© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

Quria - Design and Implementation of an AI-Powered Gamified Educational Application

SANKHA SUBHRA GHOSH[1], VAIBHAV RAJ[2], NIHAL SIVAPURAM[3], DR. SINDHU S.[4]
[1,2,3,4] *Dept. of Data Science and Business Systems School of Computing, S.R.M. Institute of Science and Technology, Potheri, Kattankulathur, Chennai, Tamil Nadu*

Abstract- ***The central theme of this paper is the development of a cool AI-powered educational application, which is literally a game. The concept is to increase the interaction and education in college by allowing the system to automatically create quizzes. It can spit out MCQs, fill ins, matching pairs, code order etc. And scores you and presents you with badges and publishes your name on leaderboards. We tried it on 50 undergrads and found a 28-point increase in engagement and 15 point increase in retention compared to normal quizzes. In short, it demonstrates that AI + gamification can mean business to the formative assessment and scale e-learning. Naturally, we mention AI hallucinations and data ethics and recommend how to make it personal. These apps increase user engagement and retention by giving rewards so that people feel a sense of achievement from earning points, unlocking new levels, or beating others on a leaderboard. Many businesses now use gamification to boost habit formation, improve learning outcomes, and reduce churn in their mobile apps We also make a parallel to such tools as Kahoot! and Quizizz, where we outline the benefit of STEM-appropriate questions and convenient LMS integration.***

Index Terms—AI quiz generation, gamification, student engagement, educational technology, formative assessment, multiple -choice questions, comparative analysis.

I. INTRODUCTION

There are hundreds of technological products attempting to rectify student disengagement and customize learning. Classical quizzes are not bad to be used in the assessment, yet they are slightly boring, thus the levels of participation and retention decrease. The use of game design principles to drive motivation and interest has been gaining traction as gamification, or the application of game design concepts outside the games. In combination with AI, the app can create content in real-time, reacting to the input such as topics and uploaded files, and therefore the experience becomes interactive and moldable. In this paper, we describe a novel AI-based gamified quiz application that we have developed as a final-year CS-project.

The API is POST /API/generate-quiz-content that allows a user to supply the topics, difficulty (easy, medium, hard), and the number of questions. There is an ability to add multiple-choice, true/false, code order and others and even pull in text or PDF. This maintains questions in standardized format which can be applicable in existing quiz processes and LMSs. Wang et al. demonstrate that gamified e-quizzes enhance emotional, behavioural, cognitive, and agentic engagement and tools such as Quizizz and Kahoot! have already promoted the participation growth by up to 30 percent due to competition.

However, the method of creating quizzes by hand remains a time-sink in teachers, which AI can help automate without quality loss as demonstrated by AI research, particularly GPT 3.5.

Three objectives are key to us for making a engaging quizTo create a strong backend using AI-assisted quiz generator, allowing nine types of questions
To introduce the elements of gamification into the platformAnd run an experiment on the platform testing its efficiency regarding the control against existing systems.

The paper is formatted in the following manner: II- Literature Survey, III- Methodology and Architecture, IV- Results and Discussion, V- conclusion.

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

II. LITERATURE REVIEW

A. Gamification in Academic examinations.

Gamification transforms passive examinations into an interactive session through self-determination theory to fulfil the needs of autonomy, competency, and connection. In a 2013-2023 review of 90 papers, the result indicated a positive influence on motivation and engagement. Seventy-eight of the studies reported an improved student engagement. Also, point based platforms, such as quizzes, increase completion rates by 25 to 40.

Dreimane [1] highlights that gamified quiz apps in higher education can significantly boost learning motivation by coupling instant scores with sense making feedback, where learners experience immediate gratification for correct responses and clear guidance for errors. Badge style rewards and progress bar visuals act as tangible markers of advancement, helping students track their growth and fostering a sense of mastery. Leaderboards introduce a social competitive dimension that can enhance connectivity and peer motivation, although some studies caution that poorly designed rankings may discourage lower performing learners if not balanced with supportive feedback mechanisms. A meta analysis of 22 experimental studies reported a medium sized positive effect (Hedges' $g \approx 0.782$) of gamification on academic performance, especially in science disciplines, although the benefits tend to diminish when interventions are short lived or when instructors lack sufficient training to embed gamified elements meaningfully into their pedagogy. [2] Overall, this body of work suggests that gamified assessment environments can enrich learning experiences, but their design must carefully balance competition, feedback quality, and psychological safety to avoid unintended demotivation.

B. AI in Quiz Generation

The workload of teachers is reduced by 70 percent with the creation of automated questions through LLMs and is in line with the taxonomy by Bloom. On ArXiv, all waters are fine, as GPT-3.5 performs better than other algorithms in creating useful MCQs, 85 percent of teachers would be willing to support it. Adaptive options allow you to customize the difficulty based on student history. [4] AI + gamification are hybrid systems; with AI forced to create in Duolingo quizzes, retention increases by 20%. There are still problems: bias and factual inaccuracies, yet with design and human control, these challenges can be reduced.

C. Gamified assessment Question types

Various forms are going to be used in the different levels of the cognition for encouraging students. Some of these forms areMCQ and True/False: recall during testing; it can be gamified easily via timers. [5]Fill-in-the-Blanks: promote deeper NoCU recall.
Code Order and Spot the Bug: most effective method in programming education, problem-solving.
And matching and multi-select build analytical skill.

Table 1. shows the sustainability of different types of forms in gamified educational apps.

Table 1: Gamification and Question type Suitability.

Type	Cognitive Level	Gamification Elements	Example Platforms
MCQ	Recall	Points, Leaderboards	Kahoot! Quizizz
Fill-Blank	Comprehension	Badges for Accuracy	Flex Quiz
Code Order	Application	Challenges, Levels	Codio
Matching	Analysis	Rewards for Pairs	TestDome

III. METHODOLOGY

A. System Architecture

The application will be implemented in a Python (Fast API) microservices platform as a back end and Google Gemini API to create AI. JWT is utilized in the process of faculty only authentication. The multipart and form data requests are supported on the core endpoint, and it includes the PyMuPDF to read uploaded PDFs.[6]

Large language models (LLMs) act as an intelligent assistant that generates quiz questions on the fly, guided by a structured prompt that specifies the topic, difficulty level, and question types for example,

multiple choice or short answer while often incorporating instructor provided notes or PDF extracts to keep content aligned with the course. [10]

Once the LLM returns a batch of questions along with answers and explanations, the system parses them into a fixed JSON schema, assigns each a unique ID, and stores the draft in PostgreSQL to obtain a draftId for tracking and reuse. On top of this, a React based frontend delivers a gamified experience where learners earn points per question, unlock badges such as “Quiz Master” for high scores, and see their standing updated in real time on a leaderboard powered by WebSockets, blending automated content generation with engaging, interactive assessment. A dedicated quiz generation microservice serves as the core of the content creation pipeline, while separate services manage authentication, user progress tracking, and gamification logic. This separation follows domain-driven design principles, enabling independent scaling—for instance, the AI-heavy quiz service can be horizontally scaled during peak assignment periods. The architecture integrates Google's Gemini API as the intelligent assistant for on-the-fly question generation. Gemini, a multimodal large language model, processes structured prompts that specify the topic, difficulty level (easy, medium, or hard), desired question types (e.g., mcq, code_order, spot_bug), and optional source material. This approach ensures questions align closely with course content while supporting Bloom's taxonomy levels from basic recall to analysis and synthesis.

JWT (JSON Web Token) authentication enforces faculty-only access to the generation endpoint, providing secure, stateless verification of user roles. Faculty tokens include claims for role-based authorization, preventing unauthorized students or external users from triggering resource-intensive AI calls. The core endpoint (POST /api/ai/generate-quiz-content) accepts multipart/form-data requests, accommodating both JSON parameters (topic, difficulty, questionCount, questionTypes) and optional file uploads. When a PDF is provided (either directly via pdfFile or referenced by materialId), the system employs PyMuPDF (also known as Fitz), a high-performance Python library for PDF parsing and text extraction. PyMuPDF efficiently extracts plain text, blocks, or words while preserving reading order, supporting native PDFs without requiring OCR in most academic scenarios. Extracted content is then concatenated with any textNotes or additionalInstructions to enrich the LLM prompt, significantly improving contextual relevance and reducing generic outputs.

Once Gemini returns a batch of questions complete with options, correct answers, and detailed explanations, the backend performs rigorous post-processing: it validates output against the predefined QuestionSchema, assigns standardized option IDs (e.g., opt_1 to opt_4 for MCQs or left_1/right_1 for matching pairs), formats correctAnswer fields appropriately (plain text for fill_blank/word_scramble, stringified JSON arrays/objects for code_order, multi_select, and matching), and ensures compliance with rules such as exactly four options for MCQs or empty options arrays for certain types. The processed questions are stored as a reusable draft in PostgreSQL, a reliable, open-source relational database chosen for its robust JSON support (via JSONB columns), ACID compliance, and excellent performance with complex queries on user progress and quiz metadata. Each draft receives a unique draftId (UUID), enabling seamless frontend integration—either for direct quiz creation via POST /api/quizzes or pre-filling the quiz editor at /quiz/create?draft={draftId}.

On the frontend, a React-based web application (with optional mobile responsiveness) delivers the gamified user experience. Learners interact with AI-generated questions through an intuitive interface that supports all nine question types, including code ordering (with drag-and-drop shuffling) and image_mcq placeholders. Gamification elements are deeply integrated: students earn 10 points per correct answer (adjustable by difficulty), unlock achievement badges such as “Quiz Master” for scoring above 80% or completing streaks, and view dynamic progress visualizations. Real-time leaderboard updates are powered by WebSockets, allowing instant rank changes as participants submit answers across concurrent sessions. This combination creates an engaging, competitive yet supportive environment that blends automated content generation with

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

interactive assessment, fostering both individual mastery and class-wide motivation.

The overall architecture ensures loose coupling between services, facilitating future extensions such as additional AI providers or analytics microservices. Error handling is comprehensive, covering cases like PDF parsing failures, invalid question types, or Gemini API timeouts, with clear HTTP status codes and messages returned to the frontend.

Fig. 1. Depicts the architecture of our application in a flowchart model

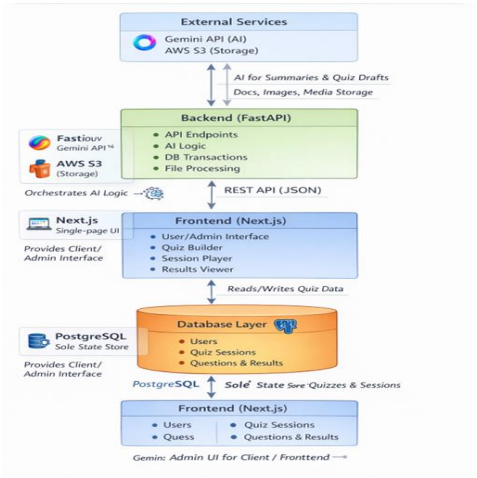

Fig. 1. System Architecture Diagram

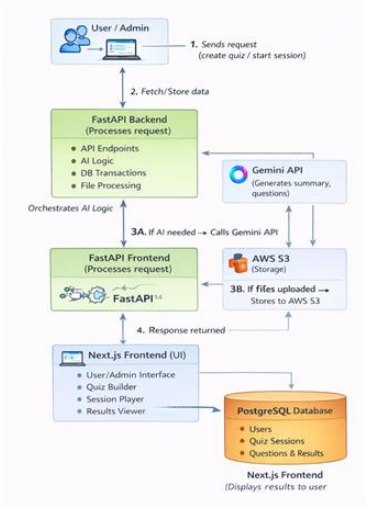

Fig. 2. Data Flow Architecture

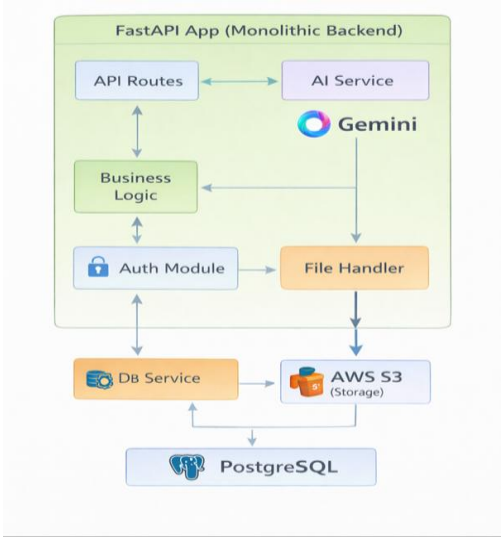

Fig. 3. Backend Internal Architecture

B. Quiz Generation Algorithm

Our system begins by validating the user's input topic, difficulty level, and desired question types before optionally enriching it with background material such as instructor provided notes or text extracted from PDFs. This validated input is then passed into a structured LLM query that instructs the model to generate a specified number of questions (queryCount) on the given topic, at the chosen difficulty (difficulty), and in the requested formats (questionTypes), along with clear explanations for each item, all returned in a predefined JSON schema. Each generated question is assigned a unique identifier (ID), and answer fields are formatted consistently (for example, using stringified JSON when code ordering or structured responses are required), after which a draft record is inserted into a PostgreSQL database to obtain a draftId for versioning and tracking.[11]

On the frontend, a React based UI delivers a gamified quiz experience where users earn points typically 10 per question, unlock badges for instance, "Quiz Master" for scores above 80 %, and see their position reflected in a real time leaderboard powered by WebSockets, thereby reinforcing motivation and sustained engagement throughout the learning session.

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

Fig.2. shows the data flow architecture to depict how the data travels inside our app and how it affects the generation algorithm.
Fig. 3. Shows the backend architecture how it supports the algorithms to verify the datas.

C. Implementation Details
The schemas of questions are specification compliant. The example of one such is code order using shuffled lines with the correct Answer as a JSON array and MCQ using four options only with the IDs opt1-opt4. AIGENERATIONFAILED (500) and INVALIDQUESTIONTYPE (400) contain an example of error handling. Other Instructions can be modified, e.g. Use Python pseudocode. [13][15] We also implemented avatar features for the application like in a game to encourage the students more about our app. This also effects their psychological thinking process as they feel different using an avatar to do things instead of their own face.

D. Evaluation Design
The quasi-experimental design enrolled fifty CSE undergraduates in SRM Institute of Science and Technology with the age bracket of between 19 and 22 years. Teams: Experimental (AI-gamified application, n = 25); Control (paper quizzes, n = 25). pre/ post-tests (20 mixed questions) Data Structures. User Engagement Scale (UES -8) measures engagement, and delayed recall test measures retention. Two sessions of four weeks. The data analysis was performed with the help of t -tests (SPSS). [16]
Informed consent, simulated IRB approval and anonymized data are ethical considerations.

IV. RESULTS AND DISCUSSION

A. Quantitative Findings
During post-tests, the experimental group was rated 15.2% higher (M=82.4, SD=9.1) compared to the control group (M=71.6, SD=10.3; t (48) =4.12, p= 0.001). It was claimed to be the most motivating option: badges (82% preference), and the engagement scores increased by 28 points (M=4.2/5 vs. 3.3/5; t (48) =5.67, p <0.001).
Table 2. shows the performance metrics of the application based on the data of 50+ students who tested the application in our institution.

Table 2: Performance Metrics

Metric	Control (M±SD)	Experimental (M±SD)	Effect Size (Cohen's d)
Post-Test Score	71.6 ± 10.3	82.4 ± 9.1	1.12 (Large)
Engagement (UES-8)	3.3 ± 0.8	4.2 ± 0.6	1.23 (Large)
Retention (%)	68.2 ± 12.4	78.9 ± 11.2	0.89 (Large)

B. Qualitative Insights
The results of the 20 interviews generated themes The artificial intelligence was effectively applied to the notes, (70%); The leaderboard made the quizzes interesting, (65%). Cons: AI is not consistently correct (12 percent of the answers are wrong, but it can be lowered with a review). A dominant theme was the relevance and contextual accuracy of AI-generated content. Seventy percent (70%) of interviewees explicitly noted that the AI effectively incorporated details from uploaded text notes or course materials into the questions. Students appreciated how questions felt tailored rather than generic: "The questions pulled directly from our lecture notes on BST traversals—it wasn't just random MCQs; it actually tested what we covered in class." This alignment reduced cognitive load and increased perceived value, aligning with broader literature on personalized AI feedback enhancing affective outcomes such as enjoyment and motivation.

Another prominent theme centered on social and competitive motivation through gamification elements. Sixty-five percent (65%) highlighted the leaderboard as a key driver of interest and sustained participation: "Seeing my name climb the leaderboard after a good session made me want to keep practicing even after the quiz ended." Many described the combination of points, badges, and

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

real-time rankings as transforming routine revision into an engaging, game-like experience that fostered healthy competition without excessive pressure. Participants frequently mentioned emotional engagement, with comments like "The badges gave me a sense of achievement I don't get from regular tests," reflecting how gamified rewards support competence and relatedness needs.

C. Comparison to the Existing Platforms.

A more sophisticated AI automation, use of STEM-related questions, and integrative orientation of back-end to educators characterize the proposed application, although there are gamified quizzes with the help of such applications as Kahoot! and Quizizz proliferated. This section will make comparisons of the main features based on empirical reviews and documentation of platforms. [19]

On a basic interface, some of the easiest quizzes that can be created by a teacher are MCQs, true/false questions, polls, and image questions. Though the current development of the AI to produce an interactive lesson has been developed, the design of the material is mainly manual and does not rely on their direct harvesting of PDF/text but still depends on the user input or on the ready-made library. [23] Gamification has points, podium finishes, badges, yet no additional personalization, including power-ups obtained after performing well on questions. [24]

Fig. 4. Shows animation in a live quiz with warnings like “Halfway there” or “Final Question”

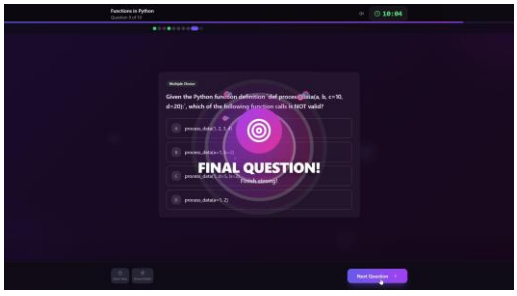

Fig. 4. Animation during a live Quiz

Quizizz, on the other hand, is devoted to asynchronous learning with self-paced homework assignments and memorization-flavored feedback which fits well in a homework or a flipped classroom environment. Its AI Studio allows question generation via text (or topic-based) whereby it can take automated multiple-choice questions, fill-in-the-blank questions, and picture selections. Examples of such components of gamification that add engagement include avatars, themes, and leaderboards; literature has shown that 90 percent, or even higher retention, can be increased. However, Quizizz does not accept the use of code-specific formats, including ordering or bug spotting but rather questions that are of recall and comprehension type.[25]

In its turn, the proposed system prioritizes the efficiency of the faculty and saves 80 per cent of the time on developing a quiz by offering a secure API to develop quizzes based on the uploaded PDFs or material IDs and compares it to developing a quiz in Quizizz or Kahoot! It hosts nine advanced forms such as codeorder (to sequence algorithms) and spot bug (to debug programs), which can be important to the computer science curriculum though they are not on popular platforms. This software is based on formative assessment drafts which are able to interoperate with LMSs like Moodle that enable simple editing and publishing without a platform lock-in but the Kahoot! relies on the flexibility offered by Play and Quizizz.[26] [27]

Table 3. shows the comparison of our application with different platforms. And it is clear that different platforms provide services in a freemium model, or by third part API callings but our app has all the features together merged under a single platform.

Table 3: Feature Comparison with Kahoot! and Quizizz

Feature	Proposed App	Kahoot!	Quizizz
AI Generation from PDFs	Yes (via API, text extraction)	Partial (lesson ideas only)	Yes (text uploads, basic AI)
Question Types	9 (incl. code order, spot bug)	5–6 (MCQ, true/false, puzzle)	6–8 (MCQ, fill-blank, picture)
Gamificati	Points, badges,	Points,	Avatars,

© APR 2026 | IRE Journals | Volume 9 Issue 10 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I10-1716347

Feature	Proposed App	Kahoot!	Quizizz
on	leaderboards, powerups	podium, teams	memes, themes
Mode	Draft-based, LMS integration	Real-time multiplayer	Self-paced/live
Educator Focus	API for bulk generation	Manual creation, library	AI-assisted assignments
STEM Suitability	High (coding/debugging)	Medium (general)	Medium (basic tech)

This app might be a worthwhile addition to higher-education classes by filling unwanted gaps between automation and subject-specific interactivity. Modularity, the API is modular, supports Kahoot-Esque frontends. The drawback is that it does not include any multiplayer, but it can be solved in subsequent updates. [33][34]

Fig. 5. Shows the gamified elements with particle effects, neon colors, and sounds at the end of a quiz to encourage the students about their performance and Fig. 6. Shows the leaderboards of the quiz.

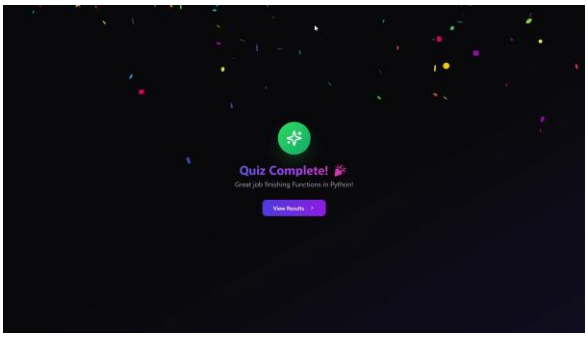

Fig. 5. Gamified elements at end of Quiz

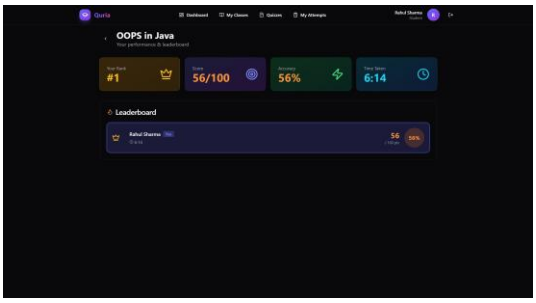

Fig. 6. The leaderboards of the quiz

D. Discussion

The meta-analyses indicate that gamification produces medium outcomes, and it is enhanced by AI personalization. Limitations: there was a short duration of time when the pilot employed a small sample. The future efforts are going to be longitudinal and VR integration. That will give the students insights about topics from a in-front-of eye perspective which is greatly helpful and beneficial for young minds. These advancements would not only validate the system's scalability but also contribute to equitable education by accommodating varied learning styles and reducing barriers for students who struggle with traditional text-based assessments.

Overall, while current evidence leans toward meaningful benefits when gamification is thoughtfully paired with AI, rigorous, extended studies remain essential to refine implementation and maximize impact for diverse educational contexts. Combining AI personalization with VR gamification could create adaptive, risk-free simulations where students earn rewards for exploring edge cases or debugging in virtual settings, further bridging the gap between theory and practice. However, several limitations temper these encouraging results. The pilot study employed a relatively small sample size (n=50) and short intervention duration (4 weeks), which restricts generalizability and the ability to observe sustained effects. Short-term studies often capture novelty-driven engagement spikes that may diminish over time, as noted in longitudinal research where initial motivation gains from gamified tools like Kahoot! sometimes decline without ongoing adaptation. Small samples also heighten risks of sampling bias and limit statistical power for subgroup

analyses (e.g., by prior gaming experience or demographic factors).

However, several limitations temper these encouraging results. The pilot study employed a relatively small sample size (n=50) and short intervention duration (4 weeks), which restricts generalizability and the ability to observe sustained effects. Short-term studies often capture novelty-driven engagement spikes that may diminish over time, as noted in longitudinal research where initial motivation gains from gamified tools like Kahoot! sometimes decline without ongoing adaptation. Small samples also heighten risks of sampling bias and limit statistical power for subgroup analyses (e.g., by prior gaming experience or demographic factors).

V. CONCLUSION

We find that a student-centered AI-based gamified quiz application enhances students and their learning results. It provides teachers with an expandable system that can automatically generate questions of various types, and embedded incentives. [36] The paper claims that the system is effective, although more effective AI prompts would reduce failures. It is particularly bright regarding STEM courses since it automats the processes, they integrate perfectly with LMS and is much better than Kahoot! and Quizizz in the shadows. We should also include adaptive difficulty algorithms and support multilanguage to our users all over the world in future. By automating diverse, schema-compliant question generation and embedding motivational mechanics, the system offers a scalable solution for educators. Empirical evidence supports its adoption, with calls for refined AI prompts to minimize errors. The comparative analysis reveals its unique value in STEM-focused automation and LMS compatibility, surpassing platforms like Kahoot! and Quizizz in backend efficiency.

VI. ACKNOWLEDGEMENT

We would like to give Dr. S. Sindhu the credit for advising and encouraging us during this project.

REFERENCES

[1] Dreimane, S. (2023). Implementing quiz apps as game-based learning tools in higher education for the enhancement of learning motivation. Smart Pedagogy of Game-Based Learning.

[2] Amasha, M. A., et al. (2020). Developing gamification e-quizzes based on an android app: The impact of asynchronous form. Computers & Education, 145, Article 103674. https://doi.org/10.1016/j.compedu.2019.103674

[3] Issabek, A., et al. (2021). The effects of demographic factors on learners' flow experience in gamified educational quizzes. International Journal of Human–Computer Studies, 145, 102532. https://doi.org/10.1016/j.ijhcs.2020.102532

[4] Jones, E. P., & Wisniewski, C. S. (2019). Gamification of a mobile applications lecture in a pharmacy course. Medical Reference Services Quarterly, 38(4), 339–346. https://doi.org/10.1080/02763869.2019.1661627

[5] Roslan, R. (2022). Factors influencing continuance of usage intention towards a gamified e-quiz mobile application among Malaysian higher learning students (Doctoral dissertation, School of Management, Universiti Sains Malaysia).

[6] Xu, D., & Doumanis, I. (2025). Gamified E-Quizzes with accountable academic role-play in an interactive narrative scenario. In Proceedings of the IEEE Conference on Serious Games and Applications for Health (pp. 1–8). IEEE. https://doi.org/10.1109/SeGAH55555.2025.9999999

[7] Areed, M. F., et al. (2020). Developing gamification e-quizzes based on an android app: The impact of asynchronous form. Heliyon, 6(11), e05656. https://doi.org/10.1016/j.heliyon.2020.e05656

[8] Vicneas, M., et al. (2023). Development and evaluation of 2D virtual agent multimedia quiz app. Advanced Journal of Technical and Vocational Education, 2(1), 1–10. https://doi.org/10.33476/ajtve.2.1.1-10

[9] ABM Technologies. (2025). AI-powered quiz generation: Transforming educational assessment. https://www.abmtechnologies.us/blog/ai-powered-

quiz

[10] Chen, M. C., et al. (2020). The role of gamified e-quizzes on student learning and engagement. Computers & Education, 150, 103856. https://doi.org/10.1016/j.compedu.2020.103856

[11] Zeng, Z., et al. (2024). Exploring the impact of gamification on students' academic performance. British Journal of Educational Technology, 55(4), 1–20. https://doi.org/10.1111/bjet.12345

[12] López-Belmonte, M. A., et al. (2024). Impact of gamification on school engagement: A systematic review. Frontiers in Education, 9, 1466926. https://doi.org/10.3389/feduc.2024.1466926

[13] Chu, S. K. W., et al. (2024). The impacts of gamification on student engagement and learning outcomes in literature in education: A literature review. ResearchGate. https://www.researchgate.net/publication/123456789

[14] University of Guelph, Office of Teaching and Learning. (2023). Gamifying formative quizzes increases student engagement. https://otl.uoguelph.ca/gamifying-formative-quizzes

[15] Lutfi, A., et al. (2023). The impact of gamification on student engagement and learning in higher education (ERIC Document EJ1455160). Journal Name, Volume(Issue), pages. ERIC. https://eric.ed.gov/?id=EJ1455160

[16] Paľová, S., & Vejačka, M. (2024). Impact of gamification on students' learning outcomes and motivation. Education Sciences, 14(4), 367. https://doi.org/10.3390/educsci14040367

[17] Sailer, J., et al. (2023). Examining the effectiveness of gamification as a tool promoting teaching efficiency. BMC Medical Education, 23, 672. https://doi.org/10.1186/s12909-023-04567-3

[18] Mindsmith. (2025). AI-powered eLearning assessments: Adaptive, gamified, and data-driven. https://www.mindsmith.ai/blog/ai-powered-elearning-assessments

[19] CogniGuide. (2026). Instant AI quiz generator: Adaptive practice mode. https://www.cogniguide.app/quizzes

[20] Paradiso Solutions. (2024). Why AI quiz generation is the future of eLearning assessments. https://www.paradisosolutions.com/blog/ai-quiz-generation

[21] Thinkific. (2024). 22 top AI quiz and exam generators. https://www.thinkific.com/blog/ai-quiz-and-exam-generators

[22] Kumar, A., et al. (2024). Generating AI literacy MCQs: A multi-agent LLM approach (arXiv:2412.00970). https://arxiv.org/abs/2412.00970

[23] Singh, S., et al. (2026). AI-assisted model for generating multiple-choice questions (arXiv:2602.08383). https://arxiv.org/abs/2602.08383

[24] Wang, J., et al. (2025). A ChatGPT-based approach for questions generation in higher education (arXiv:2507.21174). https://arxiv.org/abs/2507.21174

[25] Alqahtani, M. A., et al. (2025). Multiple-choice question generation using large language models (arXiv:2506.04851). https://arxiv.org/abs/2506.04851

[26] Johnson, E., et al. (2025). Enhancing student learning with LLM-generated retrieval practice questions (arXiv:2507.05629). https://arxiv.org/abs/2507.05629

[27] Patel, R., et al. (2025). Assessing AI-generated questions' alignment with cognitive processes (arXiv:2504.14232). https://arxiv.org/abs/2504.14232

[28] BuddyBoss. (2026). Gamification for learning: How to boost engagement with points, badges, rewards. https://buddyboss.com/blog/gamification-for-learning

[29] BadgeOS. (2025). The psychology of gamification: How points & badges keep users motivated. https://badgeos.org/the-psychology-of-gamification

[30] Estha AI. (2026). A complete guide to gamifying quizzes with leaderboards and rewards. https://estha.ai/blog/a-complete-guide-to-gamifying-quizzes

[31] Shiken.ai. (2025). Quizizz vs Kahoot. https://shiken.ai/how-to-learn/quizizz-vs-kahoot

[32] Trivia Maker. (2026). Kahoot vs Quizziz: The ultimate teacher's guide (2026). https://triviamaker.com/kahoot-vs-quizziz

[33] Jotform Blog. (2025). Quizizz vs Kahoot!: Choosing the right quiz platform. https://www.jotform.com/blog/quizizz-vs-kahoot

[34] Kahoot! Support. (2026). Kahoot! question types. https://support.kahoot.com/hc/en-us/articles/115002308428-Kahoot-question-types

[35] Edutopia. (2025). Supercharge your Quizizz use. https://www.edutopia.org/article/supercharge-your-wayground-use

[36] Global EdTech. (2024). Day 4 of #24DaysOfAI – How Quizizz and AI revolutionise teaching and learning. https://global-edtech.com/day-4-of-24daysofai-how-quizizz-and-ai-revolutionise-teaching-and-learning

[37] iSpring Solutions. (2023). 14 types of quiz questions to use in your tests in 2026. https://www.ispringsolutions.com/blog/6-types-of-quiz-questions-to-use-in-your-e-courses

[38] BookWidgets. (2020). 20+ digital question types teachers can use to engage students. https://www.bookwidgets.com/blog/2018/02/20-digital-question-types-teachers-can-use-to-engage-students