

# Eduvanta: Student Learning Management System with Gamification

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**Abstract**—Learning Management Systems (LMS) in educational institutions. Although current systems such as Moodle, Canvas, and Blackboard are equipped with necessary features for course management and content delivery, they tend to be inadequate in maintaining learner engagement, ensuring secure onboarding processes, and facilitating personalized learning experiences. Most existing LMS solutions are also deficient in having efficient motivational tools, easy cross-platform compatibility, and smart performance evaluation tools, leading to lower learner engagement and limited learning outcomes. To overcome these limitations, this paper introduces EduVanta, a novel, gamified Student Learning Management System (SLMS) that aims to improve learner engagement, security, and performance in an integrated and scalable digital platform. EduVanta integrates learning processes with gamification elements such as points, levels, badges, leaderboards, and achievements to motivate learners and promote regular engagement. The system provides role-based access to students, teachers, and administrators, facilitating efficient course, assessment, and learning analytics management. A secure onboarding process with identity and role verification is also incorporated to ensure platform integrity and protect against unauthorized access. This security-oriented approach is highly applicable in an educational setting, where data privacy and authenticity of users are of utmost importance. The proposed system also incorporates automated code evaluation and assessment tools, making it highly appropriate for technical and engineering education. These modules offer instant feedback, minimize the instructor's workload, and enable students to enhance their learning through iterative learning. Moreover, EduVanta is developed as a cross-platform solution, which facilitates easy access through web and mobile platforms, thus facilitating anytime, anywhere learning. Personalized dashboards and progress visualization tools assist learners in monitoring their academic development, while instructors can analyze student performance through analytical reports. From a method-

ological standpoint, this research work offers a theoretical system architecture that defines the basic modules like user management, course management, gamification engine, assessment engine, and analytics dashboard. The architecture is designed to be modular, scalable, and extensible, which will facilitate future integration with emerging technologies like artificial intelligence-based recommendation and adaptive learning paths. Unlike traditional LMS systems, EduVanta is designed to develop an engaging learning ecosystem instead of a content-repository system. In summary, EduVanta overcomes the major drawbacks of existing LMS systems by integrating secure system design with gamification and automated assessment approaches. The proposed SLMS system is expected to enhance learner motivation, optimize instructional efficiency, and facilitate contemporary educational needs. This research work offers a complete theoretical framework for next-generation learning platforms and lays a foundation for future implementation and experimental validation in real-world academic settings. **Index Terms**—Learning Management System, OTP Verification, Gamification, Automated Code Assessment, Secure LMS

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## I. INTRODUCTION

The adoption of digital technologies in the education sector has resulted in the modification of conventional teaching and learning processes, resulting in the widespread use of Learning Management Systems (LMS) in educational institutions. LMS systems support a centralized learning platform for teaching, content management, communication, and evaluation. However, most of the existing LMS systems in use today are more focused on administrative efficiency and lack the engagement, personalization, and motivational aspects for learners. This has resulted in decreased interaction, reduced completion rates, and lack of active participation of learners in online learning environments.

In recent years, the importance of more engaging and student-centric learning platforms has become increasingly apparent, especially in technical and engineering education where continuous practice and timely feedback are required. Traditional learning platforms such as LMS do not support intelligent assessment tools, real-time tracking, and motivational tools that promote continuous learning. In addition, issues pertaining to secure user enrollment, identity verification, and role-based access are still not appropriately addressed in existing LMS systems, which can be a threat to data privacy and academic integrity.

To address these issues, this paper proposes EduVanta, a gamified Student Learning Management System (SLMS) that aims to improve learner engagement, security, and academic outcomes. EduVanta incorporates game mechanics such as points, levels, badges, and leaderboards into a structured learning process, transforming the learning experience into an engaging and motivating activity. The system supports multiple user roles, including students, instructors, and administrators, enabling effective course management and performance analysis.

EduVanta also features automated assessment tools and analytical dashboards that provide instant feedback and insights for both learners and educators. The system is developed as

a scalable, cross-platform solution with web and mobile accessibility, ensuring flexibility and ease of use. By integrating secure system architecture with gamification and automated evaluation, EduVanta seeks to overcome the limitations of existing LMS platforms and contribute to the development of next-generation digital learning ecosystems.

The main contributions of this work are as follows:

- A secure OTP-based email verification mechanism with expiry and resend controls.
- Role-based dashboards and workflows for students, instructors, and administrators.
- A signal-driven gamification engine that rewards meaningful learning events.
- A sandboxed automated grading subsystem with strict resource constraints.
- An evaluation framework to assess performance, engagement, and learning outcomes.

## II. RELATED WORK

Learning Management Systems (LMS) have been widely adopted in educational institutions to support online and blended learning. Popular platforms such as Moodle, Canvas, Blackboard, and Google Classroom

support essential functionalities such as course content delivery, assignment submission, grading, and communication. Although these platforms are effective for administrative management, several studies have pointed out their limitations regarding learner engagement, motivation, and personalized learning experiences. Most traditional LMS platforms are content-centric, offering low interactivity and insufficient support for adaptive learning.

To overcome engagement-related limitations, researchers have investigated the integration of gamification in educational systems. Gamification techniques such as points, badges, leaderboards, and levels have been demonstrated to enhance student motivation, participation, and learning outcomes. Prior research suggests that game-based elements can positively influence learner behavior when applied in a structured and goal-oriented manner. However, most existing gamified LMS implementations focus on isolated features rather than a unified and scalable gamification framework embedded throughout the learning process.

Another significant area of related work involves secure onboarding and identity verification in e-learning platforms. Several studies highlight the importance of role-based access control and authentication mechanisms to ensure academic integrity and data security. Nevertheless, many LMS platforms rely on basic authentication approaches that lack strong verification and continuous monitoring capabilities.

Automated assessment systems, particularly for programming and technical subjects, have also gained attention. Tools that support automatic code evaluation and instant feedback help reduce instructor workload and promote iterative learning. However, these tools are often developed as standalone solutions and are not seamlessly integrated into LMS platforms.

EduVanta distinguishes itself by integrating gamification, secure onboarding, and automated assessment within a unified SLMS architecture, thereby addressing key gaps identified in existing research.

## III. SYSTEM OVERVIEW

EduVanta is a secure, gamified Student Learning Management System (SLMS) that aims to enhance learner engagement, academic performance, and instructional efficiency. The system is built on a modular, role-based architecture that supports three primary user roles: students, instructors, and administrators. Each role is assigned specific functionalities to ensure seamless interaction, efficient course management, and controlled access to system

resources.

At the core of EduVanta is the User Management Module, which is responsible for secure user registration, authentication, and role validation. This module ensures that only authorized users can access the platform while maintaining data privacy and academic integrity. The Course Management Module allows instructors to create and manage courses, upload learning materials, define assessments, and monitor student performance. Students can enroll in courses, access learning resources, submit assignments, and track their achievements. A major component of the system is the Gamification Engine, which integrates game-based elements such as points, badges, levels, and leaderboards into learning activities. These elements are dynamically awarded based on user interactions, assessment outcomes, and participation, encouraging learners to remain actively engaged. The Assessment and Evaluation Module supports quizzes, assignments, and automated code evaluation, offering instant feedback and reducing instructor workload.

EduVanta also includes an Analytics and Reporting Module that delivers performance metrics and learning insights through interactive dashboards. Instructors gain visibility into student engagement and outcomes, while students can monitor their own progress. Designed as a cross-platform solution, EduVanta supports both web and mobile access, ensuring flexibility and scalability. The integrated architecture enables seamless communication between modules, making EduVanta a comprehensive and future-ready digital learning ecosystem. This illustrates a high-level overview of the system architecture and role-based interactions. The platform enforces OTP verification during onboarding to ensure that only verified users can access protected resources.

#### IV. ARCHITECTURE AND DESIGN

The architecture of the EduVanta system is designed to be modular, scalable, and secure, enabling efficient management of learning activities while supporting future enhancements. The system adopts a layered architecture that separates the presentation layer, application logic, and data management to ensure maintainability and flexibility. This approach allows individual components to be developed and scaled independently without affecting overall system performance.

The Presentation Layer provides web and mobile interfaces for students, instructors, and administrators.

It includes interactive dashboards, course views, assessment interfaces,

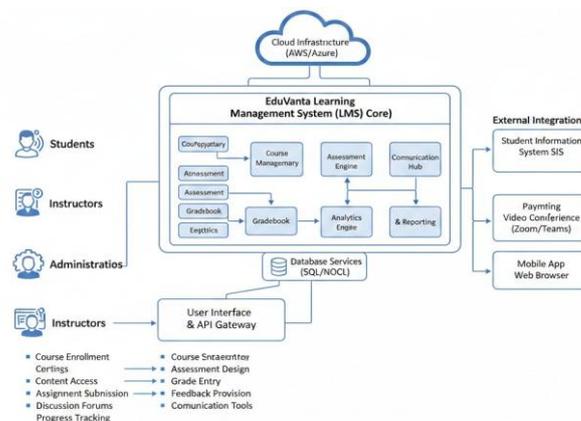


Fig. 1: High-level EduVanta system architecture and role-based user flow.

and gamification elements such as badges and leaderboards. The user interface is designed to be intuitive and responsive, improving usability across different devices.

The Application Layer contains the core business logic of the system. It includes modules for user management, course management, gamification, assessment, and analytics. The Gamification Engine processes user interactions and assigns rewards based on predefined rules, while the Assessment Module supports quizzes, assignments, and automated code evaluation. Role-based access control is enforced at this layer to ensure secure interaction between users and system resources.

The Data Layer is responsible for persistent storage of user profiles, course content, assessment records, gamification data, and analytics logs. A centralized database ensures data consistency and integrity, while secure access mechanisms protect sensitive information. Communication between layers is achieved through well-defined interfaces and APIs, enabling seamless data flow and system integration.

Overall, the architecture emphasizes security, extensibility, and performance, making EduVanta well suited for modern educational environments. The design also supports the future integration of advanced features such as adaptive learning, artificial intelligence-driven recommendations, and third-party educational tools.

#### V. AUTOMATED CODING ASSESSMENT

Automated coding assessment is a key feature of the EduVanta Student Learning Management System, particularly for technical and engineering education where hands-on programming practice is essential. Traditional approaches to evaluating coding assignments are often time-consuming, subjective, and difficult to scale for large classes. To address these limitations, EduVanta incorporates an automated coding assessment module that enables efficient, objective, and real-time evaluation of programming tasks.

Fig. 2: Automated coding assessment workflow in EduVanta.

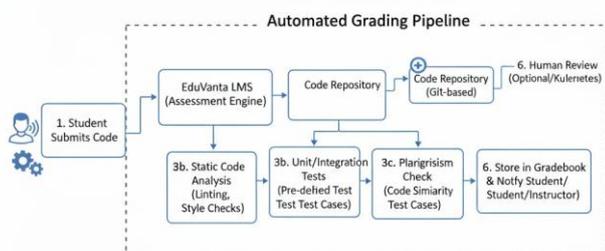


Fig. 2 illustrates the automated coding assessment workflow in EduVanta. The module allows instructors to design programming problems with predefined constraints, input-output test cases, and evaluation criteria. Students submit their source code through the platform, where it is automatically compiled and executed within a controlled environment. Submissions are evaluated based on correctness, execution time, memory usage, and compliance with problem requirements. Immediate feedback is provided, allowing students to identify errors and refine their solutions through iterative learning.

Security and fairness are central to the assessment design. Code execution is sandboxed to prevent unauthorized system access and ensure safe execution of student programs. Plagiarism detection mechanisms can be integrated to identify similarities among submissions, thereby promoting academic integrity. In addition, the module supports multiple programming languages, making it adaptable to a wide range of technical curricula.

To further enhance learner motivation, the automated coding assessment module is tightly integrated with the gamification engine. Students earn points, badges, and progress-based rewards according to performance, code efficiency, and timely submissions. Performance analytics are recorded and visualized through dashboards, enabling instructors to monitor learning trends and identify areas where students may require additional support.

Overall, the automated coding assessment module improves evaluation efficiency, enhances learning quality, and supports scalable programming education within the EduVanta platform. Structured feedback, including pass/fail status, execution errors, and partial scores, is returned to learners, encouraging continuous improvement while maintaining consistency and fairness in grading.

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## VI. GAMIFICATION ENGINE

The Gamification Engine is an integral component of the EduVanta Student Learning Management System, designed to improve learner engagement, motivation, and participation through game-based learning principles. Conventional LMS

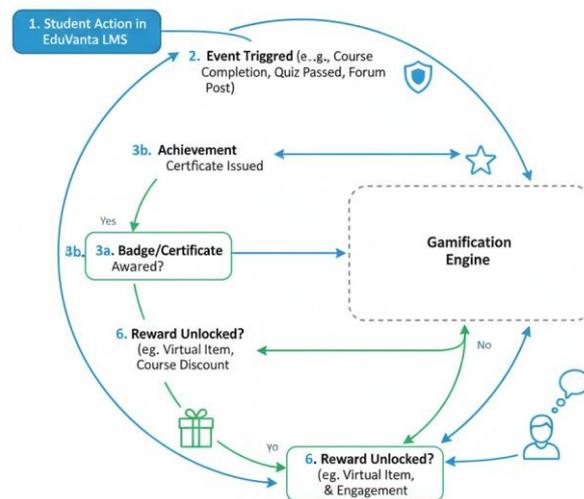


Fig. 3: Gamification event flow and reward allocation.

platforms often lack mechanisms that promote sustained interaction, which can result in declining learner involvement over time. The Gamification Engine addresses this challenge by embedding motivational elements directly into the learning workflow. The engine incorporates core gamification elements such as points, levels, badges, achievements, and leaderboards. Points are awarded for completing learning activities, submitting assignments on time, achieving strong assessment performance, and actively participating in discussions. As learners accumulate points, they advance through predefined levels that represent their academic progress and consistency. Badges and achievements are granted for reaching milestones,

demonstrating skill mastery, or maintaining continuous learning streaks. Leaderboards create a competitive yet collaborative environment by highlighting top-performing students based on criteria such as course progress or assessment results. To ensure fairness and inclusivity, the system supports configurable leaderboard scopes, including course-specific and time-bound rankings. Instructors can customize gamification rules to align with course objectives and intended learning outcomes. The Gamification Engine is tightly integrated with other system modules, including assessment, analytics, and user management. Performance data collected from quizzes, assignments, and automated coding assessments directly influences reward allocation and learner progression. Gamified feedback is presented through visual dashboards, enabling learners to track achievements, monitor progress, and set personal goals. Overall, the Gamification Engine transforms EduVanta into an interactive and engaging learning ecosystem that promotes active participation, self-motivation, and continuous improvement while supporting meaningful, outcome-driven education.

#### SECURITY AND OTP VERIFICATION

Security is an integral component of the EduVanta Student Learning Management System, as it manages sensitive academic information, user credentials, and assessment data. To ensure data confidentiality, system integrity, and protection against unauthorized access, EduVanta adopts a multi-layered security framework supported by strong authentication and verification mechanisms. One of the primary security features implemented in the system is One-Time Password (OTP) verification.

OTP verification is applied during critical operations such as user registration, login, password recovery, and role-based access validation. When a user initiates authentication, the system generates a unique, time-bound OTP and sends it to the user's registered email address or mobile number. The user must enter the correct OTP within a specified time limit to complete the verification process. This mechanism significantly reduces the risk of unauthorized access, credential compromise, and brute-force attacks.

In addition to OTP-based authentication, EduVanta employs role-based access control to restrict system functionalities according to user roles, including students, instructors, and administrators. Secure session management and encrypted communication protocols are used to protect data transmitted between the client

and server. Sensitive information, such as passwords and authentication tokens, is securely stored using encryption and hashing techniques.

The security architecture is designed to be scalable and adaptable, enabling future integration of advanced security measures such as multi-factor authentication, biometric verification, and anomaly detection. By combining OTP verification with robust access control and data protection strategies, EduVanta provides a secure and reliable learning environment, ensuring academic integrity and fostering user trust across the platform.

#### VII. EVALUATION METHODOLOGY

The evaluation of the EduVanta Student Learning Management System is intended to measure its effectiveness in improving learner engagement, system usability, security, and academic performance. A mixed-method evaluation approach is proposed, combining quantitative performance metrics with qualitative user feedback to gain a comprehensive understanding of system behavior and impact.

Learner engagement is assessed using metrics such as course completion rates, platform usage frequency, assessment participation, and gamification progress, including points earned, badges achieved, and level advancement. These indicators help evaluate the influence of gamification elements on student motivation and learning consistency. Academic performance is measured by comparing assessment scores and improvement trends before and after the adoption of automated coding assessment tools.

System usability is evaluated through structured questionnaires and usability surveys administered to both students and instructors. Factors such as ease of navigation, clarity

of feedback, and overall user satisfaction are measured using standardized usability scales. Instructors also provide feedback to assess the effectiveness of automated assessment features and analytics dashboards in reducing manual effort and supporting informed instructional decisions.

Security evaluation focuses on the reliability and effectiveness of OTP-based authentication and role-based access control mechanisms. Metrics such as authentication success rate, failed login attempts, and system response time during verification are monitored. Additionally, the system is tested under varying user loads to evaluate scalability, stability, and response efficiency.

The collected data are analyzed statistically to

identify patterns, strengths, and limitations of the system. This evaluation framework provides a structured approach to validating the proposed SLMS and supports future enhancements through data-driven insights.

## VIII. DISCUSSION AND LIMITATIONS

The proposed EduVanta Student Learning Management System illustrates how the integration of gamification, automated assessment, and secure authentication can significantly enhance learner engagement and instructional efficiency. By embedding game-based elements into academic workflows, EduVanta promotes active participation and consistent learning behavior. Features such as automated coding assessment and real-time feedback support self-paced learning while reducing instructor workload. In addition, the modular and scalable architecture enables the system to adapt to diverse educational needs and accommodate future technological advancements.

Despite these benefits, the proposed system has certain limitations. As a theoretical and prototype-level design, EduVanta has not yet been validated through large-scale, real-world deployment. The effectiveness of gamification elements may differ among learners, as not all students respond equally to competitive or reward-based mechanisms. Furthermore, the automated coding assessment module may encounter challenges when evaluating highly creative or open-ended programming solutions that require subjective judgment.

From a technical perspective, system performance may be affected when handling a large number of concurrent users, particularly during assessment periods. Dependence on reliable internet connectivity may also restrict accessibility in low-bandwidth environments. Future work should focus on empirical validation, adaptive gamification strategies, scalability optimization, and the integration of intelligent learning analytics to address these limitations and further enhance overall system effectiveness.

## IX. CONCLUSION AND FUTURE WORK

This paper introduced EduVanta, a gamified Student Learning Management System aimed at addressing key limitations of traditional LMS platforms, such as low learner engagement, limited automation, and inadequate security mechanisms. By integrating gamification techniques, automated coding assessment, and OTP-based authentication, EduVanta provides an interactive, secure, and learner-centric digital education environment. Its modular and

scalable architecture supports role-based access, real-time feedback, and performance analytics, making it well suited for modern academic institutions, particularly in technical and engineering education.

The proposed system demonstrates how game-based elements—including points, badges, levels, and leaderboards—can effectively motivate students and encourage continuous learning, while automated assessment tools help reduce instructor workload and improve evaluation consistency. Robust security mechanisms further ensure data integrity and user authenticity across the platform.

Despite these strengths, EduVanta is currently presented as a theoretical framework and prototype-level design. Future work will focus on full-scale implementation and deployment in real educational environments to empirically validate system effectiveness. Additional enhancements may include artificial intelligence-driven personalized learning paths, adaptive gamification strategies, advanced plagiarism detection techniques, and improved scalability to support large user populations. These developments aim to further enhance learning outcomes and establish EduVanta as a next-generation learning management solution.

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