

Next Level E-Learning: From Scrolling to Scoring Success

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ABSTRACT

Advancements in technology have reshaped education, providing students with vast digital resources and the flexibility to learn remotely using connected devices. Yet, these benefits are accompanied by challenges, including distractions from notifications and multitasking, which can undermine students' focus and productivity. To tackle these issues, we introduce a gamified web-based educational platform that combines video lessons with interactive quizzes to boost engagement, motivation, and knowledge retention. By incorporating game-inspired elements such as rewards, progress tracking, and leaderboards, the platform encourages active participation and minimizes distractions. Quizzes embedded within videos further promote sustained attention, fostering a dynamic and immersive learning experience. Designed to support students, educators, and institutions, this solution addresses the critical need for enhanced engagement in online learning, often neglected by conventional e-learning systems. The platform employs scalable technologies, including AWS S3 for secure multimedia storage and Firestore for efficient metadata management, ensuring robust performance. This paper outlines the development of this innovative platform, emphasizing its interactive features - quizzes, leaderboards, and streak-based incentives and its potential to transform online education by creating a focused, learner-centric environment that bridges engagement and academic success.

Keywords: Gamified Education, e-learning, Student Engagement, Interactive Learning, Quizzes, Leaderboards, Rewards System, Distraction Reduction, Online Education, Knowledge Retention, AWS S3, Firestore, Scalable Learning Platforms

INTRODUCTION

The Covid-19 pandemic accelerated the global shift to digital learning across all academic levels [1], redefining knowledge delivery and introducing new pedagogical challenges [3,4]. While online education offers flexibility and broad access, it also raises concerns about sustaining student attention, motivation, and achievement without structured physical environments [5,6].

A major challenge in online learning is the high potential for distractions, as students frequently shift between video lessons and competing digital stimuli like social media and entertainment [1]. This fragmented attention undermines comprehension and retention [6]. As virtual education loses its novelty, learners report growing disengagement, declining motivation, and limited interaction—factors linked to poorer long-term outcomes [3]. At the same time, educators face the demands of mastering new digital tools, addressing technical issues, and adapting teaching methods to sustain engagement [2,7,8].

In response to these evolving challenges, the concept of gamification has gained widespread attention as an effective strategy to enhance engagement and counteract digital fatigue [1,18]. Gamification introduces elements of gameplay such as points, levels, streaks, leaderboards, and achievements into non-gaming contexts to foster a sense of progress and motivation [10,11]. Educational research has demonstrated that gamified environments can significantly improve learner attention, participation, and satisfaction, particularly in asynchronous and self-paced learning contexts [9,12,13]. By transforming passive content consumption into interactive learning experiences, gamification enables deeper engagement and more consistent participation, thereby improving overall learning outcomes [14,19,20,21].

This paper introduces Treasure Map Academy, a fully implemented gamified educational platform designed to

tackle engagement, distraction, and content delivery challenges in online learning.



Figure. 1. TMA's Gamification Strategies for Distraction-Free Online Learning

Daily learning streaks and coin-based reward systems to incentivize consistent participation and reinforce positive learning habits;

Achievement badges and leaderboards to foster a healthy sense of competition and progress tracking among peers.

Beyond learner-focused features, Treasure Map Academy offers a streamlined backend for educators. Creators can upload videos, embed timestamped quizzes, assign course metadata, and preview lessons in real-time. A dedicated admin interface handles course approvals and quality checks, supporting scalability and content integrity [1]. Treasure Map Academy's technical foundation prioritizes scalability, cost-efficiency, and performance. It uses AWS S3 for media storage, Firebase Firestore for real-time database and authentication, and EC2 for backend logic [16,17].

Performance benchmarks for video uploads, data loading, and page rendering

Scalability analysis under simulated content loads and user interactions

Security and data integrity strategies for file deletion, course updates, and access control

Cost analysis demonstrating feasibility within free-tier constraints for video-centric content

A proposed user study to evaluate engagement and learning outcomes in future use

Treasure Map Academy addresses key challenges in online learning through a gamified, scalable model aimed at enhancing engagement and educational quality.

COMPARISON

Table. 1. Comparison: TMA vs other platforms

Feature	TMA	Udemy	Duolingo
Timestamp Based Quizzes	yes	no	no
Creator Uploaded Custom Courses	yes	yes	no
Daily Streaks	yes	no	yes
Coin Economy & Badges	yes	no	yes
Real Time Preview Editor	yes	no	no

Proposed Solution

Distractions and multitasking significantly hinder effective online learning. Gamification has emerged as a viable strategy to mitigate these challenges [1]. In response, we propose the development of a gamified e-learning platform aimed at enhancing learner focus and engagement. A key innovation of the platform lies in its ability to embed quizzes directly into video content at specific timestamps. The platform architecture comprises two core components: a content creator interface and a learner interface [1].

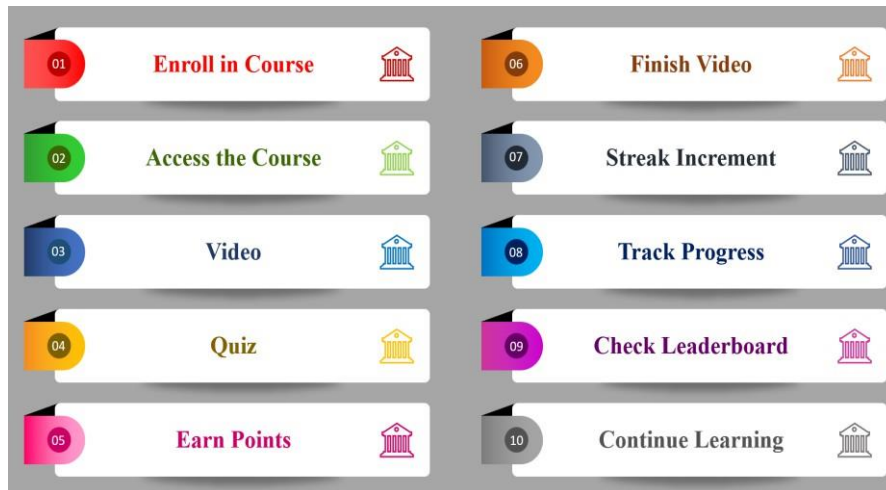


Figure. 2. Learner's Journey through TMA

The learner's journey through the TMA platform is illustrated in Figure 1. Students begin at a central Dashboard, where they can explore available courses. The platform encourages community interaction through a Leaderboard System, where learners can compare their performance with peers across multiple metrics such as engagement frequency and point totals.

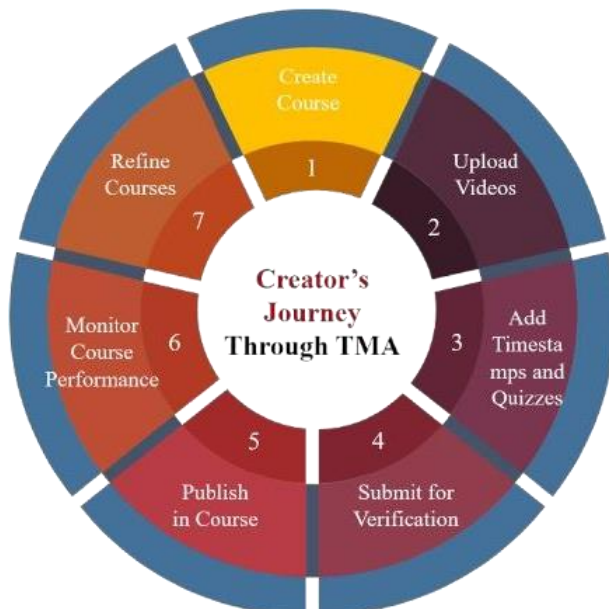


Figure. 3. Creator's Journey through TMA

As shown in Figure 3, course creation on the platform follows a well-defined workflow. Educators start at the Dashboard, where they can initiate a new course via the Create Course module. They proceed to Upload Videos, providing core instructional content, which is then enriched by adding Quizzes and Timestamps to enhance learner interaction.

Once the course is finalized, it undergoes a Verification Process to ensure alignment with platform guidelines. Upon approval, the instructor can Publish the Course, making it available to learners. Post-publication, instructors can use Analytics Tools to monitor student engagement and learning outcomes.

As shown in Table 1, Treasure Map Academy (TMA) combines several unique features not found together in popular platforms like Udemy and Duolingo. By supporting timestamp-based quizzes, creator-uploaded custom courses, daily streaks, a reward system of coins and badges, and a real-time preview editor, TMA offers a well-rounded solution that enhances both content delivery and learner engagement. This integrated approach strengthens the platform's ability to maintain focus, encourage consistency, and deliver a truly interactive learning experience.

System Workflow

This system flow diagram defines the user interaction within the Treasure Map Academy (TMA) platform. The architecture involves three distinct user roles: Creator, Admin, and Learner, each with a specific set of features and access. Below is a detailed breakdown of each user's flow.

Creator Flow

The Creator is responsible for designing and publishing educational courses. Their journey through the system is as follows:

Authentication: Log in or sign up.

View Profile: Access personal details and stats..

Creator Dashboard: Central hub for course management.

Manage Courses: View, edit, or delete existing courses.

Create Course: Add course details, upload videos, and embed quizzes.

Send for Verification: Submit for admin review.

Publish Course: Upon approval, the course is made public.

View Progress: Monitor learner interactions and quiz completions.

Creator - UI Snapshots

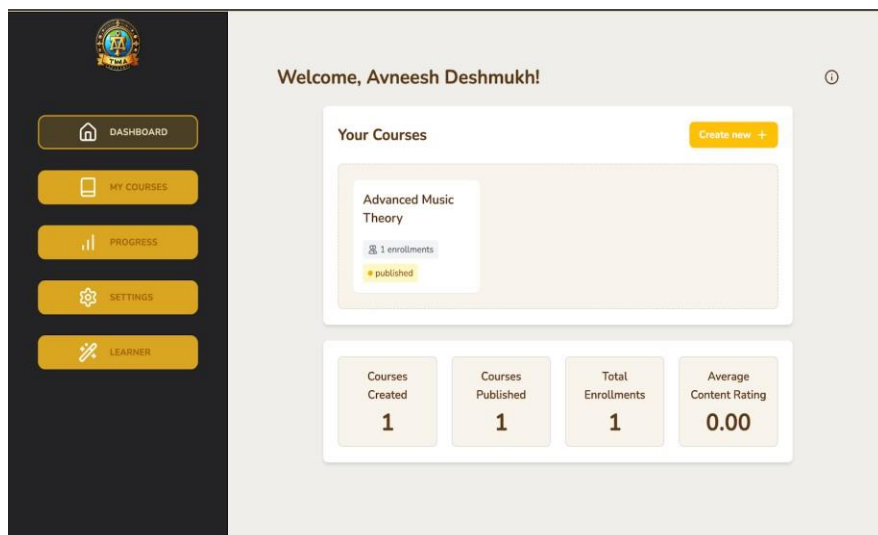


Figure. 4. Creator Dashboard

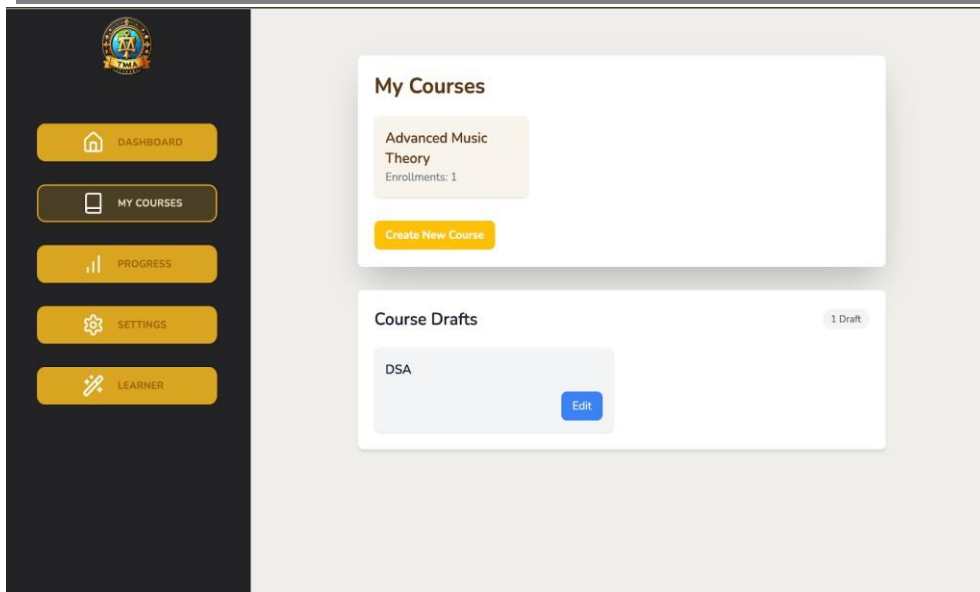


Figure. 5. Course Creation Platform

Admin Flow

Admins ensure content quality and adherence to platform standards :

Authentication: Secure login for access.

Admin Dashboard: Manage course submissions.

Reject Course: Deny courses that don't meet standards, with feedback.

Approve Course: Publish courses that meet criteria.

Give Feedback: Provide suggestions for improvement.

Admins evaluate courses for quality, gamification elements, and effective quiz integration.

Admin - UI Snapshots

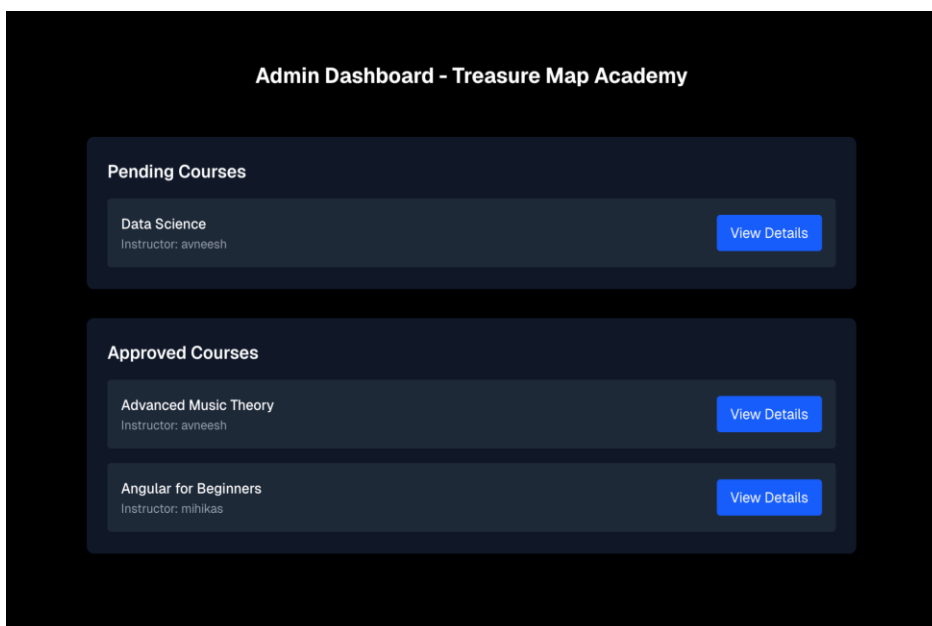


Figure. 6. Admin Dashboard

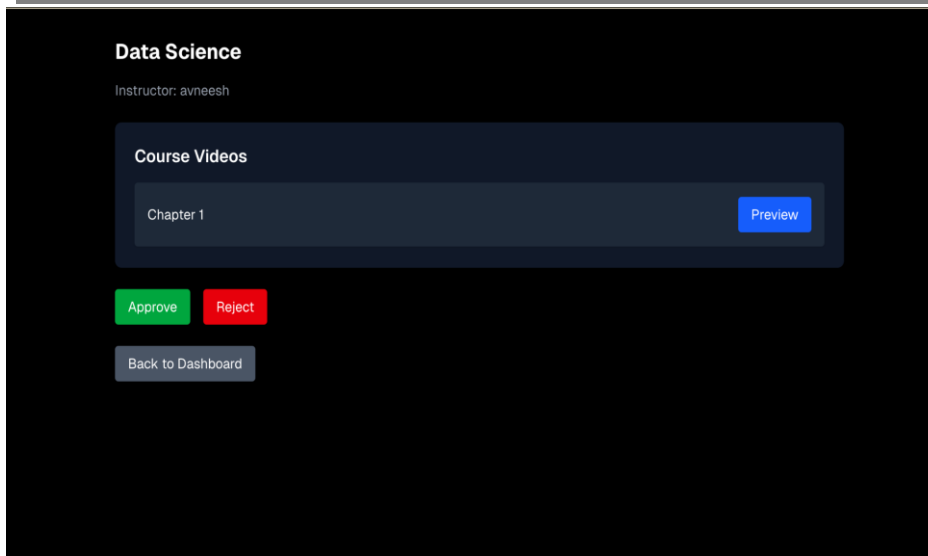


Figure. 7. Course Verification Interface

Learner Flow

Learners interact with the platform as follows:

Authentication: Log in or register for a personalized experience.

View Profile: Access learning stats and user information.

Learner Dashboard: Navigate learning materials.

View Courses: Browse courses by category or interest.

Course → Video → Quiz: Watch lessons and complete embedded quizzes to progress.

Increment Streak: Daily lesson and quiz completion boosts streaks, encouraging consistency.

This structured flow supports smooth learning, quality content, and user engagement.

Learner - UI Snapshots



Figure. 8. Learning Path

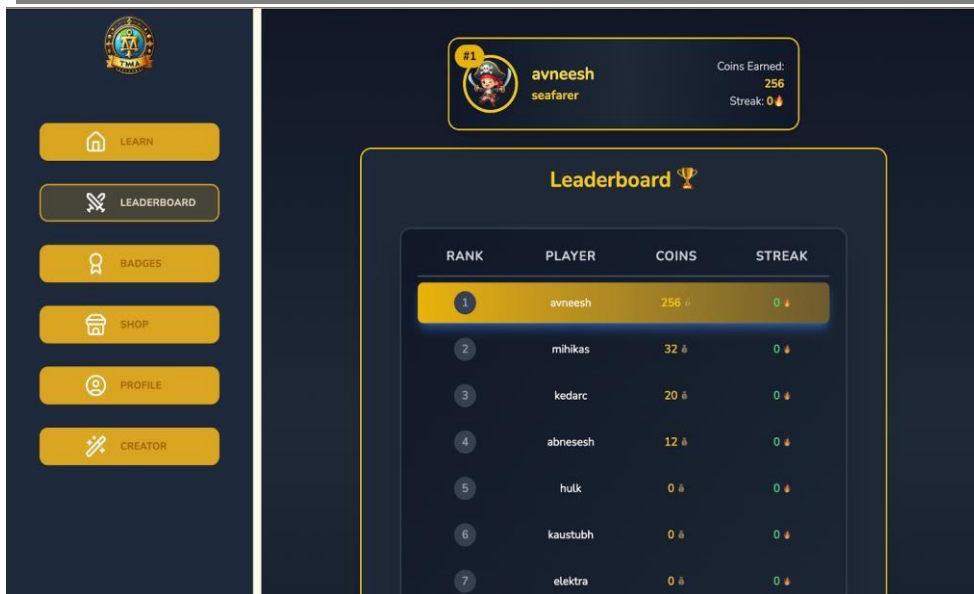


Figure. 9. Leaderboard

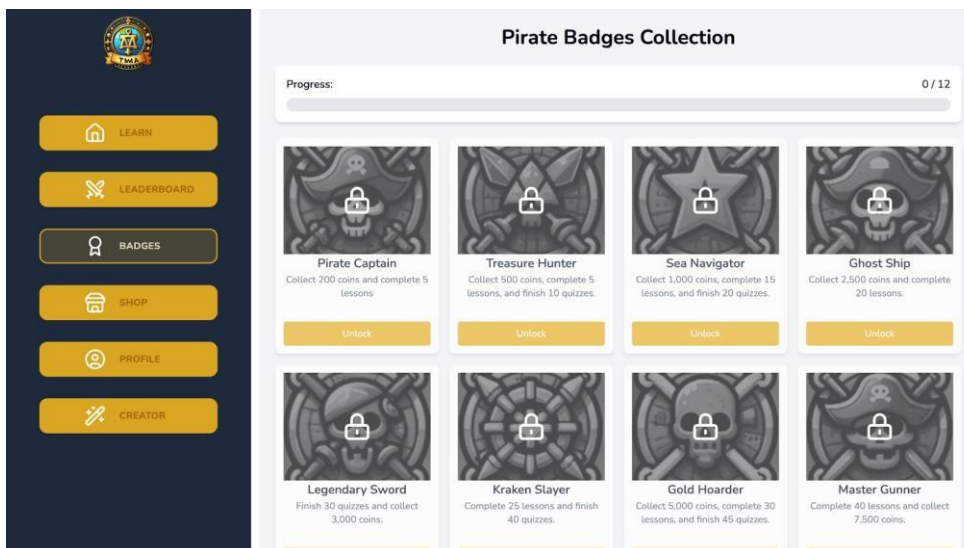


Figure. 10. Unlockable Badges for Learner

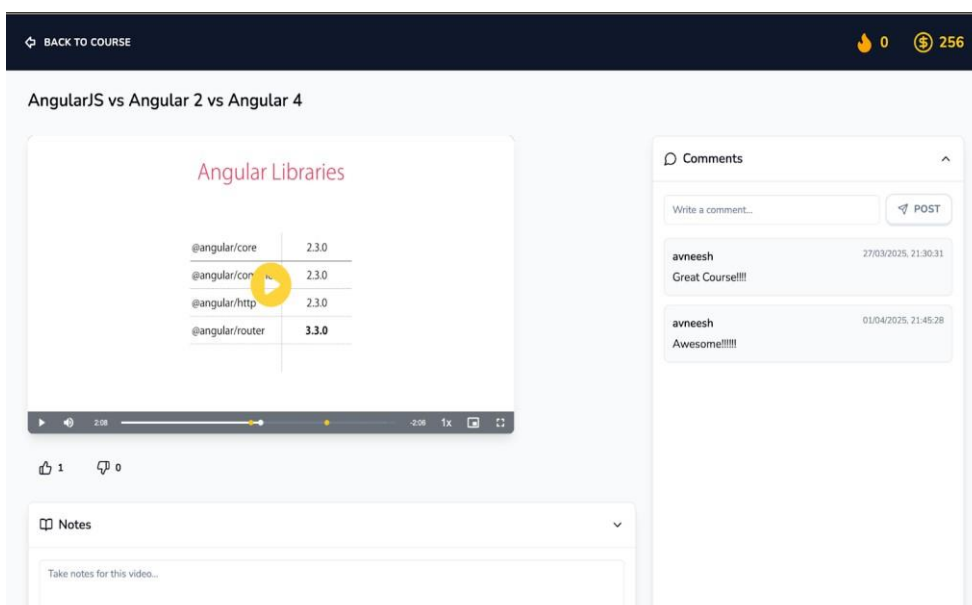


Figure. 11. Lesson Interface

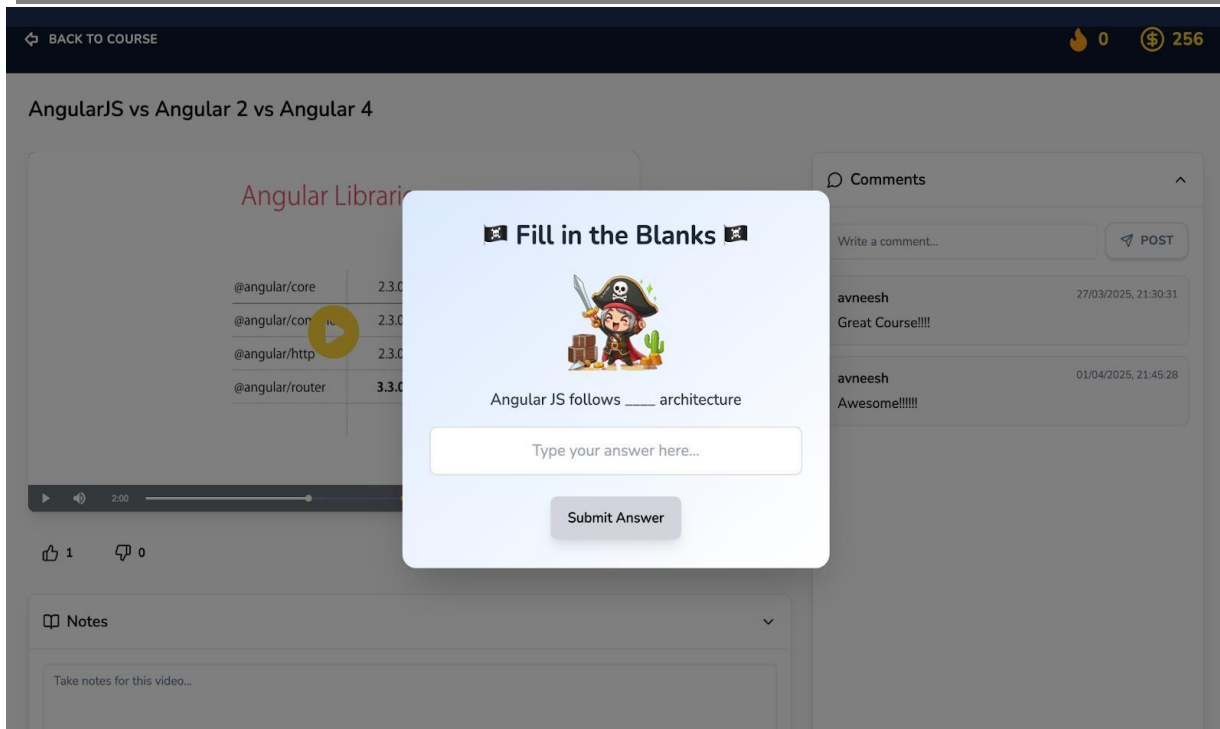


Figure. 12. Quiz Embedded in a Video

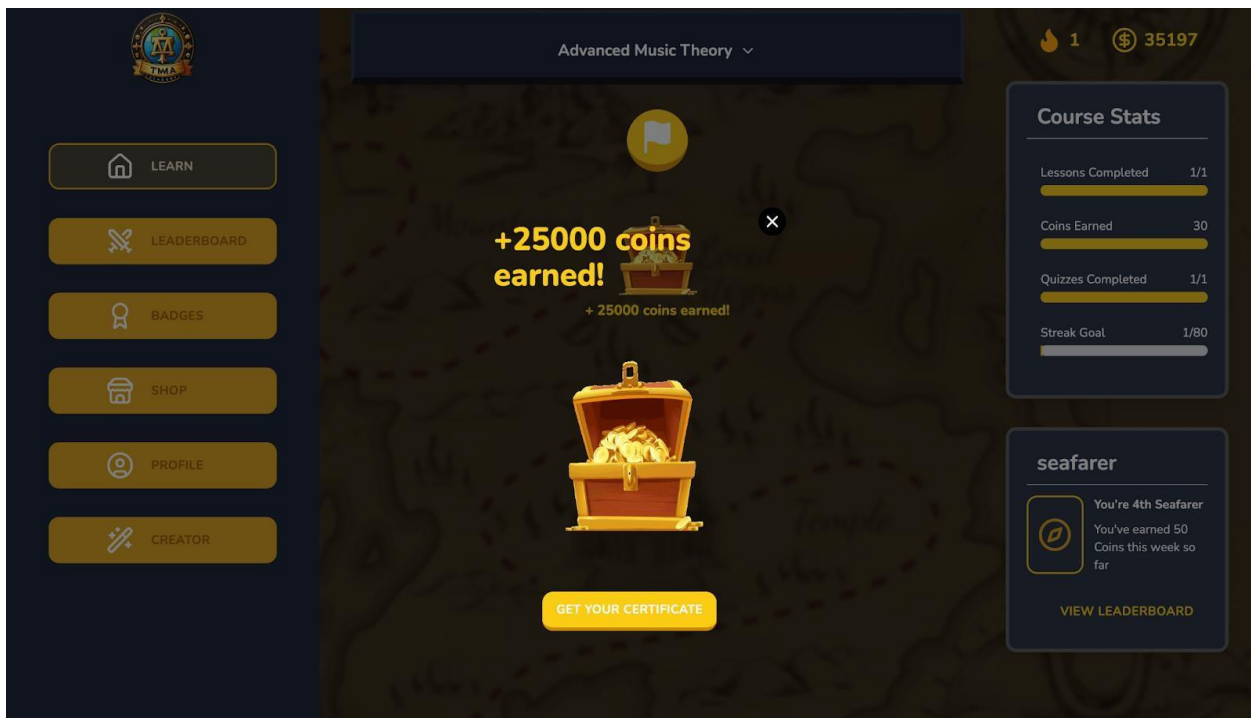


Figure. 13. Course Completion Reward

Gamification Techniques

The platform enhances student engagement through game-based strategies [1], promoting participation via achievement monitoring, reward systems, and in-course assessments. This approach fosters motivation by recognizing individual accomplishments and encouraging healthy competition.

Quizzes

Creators can embed quizzes within video lessons to break content into manageable parts, sustaining attention and promoting active learning. Quiz types include:

Multiple Choice – Tests key concepts..

Fill in the Blanks – Assesses recall and ability to apply knowledge.

True/False – Quickly evaluates basic comprehension.

Reward system - Badges and Coins:

Learners earn badges for milestones like module completion and coins through active participation. These gamified rewards provide visible progress markers, motivating consistent engagement.

Leaderboards and Streak Tracking

Leaderboards showcase top performers, while streak tracking rewards consistent daily engagement. These features build discipline and encourage regular study habits through public recognition.

Performance Level Unit Algorithm

The platform's leaderboard system employs advanced ranking algorithms to foster fair competition. It assesses metrics like quiz performance, content difficulty, and engagement to calculate a Performance Level Unit (PLU) for each learner. Learners are grouped into tiers using clustering methods (e.g., K-Means, DBSCAN), ensuring fair competition among those with similar performance levels. Rankings are updated regularly to maintain motivation and active participation.

Calculating the Performance Level Unit (PLU)

Each learner's PLU is determined through a weighted formula that combines multiple factors. For example:

$$PLU = RPS + DS + QPS + ES$$

QPS (Quiz Performance Score)

Moving average based on the ratio of currentPoints to totalPossiblePoints.

$$newQPS = oldQPS + \alpha (ratio - oldQPS)$$

Where:

$$ratio = \frac{currentPoints}{totalPoints \times attempt}$$

Updates when the learner completes a quiz.

DS (Difficulty Score)

DS is updated similarly using the **difficulty** (median of quiz difficulties):

$$newDS = oldDS + \alpha (difficulty - oldDS)$$

Where:

difficulty = median of all difficulties.

Updates when the learner completes a quiz.

ES (Engagement Score)

ES is incremented based on an exponential decay function:

$$\text{newES} = \text{oldES} + 0.1 \times 0.5^{[\text{oldES}]}$$

Rounded to two decimal places.

Updates when the learner completes the streak.

RPS (Recent Performance Score)

RPS normalizes **points** between the historical min and max to a scale of 0 to 5:

$$\text{currentValue} = 5 \times \frac{\text{newPoints} - \text{minPoints}}{\text{maxPoints} - \text{MinPoints}}$$

Updates when the learner completes a quiz.

Resets when the leaderboard is refreshed as part of the weekly reset, not when leaderboard positions change.

Tier-Based Grouping

Learners are clustered based on normalized PLU values, forming balanced competition groups.

This method ensures fair ranking among peers with similar skills.

Ranking and Updates

Learners within each tier are ranked by raw PLU and other metrics.

Leaderboards are updated daily or weekly, with re-clustering to reflect current trends.

Bonus points are awarded for streaks and milestones, encouraging continuous learning.

Platform Integration of the Leaderboard

Frontend: Displays tier-based leaderboards, highlights top performers, and showcases milestones.

Backend: Stores learner data in Firestore, with caching for real-time updates.

System Architecture and Technology Stack

The platform's architecture leverages Next.js and Firebase to create a scalable, real-time e-learning application [16]. This setup enables efficient content management and optimized server-side rendering for a seamless user experience.

Integrated Frontend and Backend (Next.js)

Next.js powers both the frontend and backend, enhancing performance through server-side rendering (SSR) and static site generation (SSG). Its modular design supports interactive features like dashboards, quizzes, and leaderboards, ensuring fast loads and a smooth interface. Real-time functionalities, such as live quiz participation and streak monitoring, benefit from Next.js's SSR and state management.

API and Server-Side Operations

Backend logic is handled through Next.js API routes, eliminating the need for external servers like Express [15]. These routes manage authentication, quiz logic, and user interactions. RESTful APIs facilitate real-time

updates for quizzes, leaderboards, and user data, ensuring a consistent experience during synchronous activities.

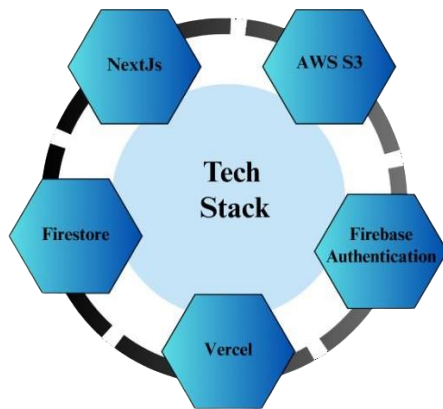


Figure. 14. Technology Stack

Database Management with Firestore

The platform uses Firestore, a NoSQL database, for storing user profiles, quiz sessions, and engagement data [16]. Firestore's real-time capabilities support live quiz updates and instant leaderboard changes, providing smooth transitions and immediate feedback. Its scalability makes it ideal for dynamic educational content.

Cloud Hosting and Video Storage

The platform is hosted on AWS for scalability and reliability [17], while video content is stored on AWS S3 for high availability and smooth streaming. This ensures stable content delivery as the user base expands.

CONCLUSION

The designed gamified e-learning platform offers a modern solution to the ongoing challenges of maintaining learner engagement and enhancing content interaction in virtual education. By integrating elements such as interactive quizzes, daily activity streaks, point systems, and leaderboards, the platform fosters a more engaging and motivating environment that encourages regular participation and supports better retention of knowledge.

For educators and content developers, the platform streamlines the course creation process with a user-friendly interface that supports video uploads, in video quiz placement, and smooth content management. Leveraging AWS S3 for dependable video storage, and utilizing Next.js and MongoDB for optimal performance, the platform is engineered to be scalable and responsive catering to the demands of an expanding user community.

Looking ahead, the continued success of the platform will depend on how effectively it handles aspects like user onboarding, maintaining high content standards, and managing system growth. With future enhancements such as adaptive learning techniques and advanced data analytics, this platform is well-positioned to transform the online learning experience and set a benchmark for interactive and gamified education.

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