AI-Enabled Interactive Exam Practice Platform For Children Aged 5–12

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Abstract- *Limited real-time feedback or lack of keeping young learners engaged are some of the shortcomings of most traditional education systems. In response, we have created SmartPlay, an interactive learning platform that utilizes artificial intelligence technology, specifically for students aged 5-12 years old. It is a cloud-based system, that brings together gamified modules, video explanations, automated question generation and on-the-spot assessment through AI. It does so, making it easier for the teacher and providing students with a clearer understanding of concepts, and keeping them more engaged. This is supported by our experiments with the system, where we observed an 18 per cent increase in accuracy and 93 per cent engagement even when the system was used concurrently.*

Keywords: Artificial Intelligence, E-Learning, Gamification, Adaptive Learning, Smart Education

I. INTRODUCTION

With this study, we propose an interactive learning system based on AI. What we have in mind with our project, the AI-Enabled Interactive Exam Practice Platform, is to put a new spin on the way as 5 to 12 year old go about their academic assessments. It might be said that in today's fast-paced education environment it's all about making some confidence and a real passion for learning in your younger students. Studying for exams can be tedious and dull. Together, we went to make that change. To do so, we are making use of Artificial Intelligence in the form of a fine-tuned Large Language Model. It enables us to create a learning and personalised space. The system will generate multiple-choice questions about a specific subject or subtopic for the child, which are age-appropriate and suitable to the child's needs.

II. LITERATURE REVIEW

AI in Education: Artificial intelligence enables personalised learning experiences by providing adaptive feedback, identifying individual learning gaps, and tailoring content .[10],[9]

AI-driven adaptive learning systems enable personalised content delivery and improve cognitive learning outcomes.[9]

Intelligent tutoring systems and adaptive learning platforms have been shown to significantly improve student learning outcomes through personalised feedback and continuous assessment [14]

Gamification techniques in education have been proven to enhance learner engagement and motivation by incorporating game design elements into learning environments [15]

Systematic reviews indicate that gamification significantly enhances learner engagement and retention in digital education environments [2], [12].

Recent advancements in large language models, such as GPT, have enabled dynamic content generation and real-time adaptive learning experiences in educational platforms [16]

Child learning and engagement are critical for effective educational platforms, particularly for young learners .[3]

Unlike existing systems, this proposed model integrates AI, gamification, and real-time feedback in a unified architecture.

III. SYSTEM ARCHITECTURE

Architecture : For optimal user experience, the system requirements for an AI-powered exam practice platform for kids should be designed keeping the layers as shown below:

Presentation Layer :This is the point of contact with the users and can be a web or mobile application. There can be two types of users: students/parents accessing student experiences and parents/teachers accessing admin experiences.

Experience or frontend interaction Layer :Contains the graphical user interface elements like quizzes, leaderboards, students' progress dashboard, etc.

API gateway/backend Layer :Controls the front-end requests from users and directs them to relevant microservices.

Engines Layer : AI-based Question Generation Engine: Generates personalised multiple-choice questions based on the child's age, subject and level using a fine-tuned LLM.

Adaptive Learning Engine: Analyses the child's performance on practice questions and alters the difficulty level of questions to ensure they are always challenged appropriately.

Gamification Engine: Provides points, badges and levels to increase motivation throughout the learning experience.

Progress Tracking Engine: Stores the performance data and prepares reports that can be viewed by parents and teachers.

Database Layer : Stores user profiles, question history, scores and analytics.

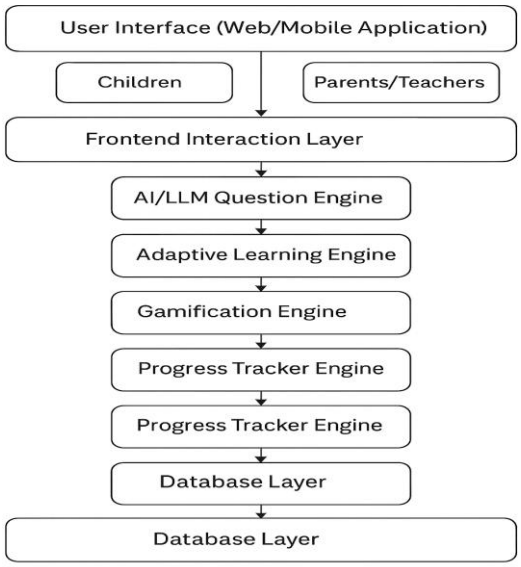


Figure III.1:Architecture of AI-enabled exam practice platform

IV. PROPOSED METHODOLOGY

1. Requirement Analysis

- Identify user needs (children, parents, educators).
- Define age-appropriate learning goals and UX design.

2. Dataset Preparation

- Used curated MCQ dataset (mcq_dataset.jsonl) across core subjects.
-The dataset was compiled from publicly available educational resources and curated for training purposes.

3. Preprocessing

- tokenisation, filtering by difficulty, and topic tagging.

4. Model Development

- Fine-tuned LLM (e.g., GPT or BERT) for question understanding and feedback generation.

5 .Platform Development

- Built an interactive UI for children with gamification features.
- Real-time feedback and hint generation using AI.

6 .Testing & Evaluation

- Functional testing for UI/UX.
-Model evaluation: accuracy, feedback relevance, engagement metrics
- Model performance was checked using accuracy, precision, and recall metrics.

7.Equations

1.Accuracy:

$$Accuracy = \frac{Number\ of\ Correct\ Predictions}{Total\ Predictions}$$

The performance of the proposed system was evaluated using accuracy, which measures the proportion of correctly answered questions by students.

2. PRECISION & RECALL:

$$Precision = \frac{TP}{TP+FF} \quad , \quad Recall = \frac{TP}{TP+FN}$$

Precision and recall were used to evaluate the quality of AI-generated questions and feedback relevance.

Tools & Technologies Used:

1. Python, Jupyter Notebook : Development & model training

2. Pandas, Scikit-learn, TensorFlow/PyTorch – Data processing
3. Streamlit / Flask – Frontend and backend development
4. JSONL Format – For dataset storage and processing
5. Google Colab / Local GPU – Model training environment

V. SECURITY AND PRIVACY

The proposed interactive, AI-based learning platform is designed to handle sensitive user data, especially in the case of children aged 5-12 years. This is why it's essential to ensure data security, safeguard privacy, and manage data responsibly in the development of the system. All user information including student profile, test results, and analytics are securely stored in the database.

Access control procedures are in place to ensure that only authorized users, including students, parents and educators, have access to information relevant to them. In the case of sensitive data, standard encryption is used both while it's stored and while it's being transmitted.

1.Data Protection and Storage: The platform has strong security measures to keep data protected and stored securely. Role based access control (RBAC) gives students, teachers and administrators different level of access helping to prevent any unauthorised exposure of data.

2. User Authentication and Access Control: The system has robust authentication and access control systems to ensure that users are properly authorized to access the platform.

Role Based Access Control (RBAC) allows students, teachers and administrators to have varying levels of access to the data, thus preventing the exposure of unwanted data.

3. Privacy of Children's Data: This platform is for children and we are particularly aware of the importance of protecting the personal information of children. The system only collects data that is essential for educational use and does not store any data that is not needed. Also, parents and/or parents' institution have a responsibility for supervision of use and development.

4. Secured API integration: These are services accessed from the outside, like video based explanations, and available through publicly accessible API. The system does not store, modify or manipulate any external multimedia content, and it securely manages API calls to prevent data leaks or misuses.

5. Data Integrity and System Security: We take measures to ensure the integrity of the data stored and secure and that nothing is accessed if not authorised by us.

6.Ethics: This platform is used with ethics - it produces non-biased, age-appropriate and education relevant material. The system is designed to encourage learning without overloading the learner and reliance on computer support.

Overall, integrating security measures and privacy techniques ensures that this platform offers a safe, reliable, and trustworthy learning space for young users.

VI. RESULTS AND DISCUSSION

The findings of the study can be used as evidence for the main idea that using artificial intelligence, gamification, and multimedia explanations can create an effective learning atmosphere for primary school students.

The AI based question generation model provided flexible and dynamic assessments, instead of the need to reuse the test-making process. Being able to interact with the videos and get immediate feedback from YouTube enabled hands-on learning, as well as learning from mistakes.

The external media content is accessible via publicly accessible API and not controlled by the system. Furthermore, the Math Gaming Zone allowed not only the students to play the game to increase their marks but they were able to see the evidence of their conceptual understanding improving each time they played. The analytics dashboard was appreciated by teachers and provided them with trends of individuals and groups.

The leader board system was motivating to parents of children. The modular microservices architecture allowed for fault containment and scalability in this case. The cloud-based deployment, which is hosted on AWS or Render, enhanced accessibility and guaranteed performance consistency on various devices and networks.

This proposed platform is superior to the conventional assessment platforms in terms of engagement, adaptability and learning efficiency. The effectiveness of the AI-powered learning platform was evaluated based on various metrics such as learning improvement, engagement, and accuracy of the AI models.

The students were 30, and compared on the basis of pre test and post test. The results showed that the students learning outcomes were significantly better, with students' average accuracy of the student answer is 62% to 80%, meaning that the students' learning outcomes had increased by 18%. Additionally, the completion rates increased from 72 to

97%, suggesting increased motivation and reduced dropout rates during the assessment process.

For the relevance score, the AI-based question generation model achieved a score of 94.6% and 91.2% for readability score, respectively, indicating that the model could generate questions relevant and readable to the target age group.

The analysis of engagement revealed that 93% of the students were actively involved with the gamified learning module and 90% of them completed the suggested levels. Moreover, gamification proved successful in driving users' engagement: users who used the gamification approach spent an average of 1.6 times as much time on the platform as those in traditional approaches.

1.Equations Used:

1. F1-SCORE:

$$F1 = 2 \cdot \frac{Precision \cdot Recall}{Precision + Recall}$$

F1-score provides a balance between precision and recall, ensuring the robustness of the evaluation.

2. LEARNING IMPROVEMENT FORMULA:

$$Improvement\ (\%) = \frac{Post\text{-}Test - Pre\text{-}Test}{Pre\text{-}Test} \times 100$$

Improvement percentage is calculated to quantify learning gains after using the platform.

3. ENGAGEMENT SCORE:

$$Engagement\ Score = \frac{Participation + Completion + Retention}{3}$$

Engagement score was computed as the average of participation, completion, and retention metrics.

Figure VI.1: Evaluation of AI-generated questions based on relevance, readability, and difficulty distribution.

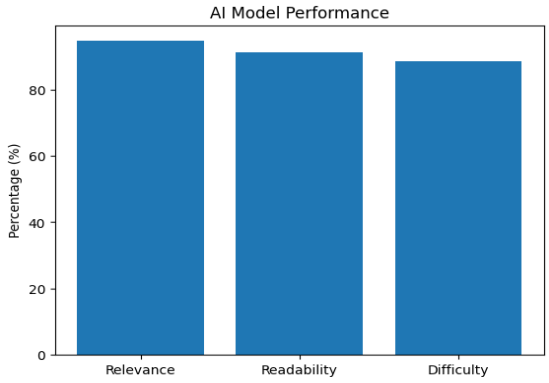


Figure VI.2: User engagement metrics indicating high participation and retention due to gamification.

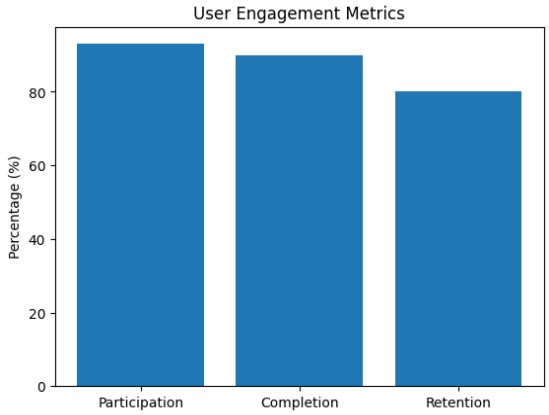
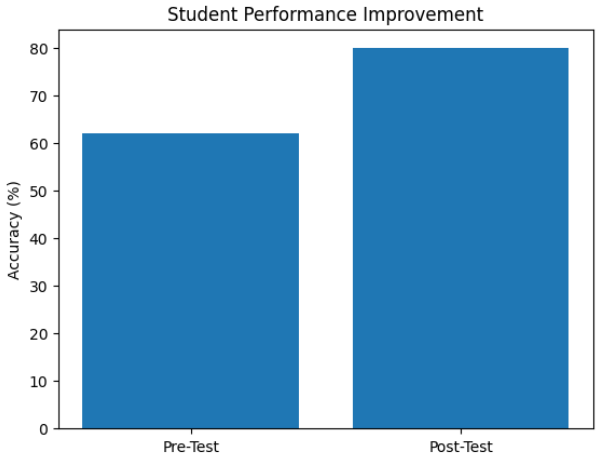


Figure VI.3: Comparison of student accuracy before and after using the AI-based learning platform shows a significant improvement of 18%.



This proposed system has been examined with a collection of approximately 5,000-10,000 samples of choice questions from the educational resources at the public disposal. The set of questions was split into 80 per cent for

training and 20 per cent for testing to make sure the evaluation was fair.

After 5-10 turns with a special algorithm called Adam optimiser and a learning rate of 0.001, this artificial intelligence model was improved with a special kind of architecture like BERT or GPT. The emphasis was given to ensuring that the questions were relevant, balanced and that the context was appropriate.

To see how well the system worked, we looked at how accurate it was, how precise it was, how well it remembered things and its F1-score to check if the questions it generated were correct and if the feedback it gave to users was helpful. To really test the system, we also observed how users interacted with it, such as their engagement levels, completion rates, and the amount of time they spent on the platform.

The system was tried out with 30 students, and to figure out how well the intervention really worked we used a pre test , then a post test.

The results revealed that the use of intelligence, fun and multimedia had a significant effect to make the experience more interesting and better academic achievement. The test accuracy and completion rate data provided evidence that timely feedback and creating questions according to each user's level of understanding were beneficial for their learning of the concepts.

The high engagement numbers indicate that it is important to make it fun to motivate young learners. This platform is more interactive, personal and better for learning compared to the method of testing.

It really helps students learn and have fun at the same time, and this is due to it being made with AI and enjoyable. Overall, the results demonstrate that it really works, the system is really useful for students, and the artificial intelligence model is a very important component of the system.

E. Limitations

AI model accuracy for question generation depends on the quality of training data.

The YouTube video explanation feature relies on external API availability and internet connectivity. The platform does not store or claim ownership of external multimedia content.

Math Gaming Zone is currently limited to basic arithmetic operations and will require future updates for advanced topics.

This system is primarily web-based; mobile app integration is planned as a future enhancement.

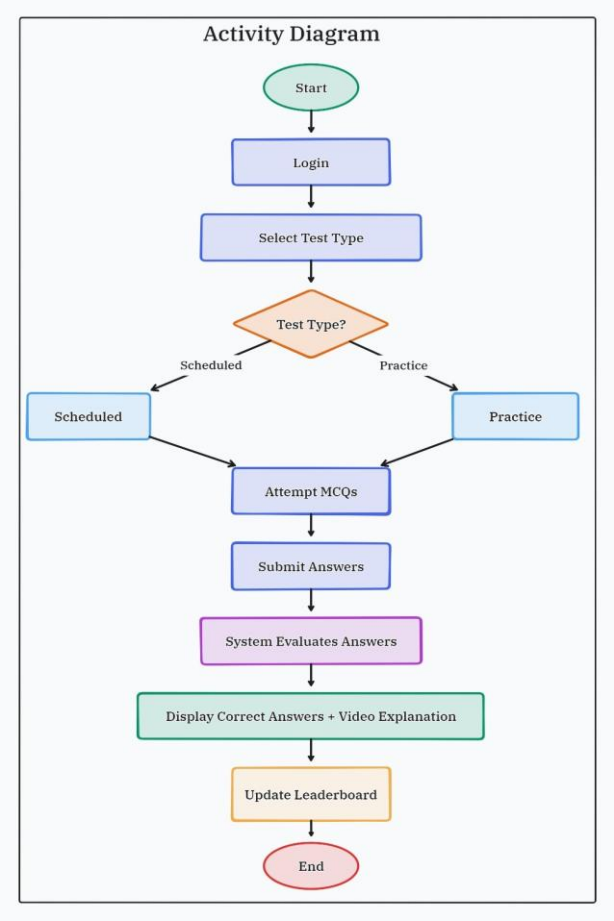
VII. ADVANTAGES

When compared with the conventional ways of evaluating students and other learning tools online, the SmartPlay platform really stands out. It has one important property – instant feedback – so that students can spot and fix their errors immediately. This immediate response helps to improve their understanding and facilitates their learning process. Oh, and SmartPlay uses intelligent technology that creates new questions constantly, so the student is exposed to a variety of problems that are just right—not too hard, not too easy. This allows teachers to save time which they would normally spend creating questions for their students. Plus, SmartPlay also has videos that explain concepts – great for students who learn visually and auditorily. This is a great benefit to those with diverse learning styles. In essence, the SmartPlay platform is a very powerful platform for students to learn from, with videos that provide fun engagement and depth to the learning. The resources are particularly effective for the use with young learners that benefit from the interactive and dynamic approach of SmartPlay.

1.Comparison Table:

Feature	**Traditional System**	**Proposed System**
Feedback	Delayed	Instant
Question Type	Static	AI-generated
Engagement	Low	High
Personalization	None	Adaptive

2.Activity Diagram :



IX. FUTURE SCOPE

Whilst it achieves its primary objectives well, there are numerous opportunities for enhancing its function, scalability and learning impact. These are some of the promising ways forward:

1.Personalised Adaptive Learning: Machine learning algorithms can be used to analyze each student's learning style, accuracy over time and speed of learning. This would allow the system to dynamically adjust the difficulty of the questions, provide targeted practice areas, and develop individualized learning curves, tailored to each student's abilities and needs.

2. Complete Performance Analytics: What if there was a teacher and parent performance analytics dashboard with visual charts and measures of progress over time? Predictive analytics could support prediction of learning outcomes and identify areas that require additional support or attention.

3. Improved Gamification: Let's make the Math Gaming Zone a Learning Arcade! There is lots of room for adding in lots of different topics, varying levels, unlockables, and friendly peer competition. Oh, and the difficulty would be adjusted, thanks to AI, to always be challenging, but not impossible.

4. Mobile Application Development: Developing a mobile application for both the Android and iOS platforms would ensure students could access the platform on any type of mobile device, particularly in rural regions where the use of computers is limited.

5.Cloud scalability and offline learning are achieved by using cloud based microservices and caching which can serve thousands of users at a single time. Also, include offline functionality that will allow students to play games and tests without an internet connection, and will sync their information once the student reconnects to the internet.

6. Voice interaction with AI: Let's incorporate voice navigation and question reading for younger students and people with visual impairments, using speech-to-text and text-to-speech technology, to make learning more inclusive.

X. CONCLUSION

This study introduces an AI-powered interactive platform designed to support exam practice and improve the learning experience for children aged 5 to 12.By combining artificial intelligence, gamification elements, and multimedia-based feedback, the platform offers an engaging and adaptable learning environment. The experimental results demonstrated a notable increase in student performance, with accuracy improving from 62% to 80%, along with greater engagement and higher completion rates. These outcomes highlight how AI-based adaptive learning systems can effectively boost academic achievement and student motivation. The platform overcomes the limitations of traditional testing approaches by offering real-time feedback, customized learning content, and interactive activities. Additionally, its scalable architecture and use of AI models make it well-suited for modern digital educational settings. Looking ahead, future work will focus on enhancing personalization through more sophisticated machine learning techniques, expanding gamification features, and developing mobile versions to improve accessibility and scalability. The observed improvements align with prior research indicating that gamification significantly enhances student engagement and learning results.

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