



Edusphere: Enhancing academic efficiency of students and educators through app-based solution

Vaibhav Saha, Sushrut Wagh, Rushil Zalke, Vaibhav Zambre and Hiral Modi

Department of Computer Engineering, Mukesh Patel School of Technology Management & Engineering,
Mumbai, India

sahavaibhav111@gmail.com

Abstract. In today's ever-changing educational environment, students and teachers face many challenges related to effective communication, attendance management, and resource accessibility. Traditional solutions address these needs alone, often resulting in ineffectiveness and timelessness. This study presents an integration-based solution designed to enhance core learning activities on a single platform. Through extensive research among students and faculty, we learned about the limitations of the current system in areas such as job search, attendance, communication and sharing of educational resources. The proposed solution integrates real-time communication, automated attendance tracking, and a job portal, which collectively enhance academic productivity and engagement. The platform is built on powerful technologies including React, Node.js, MongoDB, and PostgreSQL, providing an excellent user experience tailored to the needs of students, professional teachers, and the management. This integrated approach has the potential to improve communication, reduce administrative responsibilities, and create better learning environments, ultimately leading to better learning outcomes and efficiency.

Keywords: Interdepartmental Efficient Attendance Tracking, Student-Teacher Engagement, Academic Management, Job Opportunities, Interdepartmental Communication.

1 Introduction

In a changing learning environment, both students and teachers face many challenges in effective academic management and communication. Tracking attendance, finding jobs and internships, inter-personal messaging, raising cross-departmental queries and accessing and/or sharing quality educational resources are the key factors that create an efficient learning ecosystem [2,3]. However, managing each of them individually often leads to time inefficiencies, missed opportunities, and communication gaps [1]. Although there are many existing software's that provide solutions to these needs individually, there isn't a general system that collectively meets all these needs of students. This research paper examines these challenges through case studies, user questionnaires

and surveys, and explores the potential of the collective system as a solution. The proposed system aims to improve the communication between students, teachers and various college departments also keeping in mind the issues a student faces during their academic life. Data from surveys conducted with students and teachers played a significant role in understanding preferences and highlighting the need of a robust system that would help students navigate their academic lives with relative ease. Our goal is to propose a system that provides a solid foundation to effectively address these academic needs, and create a better and more connected academic environment

2 Literature Review

The changing environment of higher education institutions requires effective communication, access to resources, and appropriate services for students, teachers, and administrators. Research shows that there are significant communication gaps between teachers and students that can affect academic success. For example, in Chinese universities, teachers' lack of motivation and knowledge to collaborate with students, and limited communication and resources lead to serious problems [4]. Suggestions include strengthening the sharing of educational resources and strong digital communication. Using a shared platform with communication techniques (such as personalized messages) can bridge these gaps and enable real-time interaction. Likewise, most students prefer digital communication [5], where social and real-time communication can be provided through a platform that provides effective communication for users. Proven success in increasing operational efficiency and user satisfaction across departments can improve the learning platform. Aramex's research shows that portals can increase student productivity and satisfaction [6]. However, user adoption is related to perceived value, indicating a need for specialized work. For educational institutions, integrating job information into student portals can provide effective job opportunities that align with career goals.

Usability is important for student portals, which should be intuitive for students and teachers. Research shows that continuous monitoring of usage has an impact on portal adoption and user satisfaction [7]. As noted in a comparative study on the effectiveness of university portals in Malaysia, role-based platforms share information relevant to all types of users (students, teachers, or administrators) and can solve practical problems by addressing specific needs [8]. Integrating feedback strategies will also lead to continuous improvement based on user feedback, resolving complaints and improving referrals. Static job listings based on direct participation are not sufficient for companies that need effective recruiting, such as Google and Meta [9]. Integrating this information into the platform can provide students with personalized career suggestions, making their job search more efficient and relevant to their interests and qualifications. To encourage digital communication, many websites may include in-app messaging, posting, and information sharing options that teachers can use on a trial basis as needed. Additionally, research shows that digital feedback tools such as secure messaging and real-time feedback can strengthen teacher-student relationships and contribute to academic success and retention [10]. Studies on the use of UTAUT and self-determination have

investigated usage, social impact, and physical activity [11]. Social impact and service are important aspects of students' intentions to use the portal, suggesting that a user-friendly, structured, and user-friendly interface such as job listings and engagement can encourage ongoing collaboration.

To ensure a seamless experience, choosing an appropriate tech-stack is of utmost importance. For instance, we can use PostgreSQL for storing relational data of the system. PostgreSQL offers several benefits over other DBMS options. It excels in data integrity and transaction management, making it valuable for modules needing high consistency, such as storing academic records or tracking sensitive student data [12].

MongoDB's adaptability would support the platform's job portal scraping functionality by storing heterogeneous job listing data in a flexible schema. Research conducted on MongoDB highlights its efficiency in managing distributed data and its scalability for big data applications, demonstrating how it enables data parsing and aggregation tasks more effectively than traditional relational databases when complex database logic is not required [13].

A study on multi-user web chat applications using Node.js and Socket.io demonstrates the framework's low-latency response times, scalability, and support for continuous data streaming, which ensures real-time interactions are seamless and responsive [14]. Node.js's integration with Socket.io further supports low-latency data transfer, which is crucial for messaging between students and faculty.

For the frontend of the proposed system, as illustrated [15], React's design is advantageous in developing modern, responsive UIs, making it ideal for educational platforms that require real-time interface updates. The virtual DOM in ReactJS optimizes rendering performance, which is essential for user-facing components like attendance updates and personalized notification feeds that demand quick, responsive interactions [15].

Research by Bogner, Justus & Merkel, Manuel et al. [16] indicates that TypeScript's static typing feature helps improve software quality by reducing common coding errors, enhancing code understandability, and simplifying refactoring efforts. TypeScript applications exhibit significantly better code quality and lower cognitive complexity than JavaScript projects making it an ideal choice for developing this system [16].

By leveraging proven tools like MySQL, MongoDB, Node.js, ReactJS, TypeScript, and Selenium, the platform would efficiently manage real-time interactions, scalability, and data integrity, while ensuring a high-quality, maintainable, and user-friendly experience.

This literature review identifies higher education needs for software platforms that support communication, job search, and curriculum delivery. Key features include job listings that provide quick access to job postings related to career interests to discuss and share information to increase usability and satisfaction; adaptability and responsiveness to change. By integrating digital communication, user feedback, and real-time access to job listings, the platform has the potential to improve access resources, bridge communication, and enhance the learning experience for students, teachers, and administrators.

3 Research Methodology

To determine the current satisfaction levels of students and teachers, and to identify the challenges faced by them in areas such as attendance tracking, job/internship finding, messaging, robust communication, query resolution, and accessing academic resources, an online survey was conducted through Google Forms. The forms were distributed to students and teachers in NMIMS University, Mumbai, through e-mails and social media channels like WhatsApp and respondents were informed about the anonymity of their responses and the purpose of the research. Responses from a total of 206 participants were recorded out of which 150 were students and 56 were teachers.

Are you a teacher or a student?

206 responses

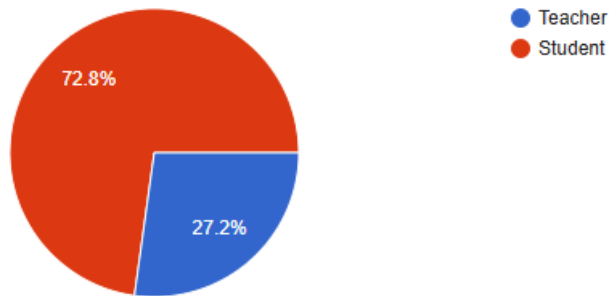


Fig. 1. Respondents

3.1 Survey Results

The data collected via online questionnaire by using Google Forms and distributed to participants to identify the issues that they faced when they used university portal. The following section is participants' response based on their opinion about the portal.

STUDENTS

a) *What challenges do you face with your current communication methods?*

150 responses

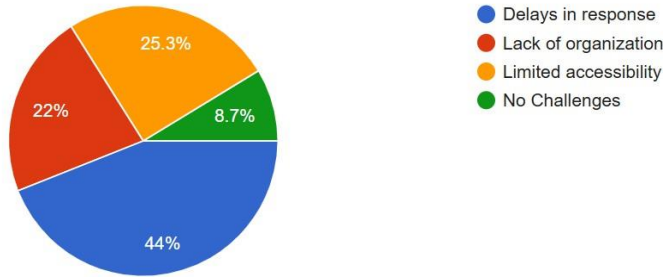


Fig. 2. Communication challenges faced by students.

(See Fig. 2.) Above shows that around 44% students have faced delays in responses, 25.3% have faced limited accessibility of resources and 22% have faced a lack of organization in communication with teachers and other academic departments.

b) What difficulties do you encounter when trying to access these resources?

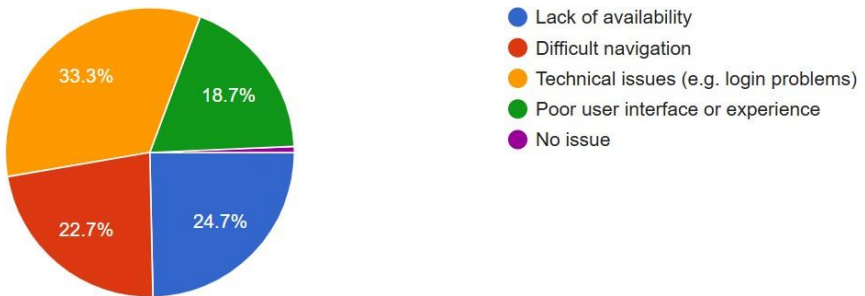


Fig. 3. Difficulties faced by students while accessing academic resources

(See Fig. 3.) Above shows that 33.3% of students faced technical issues like login problems, 22.7% of students find it difficult to navigate the system, 18.7% find the user interface not user-friendly.

c) Are there any issues with the current attendance management system?

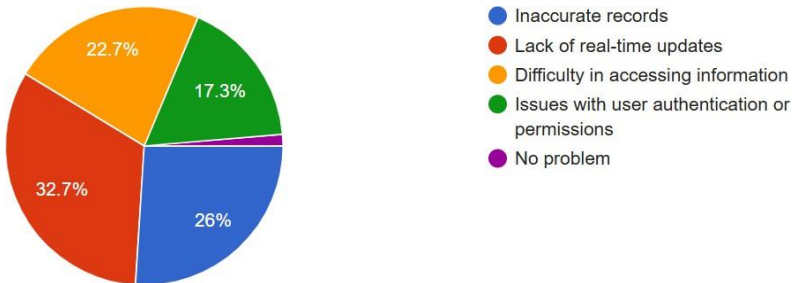


Fig. 4. Issues faced by students with their current attendance management systems

(See Fig. 4.) Above shows that 32.7% students couldn't receive real-time updates from their current attendance management systems, 26% of students received inaccurate records, 22.7% of students found it difficult in accessing information and 17.3% of students faced technical issues like user authentication and permissions.

d) How do you resolve academic or administrative queries?

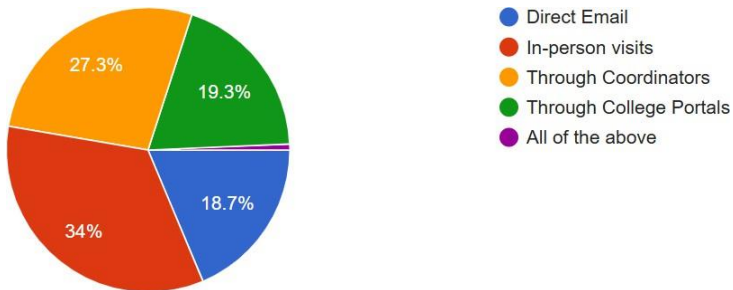


Fig. 5. How students resolve academic & administrative queries

(See Fig. 5.) Above show that 19.3% of students resolve academic & administrative queries through portal, 18.7% students through direct e-mails, 27.3% through coordinators and 34% through in-person visits.

e) What challenges do you encounter when searching for job or internship opportunities?

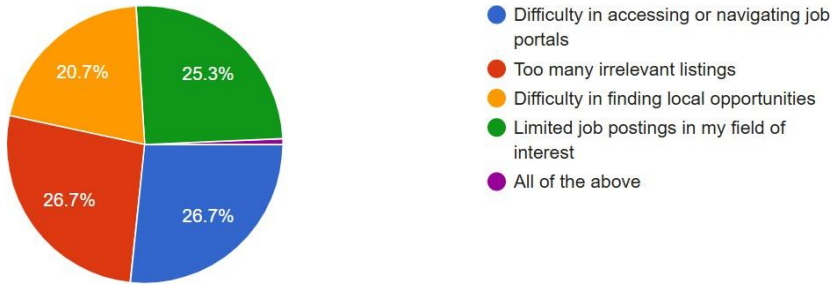


Fig. 6. Challenges faced by students while searching for jobs and/or internships

(See Fig. 6.) Above shows that 26.7% of students face difficulty in navigating or accessing job portals, 26.7% of students found too many irrelevant postings on job portals and 20.7% students found it difficult to find local opportunities.

f) How likely are you to use an app that integrates communication, attendance tracking, and job resources into one platform?

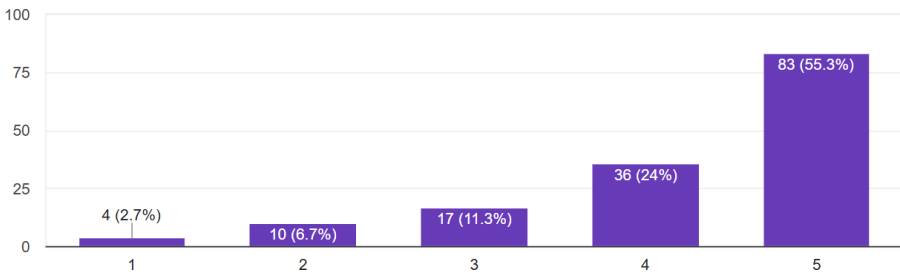


Fig. 7. Likelihood of using a comprehensive system.

(See Fig. 7.) Above shows that on a scale of 5, 63.3% were highly interested in using an application that integrates communication, attendance tracking, and job resources into one platform while 25.3% students showed some sort of interest in using such an app.

TEACHERS

a) What challenges do you face with your current communication methods?



Fig. 8. Communication challenges faced by teachers.

(See Fig. 8.) Above shows that around 33.9% teachers found it difficult to tract student interactions while 26.8% faced limited accessibility of resources.

b) What issues do you encounter in sharing these resources effectively?

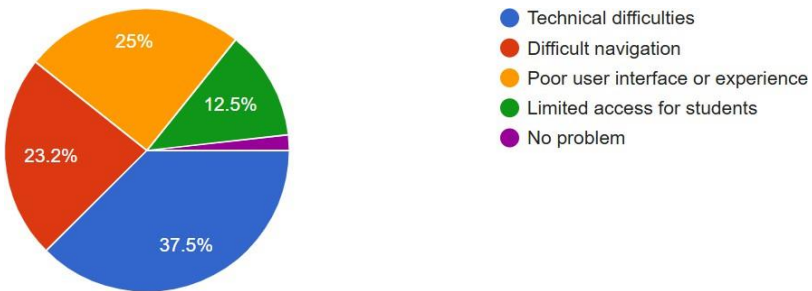


Fig. 9. Difficulties faced by teachers while accessing academic resources

(See Fig. 9.) Above shows 37.5% of teachers face technical difficulties while sharing academic resources, 25% find the user interface not user-friendly, 23.2% found it difficult to navigate through the software.

c) Are there any issues with the current attendance management system?

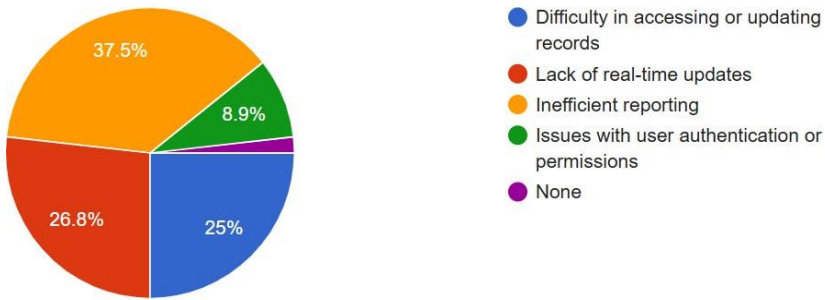


Fig. 10. Issues faced by teachers with the current attendance management systems

(See Fig. 10.) Above shows that 26.8% teachers couldn't receive real-time updates from their current attendance management systems, 37.5% of teachers found the reporting method inefficient, 25% of teachers found it difficult in accessing information and 8.9% of teachers faced technical issues like user authentication and permissions.

d) How likely are you to use an app that integrates communication and attendance tracking into one platform?

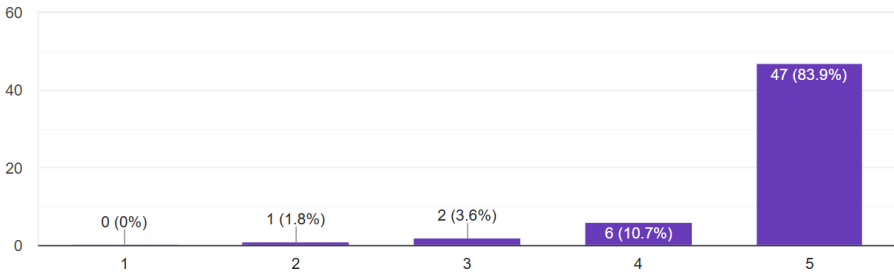


Fig. 11. Likelihood of using a comprehensive system.

(See Fig. 11.) Above shows that on a scale of 5, 83.9% were highly interested in using an application that integrates communication, attendance tracking, and job resources into one platform while 10.7% teachers showed some sort of interest in using such an app.

4 Proposed System

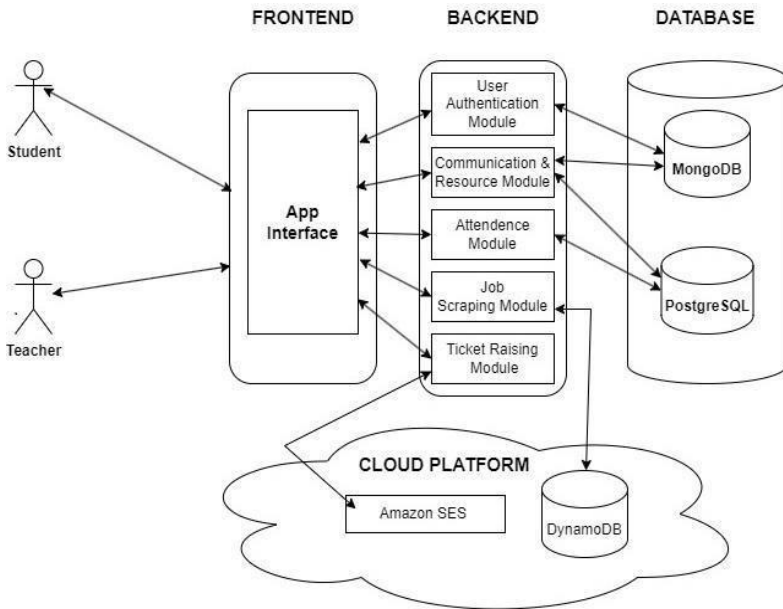


Fig. 12. Use-Case Diagram of the proposed system.

4.1 Proposed Technologies

Based on the technologies the system can be divided into the following layers: a) Front-end, b) Back-end, and c) Database, with an additional integration to a d) Cloud Platform.

- a) **Front-end Layer:** The front-end is built using React (Next.js) and TypeScript, providing a responsive, user-friendly interface that meets the needs of all the users. This interface makes it easy to browse features like task lists, attendance records, and messaging. React's component-based design allows for the creation of interactive user interfaces, while Next.js supports server-side rendering for improved performance. This approach is essential for providing a great user experience, as well as providing new information (like job opportunities) daily. The front-end support's role access by providing customized dashboards for each role, allowing students and teachers to access information specific to their needs.
- b) **Back-end Layer:** The backend is designed to handle business logic, database interactions, and instant messaging. Technologies like Node.js, Express.js, Python, Flask, and Socket.io come together to create a powerful force. Node.js and Express serve as the primary backend environment, handling API requests, validation, and CRUD (create, read, update, delete) operations. Python

supports external access functions like retrieving data from the web and integrating with Flask to provide information about new job listings. Socket.io provides instant messaging, enables instant communication, and creates a collaborative learning experience.

- c) **Databases:** The database system uses MongoDB and PostgreSQL to store different data securely and efficiently. MongoDB is a NoSQL database that stores unstructured data such as session and reference data, allowing data to be flexible and scalable. In contrast, PostgreSQL's relational database capabilities are used for complex queries and data structures that require high performance. The combination of MongoDB and PostgreSQL makes the database management system flexible and modular.
- d) **Cloud Platform:** The cloud platform, AWS(Amazon Web Services) is used to enable web scraping scripts and allow them to run at intervals to collect content from other sources. Data is stored directly in MongoDB, making it easy to access for students through the platform. Additionally, AWS services such as Amazon SES (Simple Email Service) are used to manage automated notifications, including user query prompts and task notifications, to encourage effective communication between students, teachers, and other departments.

4.2 Proposed Components

- a) **User Management Module:** The user management module is designed to provide seamless management and control of multiple user roles in the system. It will support three different user types (administrators, teachers, and students), each with specific permissions and access to specific roles. To maintain security and privacy, the system will use authentication methods such as passwords and roles to ensure that users can access the areas specific to their role only.
- b) **Attendance Management Module:** The module will focus on providing real-time tracking of class attendance. Teachers and administrators will have access to the most up-to-date information on each class or grade to ensure that attendance is properly tracked. The module will also store attendance history data and provide a dashboard, allowing users to visualize historical data and create attendance content for reporting and analysis. Automatic alerts will alert users of attendance anomalies, such as poor attendance or missed classes, helping to resolve issues before they escalate.
- c) **Communication Module:** Provide instant messaging and live chat functionality. This would include one-on-one and group messaging, providing a private space for personal discussions, study groups, or class announcements. Users will be able to message others, set up notifications to be sent to individuals or groups, and keep everyone informed of important discussions and updates.
- d) **Job and Internship Module:** The module will pull information from popular job portals to write a real-time list of available jobs. Students can filter these opportunities by interests like company, location, experience level, etc. to

ensure they only see relevant posts. The module will also include notifications that will send users personalized alerts whenever any jobs or internships match their profile.

- e) **Academic Resource Module:** This module would include sharing of study materials like textbooks and assignments. Resources will be organized by subject, course, or topic for easy access by students. Version control will also be implemented to ensure students always have access to the most up-to-date information, with updates and changes tracked to maintain the integrity of the resources.
- f) **Query Resolution Module:** The module will allow users to raise tickets to resolve various issues. Users can categorize tickets by department or issue type and track their status in real time. The system will prioritize tickets so that more urgent issues can be resolved quickly, while also providing users with updates as their questions are resolved.

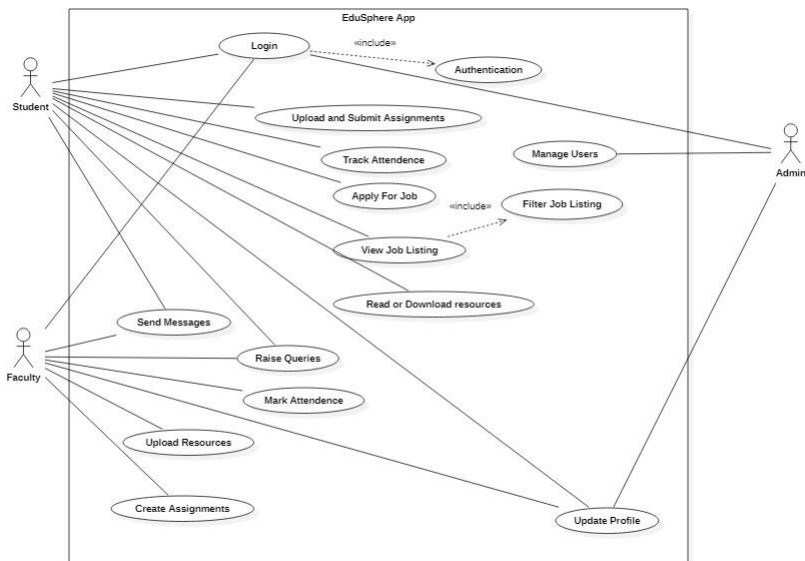


Fig. 13. Use-Case flow Diagram.

5 Conclusion

In a constantly evolving learning environment, effective management and communication between students, teachers, and educational institutions are critical to improving learning outcomes. The application-based solution solves important issues such as attendance tracking, job/internship search, inter-departmental communication, and

resource sharing all within a unified platform. By combining these resources, the system not only reduces inefficiencies but also improves real-time communication and access to critical resources. The integrated solution mentioned in this paper is supported by technologies such as React, Node.js, and hybrid database structures to be developed in an accessible, user-friendly, and appealing way to all stakeholders. With this, educational institutes can create a learning network that enables students, teachers, and administrators to complete academic tasks more effectively. Therefore, this application-based platform has great potential to improve learning management, reduce communication gaps, and ultimately increase learning success and engagement.

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