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AI Based Gamified Educational Application

Prof. P. R. Chaugule, Swejal Vairagade, Dnyaneshwari Thopate, Aryan Bhagat
Department of Computer Engineering, SKN Sinhgad Institute of Technology & Science, Lonavala, India

Abstract- Gamification in education has emerged as an effective approach to improve student engagement and learning outcomes. Traditional learning methods often fail to maintain student interest, resulting in reduced motivation and poor knowledge retention. This paper presents an AI-Based Gamified Educational Application named CodeVerse, designed to provide interactive learning through quizzes, leaderboards, rewards, and progress tracking. The system integrates AI-based question generation and performance analysis to personalize learning experiences. The application allows users to learn programming concepts through interactive gameplay. Features such as login authentication, topic-wise quizzes, score tracking, and leaderboard ranking improve user participation. The proposed system enhances learning efficiency, increases student engagement, and provides a competitive environment for learners.

Keywords- Artificial Intelligence, Educational Application, Gamification, Interactive Learning, Leaderboard, Quiz System.

I. INTRODUCTION

Gamification has become an important technique in modern education to improve student engagement and motivation. Traditional teaching methods often lack interactivity, making learning monotonous and less effective. Students tend to lose interest when learning is limited to reading or passive listening. To address this issue, gamified learning applications are being introduced to make education more interactive and enjoyable.

The proposed system, CodeVerse, is an AI-based gamified educational platform that allows users to learn programming concepts through quizzes and interactive challenges. The application provides rewards, leaderboards, and progress tracking to encourage continuous learning. Artificial intelligence is used to analyze user performance and improve question selection. This system enhances knowledge retention, improves engagement, and provides a competitive learning environment.

II. LITERATURE SURVEY

Various research efforts have explored web-based learning platforms, gamification in education, and interactive coding systems. Platforms like Codecademy, Code.org, and LeetCode provide structured programming exercises and tutorials, making coding accessible to learners. However, these platforms often lack strong gamification features, which can reduce long-term engagement.

Recent studies highlight that gamification elements such as points, badges, levels, and instant feedback significantly improve learner motivation and retention. Despite this, many existing systems only partially implement these features and do not offer a fully structured learning approach.Adaptive learning systems further enhance education by providing personalized feedback and adjusting difficulty levels. However, such systems often require complex infrastructure and may lack accessibility across devices.

Overall, existing platforms either lack proper gamification, interactivity, or adaptability. The proposed system, CodeVerse – Learning with Playing, addresses these gaps by integrating gamification, real-time

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feedback, and a structured, web-based learning environment to improve engagement and learning efficiency.

III. PROBLEM STATEMENT

Traditional learning platforms lack engagement and interactive elements, which leads to decreased student interest and poor learning outcomes. Many students find it difficult to stay motivated while learning programming concepts using conventional methods. Existing platforms often do not provide personalized learning experiences or real-time performance tracking.

There is a need for an interactive educational system that combines gamification and artificial intelligence to improve student engagement. The proposed system aims to solve these issues by introducing quizzes, rewards, leaderboard ranking, and AI-based performance tracking to create an effective learning environment.

IV. PROPOSED SYSTEM

The proposed system is designed to provide an interactive and engaging learning experience by combining Artificial Intelligence with gamification techniques. The aim is to make programming education more enjoyable, personalized, and effective through quizzes, challenges, and reward-based learning. The application offers a user-friendly and responsive interface, allowing learners to easily navigate topics, attempt quizzes, and track their progress. It reduces the monotony of traditional learning methods and enhances user motivation through competition and rewards.The system is a web-based application developed for students who seek an interactive and adaptive learning environment. It consists of the following main modules:

- Authentication Module – Secure user registration and login using backend authentication services.
- Learning Module – Provides topic-wise educational content and quizzes for programming concepts.
- Gamification Module – Implements points, badges, levels, and leaderboard to motivate users.
- AI-Based Analysis Module – Analyzes user performance and provides personalized feedback and recommendations.
- Progress Tracking Module – Tracks user scores, achievements, and overall learning progress. The working steps of the system are as follows:
- User registers or logs in to access the platform.
- User selects a topic or quiz from the dashboard.
- User attempts quizzes and interactive challenges.
- The system evaluates answers and provides instant feedback.
- Points, badges, and leaderboard rankings are updated based on performance.
- AI analyzes user performance and suggests improvements.
- The system provides continuous learning and progress tracking for users.

V. METHODOLOGY

The proposed system is developed using an Agile approach to ensure flexibility, continuous improvement, and user feedback integration. Initially, challenges in programming education such as low engagement, lack of motivation, and limited interactivity were analyzed.

A web-based gamified framework is implemented using Next.js and Tailwind CSS for the frontend, and Supabase for backend services including authentication and database management. The system integrates gamification features such as levels, points, badges, and hints to enhance user engagement. User activities like quiz attempts and challenge completion are tracked to provide personalized feedback

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and monitor progress. The system follows a modular development approach with iterative sprints, focusing on features like authentication, dashboard, gamification engine, and performance tracking, resulting in an interactive and adaptive learning platform.

VI. SYSTEM OVERVIEW

The system architecture is designed using three main layers: Presentation, Application, and Gamification. It follows a learner-centric approach to provide an interactive, engaging, and adaptive learning experience.

The Presentation Layer (Next.js) allows users to interact with the system by attempting coding challenges and quizzes. The Application Layer processes user inputs, evaluates responses, and provides instant feedback. The Gamification Layer manages points, badges, levels, and leaderboard updates to motivate learners.

The system supports two main workflows: Learner Flow and Admin Flow. In the Learner Flow, users attempt challenges, receive feedback, and progress through levels. In the Admin Flow, administrators manage content, monitor user performance, and configure gamification features.

This architecture ensures real-time interaction, scalability, and an engaging learning environment for users.

VII. RESULTS

The proposed AI-Based Gamified Educational Application (CodeVerse) was evaluated through real-time user interaction scenarios involving quiz attempts, leaderboard updates, and progress tracking. The system demonstrated stable performance and responsive behavior across all modules. Users were able to successfully register, log in, select topics, and attempt quizzes without any issues. The application provided instant feedback for each response, improving user understanding and engagement.

The system effectively displays user performance in real time, including scores, levels, and leaderboard rankings. Gamification features such as points, badges, and levels were accurately updated based on user activity, encouraging continuous participation. The response time for quiz evaluation and score updates was minimal, ensuring a smooth and uninterrupted learning experience.

The user interface is simple, clean, and easy to navigate, with separate sections for quizzes, progress tracking, and leaderboard display. The system allows users to track their improvement over time and compete with others, making learning more interactive and motivating. AI-based performance analysis helps in providing personalized feedback and improving learning efficiency.

However, minor limitations were observed such as dependency on internet connectivity for real-time updates and limited AI personalization in the current version. These can be improved by enhancing offline capabilities and integrating more advanced AI models. Overall, the system demonstrates that combining gamification and AI significantly improves engagement and effectiveness in programming education.

Traditional Learning	AI Gamified Learning (Codeverse)
Static Learning Methods	Interactive quiz-based Learning
Low engagement	High engagement with rewards
No real-time feedback	Instant feedback system

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No competition	Leaderboard and ranking system
Fixed learning path	Personalized learning experience

VIII. CONCLUSION

- The proposed AI-Based Gamified Educational Application (CodeVerse) improves student through interactive quiz-based learning.
- The system integrates gamification features such as leaderboard, rewards, and score tracking to motivate users.
- Artificial intelligence helps in analyzing user performance and enhancing personalized learning experience.
- The application provides an interactive and competitive environment for learning programming concepts.
- The developed system improves knowledge retention and encourages continuous learning.
- The platform is user-friendly and supports topic-wise quiz practice with instant feedback.
- Future enhancements include adding more subjects, advanced AI-based.

Future Scope

The system can be further enhanced by improving AI-based personalization using advanced machine learning models to better analyze user performance and adapt learning paths accordingly. Gamification features can be expanded by introducing more interactive elements such as multiplayer challenges, real-time competitions, and collaborative learning modules. The application can also be extended to mobile platforms to increase accessibility and usability for a wider range of users. Integration with additional learning resources such as video tutorials, coding editors, and external APIs can further enrich the learning experience. Moreover, incorporating adaptive AI features like difficulty adjustment, smart recommendations, and progress prediction can make the system more intelligent and user-centric. These improvements can help transform the system into a more scalable, efficient, and next-generation educational platform.

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