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Student collaboration study buddy portal

RESEARCH

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Abstract

The increasing need for effective peer-to-peer learning in digital education has necessitated the development of student-centric collaborative platforms. This paper presents the *Student Collaboration Study Buddy System*, a full-stack web application designed to enable students to connect, communicate, and collaborate through a unified digital environment. Traditional learning methods often lack efficient peer interaction and centralized access to study materials, which can limit student engagement and knowledge exchange. To address these challenges, the proposed system offers a structured and user-friendly digital solution that connects learners and facilitates effective collaboration. The portal is developed using modern full-stack architecture, with react employed for building a dynamic and responsive user interface, Node.js and Express.js for handling server-side logic and API integration and Mongo DB for scalable and flexible data storage. Key features of the Study Buddy Portal include user profile management, creation and management of study groups, real-time chat and discussion forums, file and note sharing, and a personalized dashboard that provides quick access to relevant activities and materials. Future developments of the portal may include the integration of artificial intelligence for personalized study recommendations, advanced analytics to monitor student performance, and mobile application support to ensure accessibility across multiple devices. Overall, the Study Buddy Portal represents an effective solution for modern educational challenges by leveraging technology to create a collaborative and engaging learning environment.

Keywords: *Collaborative learning, study portal, web application, react, node.js, express.js, mongo db, peer learning, resource sharing, student collaboration.*

1. Introduction

Collaborative learning has emerged as a vital component of modern education, enabling students to achieve better problem-solving ability, improved communication, and deeper conceptual understanding through peer interaction. With the rapid expansion of digital technology, student collaboration has shifted from traditional classroom settings to online platforms, increasing the demand for efficient, student-driven digital systems. Despite the widespread adoption of tools such as Google Classroom, Microsoft Teams, and Slack, these platforms are primarily designed for formal instructor led environments and lack features that specifically support flexible, peer driven academic collaboration [1]. The system incorporates secure user authentication and authorization mechanisms to protect user data and ensure controlled access to resources.

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Students are frequently required to use multiple applications for chatting, file sharing, scheduling, and progress tracking, resulting in inefficiency and fragmentation. This paper proposes a unified Student Collaboration Study Buddy System that consolidates communication, resource management, group coordination, and scheduling into a single scalable platform, specifically designed to meet the needs of students in modern digital learning environments [2].

2. Background and related work

2.1. Collaborative Platforms

Research consistently demonstrates that collaborative learning significantly improves academic outcomes. Studies show that students engaged in structured peer learning develop stronger analytical skills and deeper subject understanding. Compared to isolated study. Digital platforms that support group-based academic activities have therefore gained increasing research and development attention in recent years [3].

2.2. Existing and Limitations

Google Classroom and Microsoft Teams are widely adopted in academic institutions for assignment management and communication. However, these platforms are primarily instructor-driven and do not support personalized student group formation or student-to-student interaction models. Slack offers structured communication channels suitable for professional collaboration but lacks academic specific features such as study session scheduling, partner offers structured and group-level resource management.

2.3. Full-Stack Technologies for Collaboration

Modern collaborative applications are typically developed using full-stack JavaScript frameworks. React.js enables the creation of component-based, responsive user interfaces that support real-time state updates.Node.js combined with Express.js provides an efficient, event-driven server environment for REST ful API operations [4]. Mongo DB's document-oriented model is well-suited for collaborative applications due to its flexibility in managing varied data structures including user profiles, group memberships, messages, and shared resources.

3. Proposed system architecture

The proposed system is structured around three-tier client-server architecture. The frontend, backend, and database layers are independently designed to ensure modularity, scalability, and ease of maintenance. The system integrates five core functional modules that work together to deliver a complete collaborative learning experience.

Table 1: Core modules of the proposed system

Module	Technology	Benefit
User Auth	JWT + bcrypt	Secure access
Study Groups	Mongo DB + Express	Group collab
Real-Time Cha t	Socket.io	Live messaging
Resource Share	Mongo DB Grid FS	Central storage
Task Scheduler	React + Mongo DB	Time management

The major modules of the proposed system are summarized in (Table 1). Each module is responsible for a specific functional domain. The user authentication module ensures secure access, while the study group manager, real-time chat, resource sharing, and task scheduler modules collectively enable a comprehensive collaborative learning environment within a unified MERN stack architecture. The

frontend layer, developed in React.js, delivers a dynamic, component-based interface with client-side routing and state management. The backend layer, built with Node.js and Express.js, manages REST ful API endpoints, authentication logic, and inter-module communication. The database layer, powered by Mongo DB with Mongoose ODM, stores all application data in flexible document-based collections [5].

4. Implementation methodology

The implementation followed a structured full-stack development methodology. The frontend was developed using React.js with component-based architecture, enabling reusable UI elements across pages including registration, dashboard, group management, chat interface, and resource sections. Client-side state management and routing support smooth navigation and dynamic content updates. The backend was developed with Node.js and Express.js, implementing REST ful API endpoints for all core operations including user management, group creation, message processing, and file handling. JWT-based token authentication was implemented for secure session management. Password hashing using bcrypt ensures that user credentials are never stored in plaintext [6]. Mongo DB collections were designed using Mongoose schemas to enforce data consistency. Study group membership is managed through a dedicated Group Members collection linking user identifiers to group identifiers with assigned roles. The study partner recommendation mechanism computes compatibility scores based on subject overlap, interest similarity, and availability alignment between user profiles, ranking candidates by composite score [7].

5. Results and discussion

The proposed system was evaluated through comprehensive functional testing covering all core modules. Test scenarios included single-user operations, multi-use simultaneous access, valid and invalid input conditions, and edge cases for each functional component. The system demonstrated reliable behavior across all tested scenarios [8].

Table 2: Comparison with existing platforms

Feature	Proposed	Classroom	MS Teams
Student-Centric	Yes	Partial	No
Group match	Smart	Manual	Manual
Real-Time Chat	Integrated	Limited	Yes
Resource Management	Group-level	Course-level	Channel
Task Management	Integrated	Assignment	Limited

A comparison between the proposed system and established platforms is presented in (Table 2). The proposed system offers superior student-centric design, integrated peer group matching, and consolidated task management compared to Google Classroom and Microsoft Teams. While those platforms excel in instructor led environments, the proposed system is specifically optimized for peer-driven, independent student collaboration

Table 3: Functional test results

Module	Test Result
Authentication	Passed-secure token generation
Group Creation	Passed-correct member roles
Real-Time Chat	Passed-concurrent user sync
File Upload	Passed-metadata stored correctly
Task Scheduling	Passed-all session types

The functional test results are summarized. All core modules including authentication, group management, real-time chat, file operations, and task scheduling were confirmed to operate correctly. Minor errors identified during unit testing were resolved prior to integration testing. The system maintained stable performance under simultaneous multi-user load conditions. The functional test results are summarized in (Table 3).

6. Database design

The system's data layer is implemented using Mongo DB, a document-oriented No SQL database that provides flexibility, scalability, and efficient query performance. The database consists of six primary collections, each designed to support a specific functional domain within the application.

Table 4: Mongo DB collection schema

Collection	Key Fields
Users	Name, email, password, subjects, availability
Profiles	User Id, interests, goals, bio
Study Groups	Group Name, subject, created by
Group Members	User Id, group Id, role
Resources	Group Id, uploaded By, file URL
Notifications	User Id, message, status

The database schema is summarized in (Table 4). The Users and Profiles collections together provide comprehensive user identity and preference information used by the recommendation engine. The Study Groups and Group Members collections maintain group structure and membership with role-based distinctions. Resources and Notifications collections complete the data architecture by supporting content sharing and system communication.

7. Challenges and future scope

Despite the successful implementation of the proposed system, several challenges were identified. The system's real time features depend on stable internet connectivity. The initial development complexity, particularly integrating frontend and backend components with real-time capabilities, required careful architectural planning and iterative debugging. Future research directions include integration of AI-based recommendation engines using collaborative filtering for improved study partner matching, addition of video conferencing capabilities, development of a React Native mobile application, cloud storage integration, multi-factor authentication, and advanced analytics dashboards for tracking learning progress and participation [10].

8. Conclusion

This paper presented the Student Collaboration Study Buddy System, a comprehensive full-stack web application that addresses the limitations of existing digital learning platforms by providing a unified, student-centric collaborative environment. The system successfully integrates secure authentication, and task scheduling within a scalable MERN stack architecture. Experimental evaluation confirmed the system's functional, and performance stability under multi-user conditions. The platform establishes a strong foundation for future enhancements including AI-driven recommendations, mobile application support, and advanced analytics, contributing meaningfully to the advancement of digital collaborative education.

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