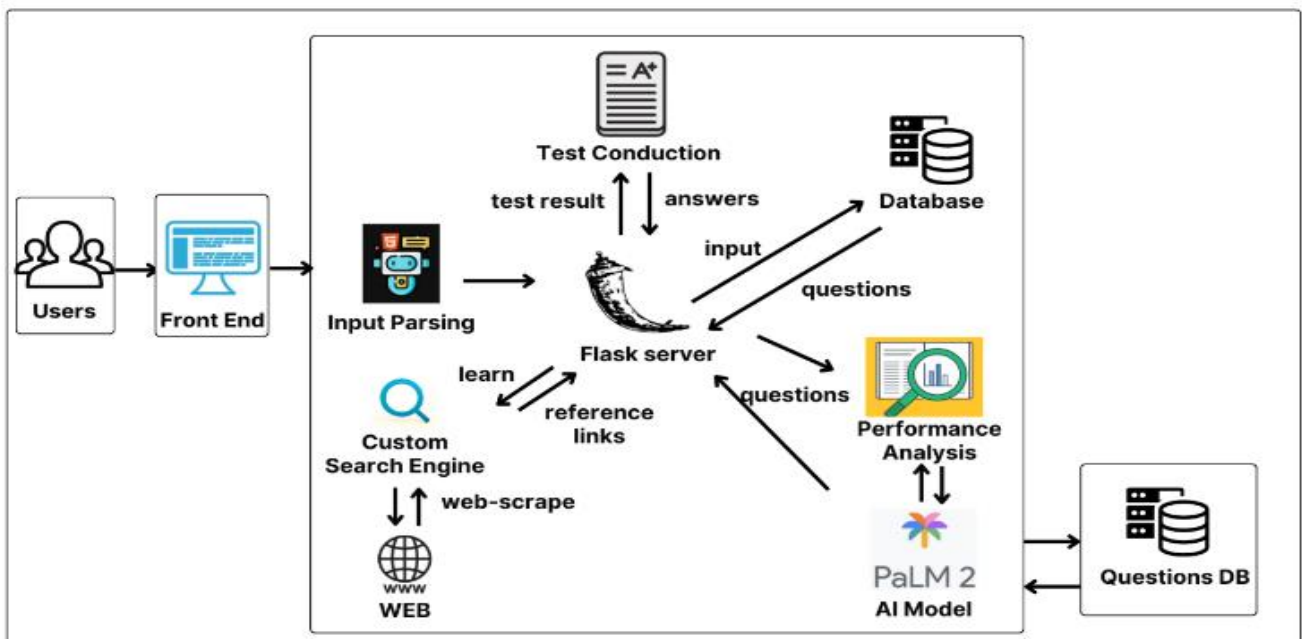

Figure 1 Process of AI Model

3. Results and Discussion

3.1 Results

The primary objective of this project was to create an interactive study tool that adapts to user performance, providing personalized feedback and resources to enhance learning. The application dynamically generated questions based on the user's selected subject, taxonomy level, and difficulty, ensuring a varied and comprehensive set of questions. User responses and scores were tracked, allowing for adaptive difficulty adjustments and personalized feedback. For incorrectly answered questions, the application provided external resources to aid in understanding, while performance was visualized through pie charts and bar charts to offer clear insights into progress. The results demonstrated the effectiveness of this approach. [9] Users received a diverse set of questions tailored to their performance levels, enhancing the learning experience with appropriate difficulty and topic coverage. Accurate performance tracking and personalized feedback helped users identify their strengths and areas for improvement. The provision of additional learning materials for incorrectly answered questions supported users in their learning journey. The visual feedback through charts further motivated users by clearly showing their progress and areas needing attention, contributing to a more engaging and effective study experience. Figure 2 shows the Selecting test selection. Figure 3 shows the Test Analysis. Figure 4 shows the Resource Generation. Figure 5 shows the Pass Percentage of Each. [3]
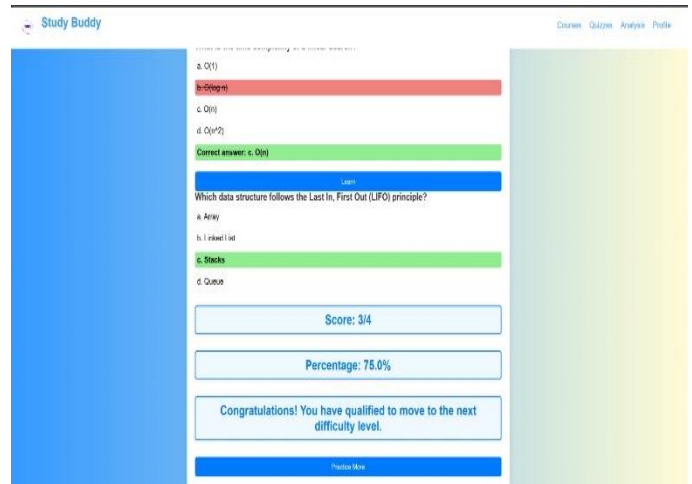

Figure 3 Test Analysis
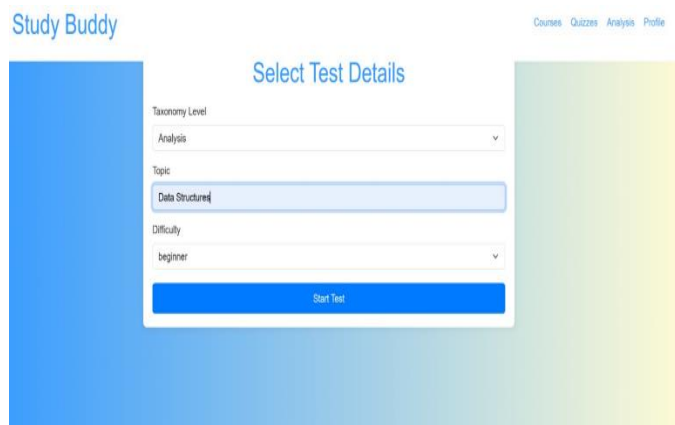

Figure 4 Resource Generation
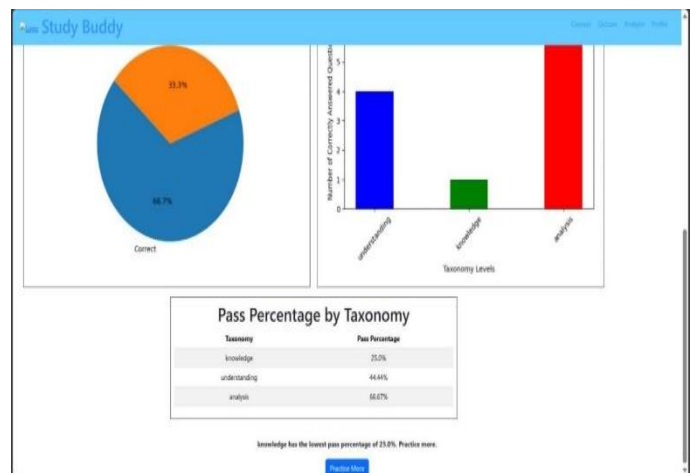

Figure 2 Test Selection

Figure 5 Pass Percentage of Each Taxonomy Levels

3.2 Discussion

The results of this study tool project illustrate several key insights into adaptive learning and personalized education. The dynamic generation of questions based on user-selected criteria and performance levels proved to be an effective way to cater to individual learning needs. This method not only ensures a comprehensive coverage of topics but also maintains an appropriate level of challenge for the user, thus preventing both boredoms from overly easy questions and frustration from overly difficult ones. By adjusting the difficulty based on user performance, the tool successfully maintains an optimal learning curve, encouraging continuous engagement and progress. The provision of external resources for incorrectly answered questions underscores the importance of targeted remediation in the learning process. This approach aligns with educational theories that emphasize the role of feedback in learning. By directing users to relevant resources, the application helps bridge knowledge gaps and reinforces learning. The visual representation of performance through charts further aids in this process by offering clear and immediate feedback. Users can quickly identify their strengths and weaknesses, which can be particularly motivating and provide a sense of accomplishment as they see their progress over time. These results suggest that adaptive learning tools, which dynamically adjust content based on user performance and provide personalized feedback, can significantly enhance the learning experience. They support the idea that personalized education, facilitated by technology, can lead to more effective

work could explore expanding the range of subjects and question types, as well as incorporating more sophisticated algorithms for even more nuanced adaptations to individual learning paths. experience with appropriate difficulty and topic coverage. Table 1 shows the Perform Analysis. [4]

Conclusion

The development of our application marks a significant leap forward in the realm of educational assessment, offering a versatile platform that generates questions across various levels of Bloom's Taxonomy, including remembrance, understanding, analysis, and creation. By leveraging Google's advanced language model, PaLM 2's text-bison-001, we ensure a robust and nuanced evaluation of learners' knowledge and skills. The four main modules—Providing Resources, Conducting Tests, Performance Analysis, and Question Generation—work in concert to deliver a personalized and comprehensive assessment experience.

Table 1 Performance Analysis

Model	Squad 2.0
gpt-z	0.871
gtp-3.5-turbo	0.69
claude-v1	0.759
text-davinci 003	0.586
text-bison@001	0.818
flan-t5 xxl	0.782

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