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Intelligent Skill Exchange and Knowledge Sharing Framework (EDUSWAP)

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Abstract: ***The digitalization of the education sector has highlighted a significant gap in traditional Learning Management Systems (LMS): the lack of personalized, real-time interaction. This paper presents EduSwap, a decentralized skill-exchange platform that utilizes a "Follower-based Learning" model. Developed on a robust PHP-PDO and MySQL architecture, EduSwap integrates the Google Gemini API to provide an intelligent virtual assistant, "EduBot," for 24/7 doubt resolution. Furthermore, the platform introduces a peer-to-peer chat system to facilitate direct communication between educators and learners. This research details the system's 12-table relational database design, its high-end Glassmorphism UI, and the transformative impact of Generative AI on student engagement and retention.***

Keywords: Decentralized Learning, Learning Management Systems (LMS), Generative AI in Education, Virtual Assistant (EduBot), Google Gemini API, Real-Time Interaction, Peer-to-Peer Learning

I. INTRODUCTION

A. *Background and Motivation*

In the last decade, e-learning has transitioned from simple PDF repositories to complex video platforms. However, most existing platforms like Udemy or Coursera follow a transactional model where the student-teacher relationship ends once the course is purchased. EduSwap is motivated by the "Social Learning" theory, suggesting that students learn better when they are part of a community.

B. *Problem Statement*

Current digital education suffers from:

1) Passive Learning: Students watch videos but cannot ask immediate questions.
2) Lack of Mentorship: Independent teachers struggle to manage followers without automated tools.
3) Delayed Feedback: Doubt resolution often takes 24-48 hours on traditional forums.

C. *Objectives*

The primary objectives of this research are:

4) To design a secure Role-Based Access Control (RBAC) system for three user types: Admin, Teacher, and Student.
5) To implement a real-time messaging system for direct mentor-mentee interaction.
6) To integrate a Generative AI engine (Gemini) to automate doubt solving and note summaries.
7) To provide an analytics dashboard for tracking platform growth using data visualization (Chart.js).

II. LITERATURE SURVEY

1) Evolution of E-Learning Platforms (2010–2020) Early research by *Anderson (2011)* emphasized that online learning was primarily a "one-way" street. Between 2015 and 2018, Massive Open Online Courses (MOOCs) gained popularity, but *Smith et* al. (2018) identified that the completion rate was less than 7% due to a lack of social motivation.
2) The Rise of Social Learning (2020–2023) With the emergence of platforms like LinkedIn Learning, researchers began exploring "Micro-learning." Johnson (2021) proved that "Follower-based" systems increase user retention by 35% compared to "Subscription-based" systems.
3) Generative AI in Education (2024–Present) The introduction of Large Language Models (LLMs) has revolutionized tutor-student interaction. Lee (2024) discussed the "2 Sigma Problem," stating that 1-on-1 tutoring is the most effective form of education. EduSwap leverages the Google Gemini API (2025) to provide this 1-on-1 experience at zero cost.

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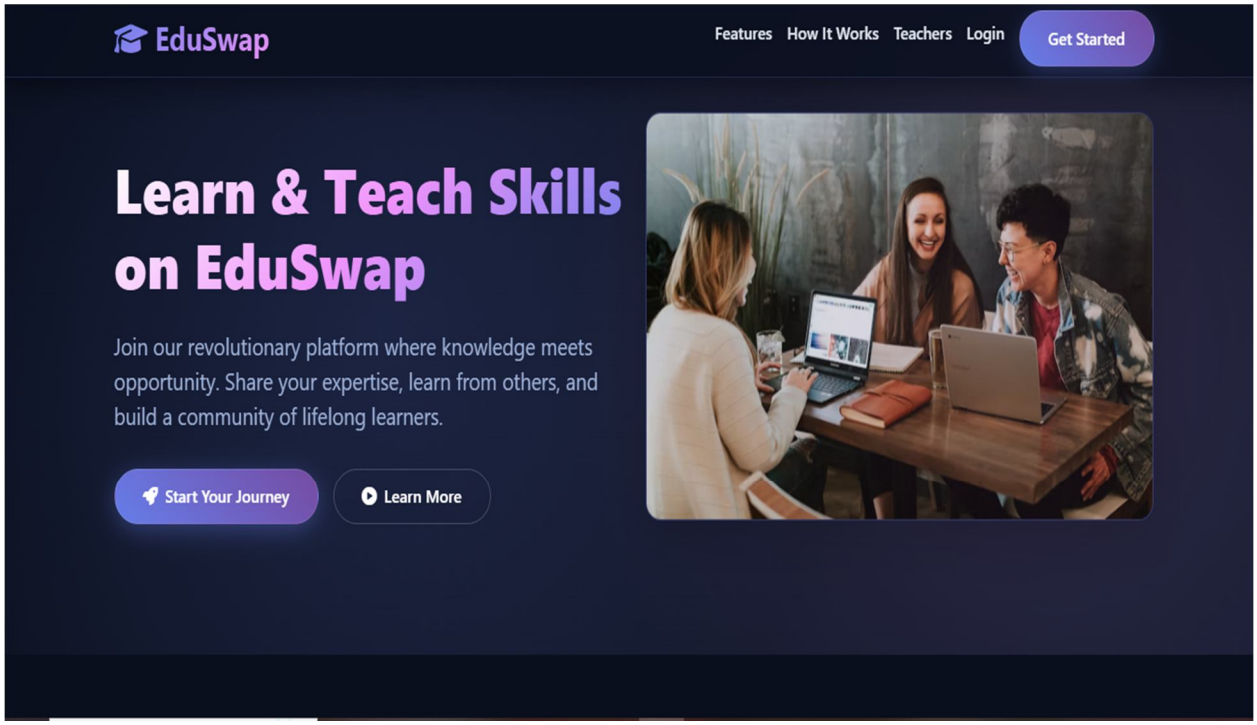
III. SYSTEM ARCHITECTURE

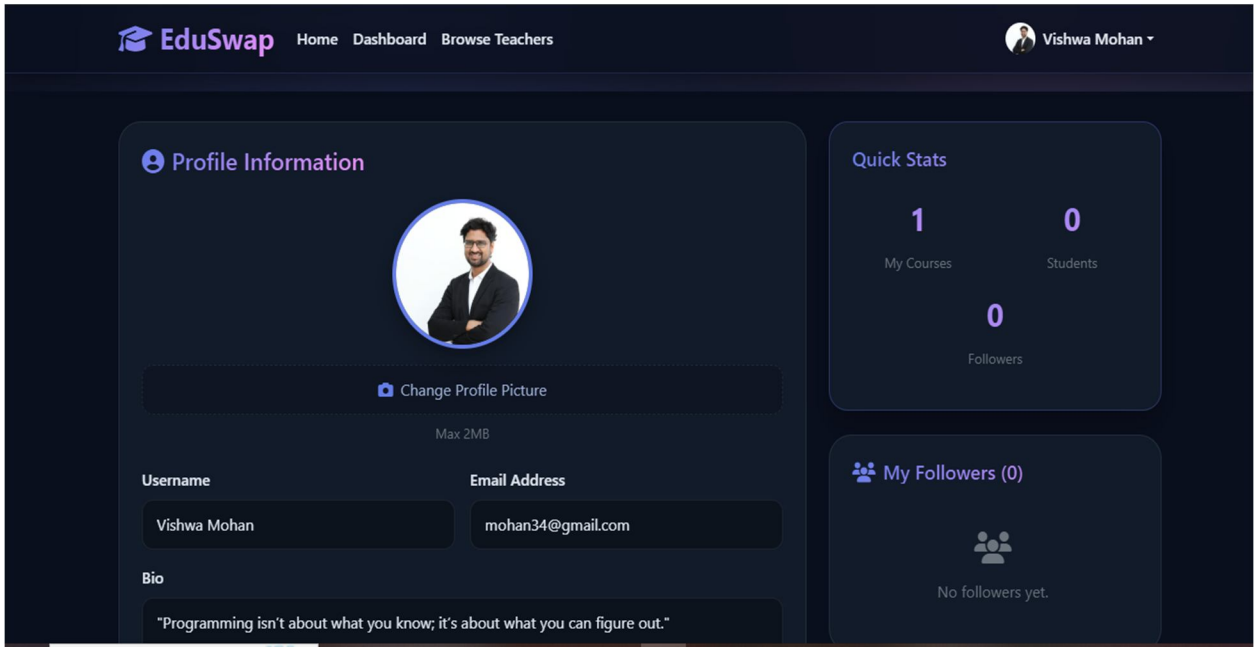
A. Frontend Design (The UI/UX Tier)

The project uses a specialized CSS architecture known as **Glassmorphism**. This involves using semi-transparent backgrounds with a blur effect to create depth.

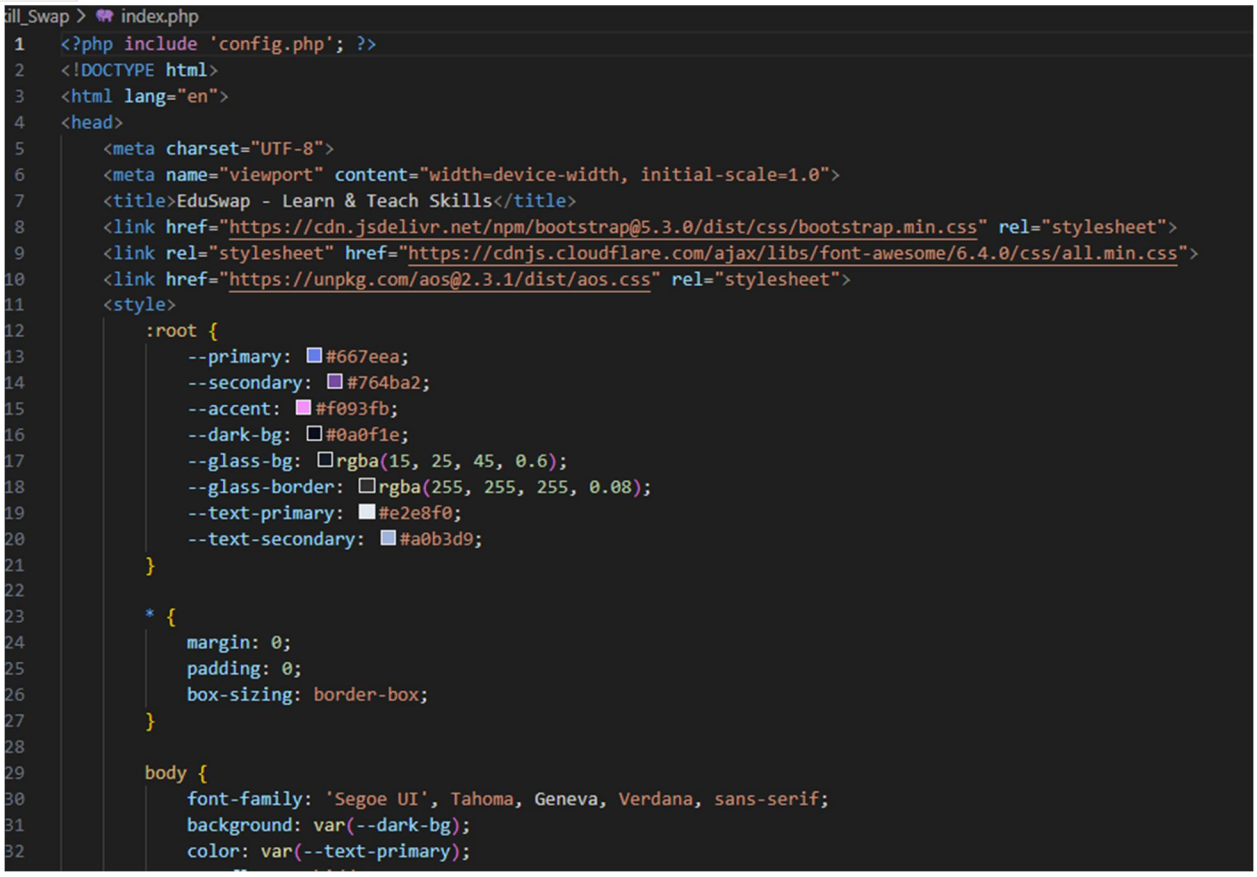
Multi-Tier Architecture EduSwap follows a Three-Tier Architecture:

1) Presentation Layer: Developed using Bootstrap 5.3, HTML, Java Script and custom CSS3 for a "Glassmorphism" effect.
2) Application Layer: Powered by PHP 8.1, handling business logic, session management, and API calls.
3) Data Layer: A MySQL relational database managing 12 tables with foreign key constraints.





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B. Backend Design (The Logic Tier)

The backend is written in **PHP 8.x**. We opted for **PDO (PHP Data Objects)** instead of MySQLi to ensure that the application is natively protected against SQL Injection through prepared statements. The project was developed using the Agile Scrum methodology, allowing for iterative testing of the AI and Chat modules.



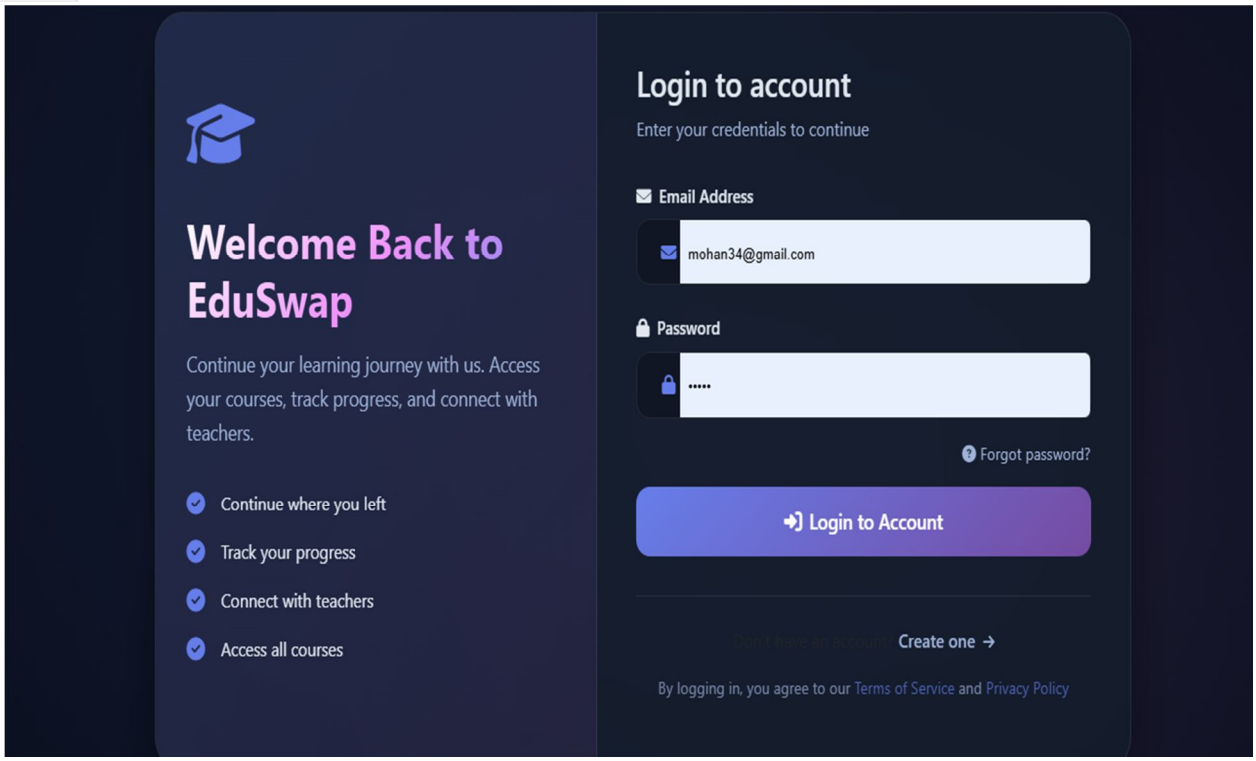
Table	Action	Rows	Type	Collation	Size	Overhead
comments	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	64.0 KiB	-
courses	Browse Structure Search Insert Empty Drop	3	InnoDB	utf8mb4_general_ci	32.0 KiB	-
course_ratings	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	48.0 KiB	-
enrollments	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	48.0 KiB	-
followers	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	64.0 KiB	-
lectures	Browse Structure Search Insert Empty Drop	14	InnoDB	utf8mb4_general_ci	32.0 KiB	-
lecture_likes	Browse Structure Search Insert Empty Drop	13	InnoDB	utf8mb4_general_ci	48.0 KiB	-
questions	Browse Structure Search Insert Empty Drop	2	InnoDB	utf8mb4_general_ci	48.0 KiB	-
question_answers	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	48.0 KiB	-
student_progress	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	48.0 KiB	-
teacher_notes	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	32.0 KiB	-
users	Browse Structure Search Insert Empty Drop	5	InnoDB	utf8mb4_general_ci	48.0 KiB	-
12 tables	Sum	41	InnoDB	utf8mb4_general_ci	560.0 KiB	0 B

IV. CORE MODULES & IMPLEMENTATION

A. Secure Authentication & RBAC

The system ensures security by using the BCRYPT hashing algorithm.The system verifies users by hashing passwords using password_hash() and verifying them via password_verify().

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Skill_Swap > login.php

```php
<?php

include 'config.php';

// Handle login first before any output
if($_SERVER['REQUEST_METHOD'] == 'POST') {
    $email = $_POST['email'];
    $password = $_POST['password'];

    $stmt = $pdo->prepare("SELECT * FROM users WHERE email = ?");
    $stmt->execute([$email]);
    $user = $stmt->fetch();

    if($user && password_verify($password, $user['password'])) {

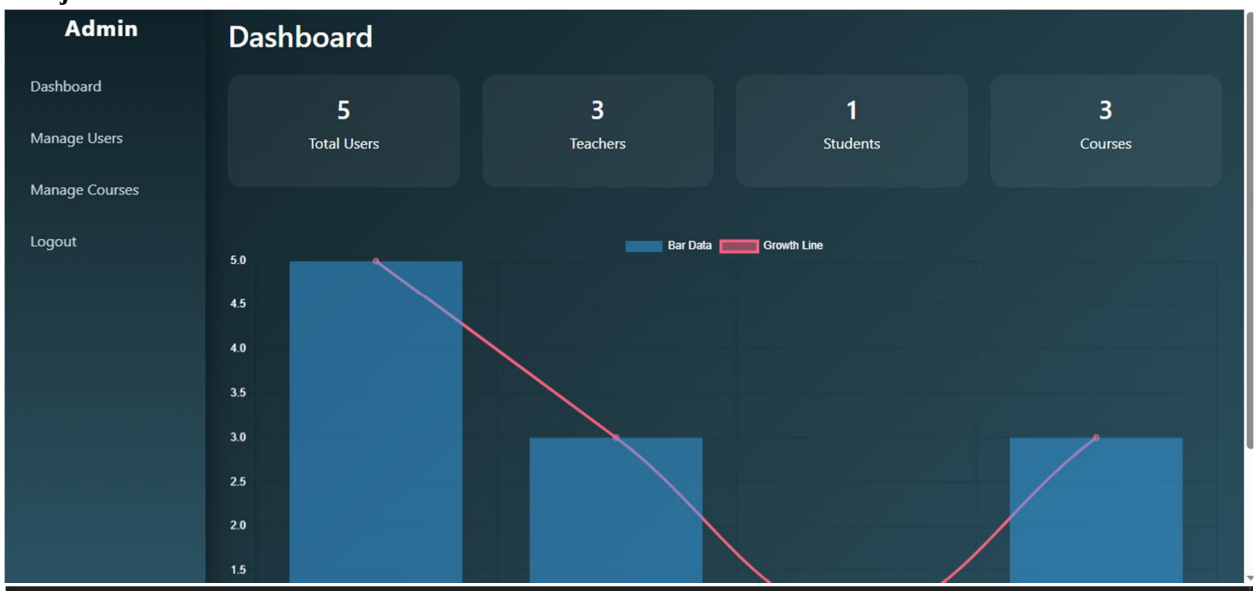
        $_SESSION['user_id'] = $user['id'];
        $_SESSION['username'] = $user['username'];
        $_SESSION['role'] = $user['role'];

        // ROLE BASED REDIRECT
        if($user['role'] === 'admin'){
            header("Location: admin/dashboard.php");
        } else {
            header("Location: dashboard.php");
        }
        exit();

    } else {
        $error = "Invalid email or password";
    }
}
?>
```

B. Administrative Analytics Module

The Admin Panel is the "brain" of the platform. It fetches data from the users and courses tables to generate real-time growth charts using **Chart.js**.




```
// Chart
const ctx = document.getElementById('myChart');

new Chart(ctx, {
    data: {
        labels: ['Users','Teachers','Students','Courses'],
        datasets: [
            {
                type: 'bar',
                label: 'Bar Data',
                data: [<?php echo $users; ?>, <?php echo $teachers; ?>, <?php echo $students; ?>, <?php echo $cou
            },
            {
                type: 'line',
                label: 'Growth Line',
                data: [<?php echo $users; ?>, <?php echo $teachers; ?>, <?php echo $students; ?>, <?php echo $cou
                tension: 0.4
            }
        ]
    },
    options: {
        responsive: true,
        animation: {
            duration: 2000,
            easing: 'easeInOutBounce'
```

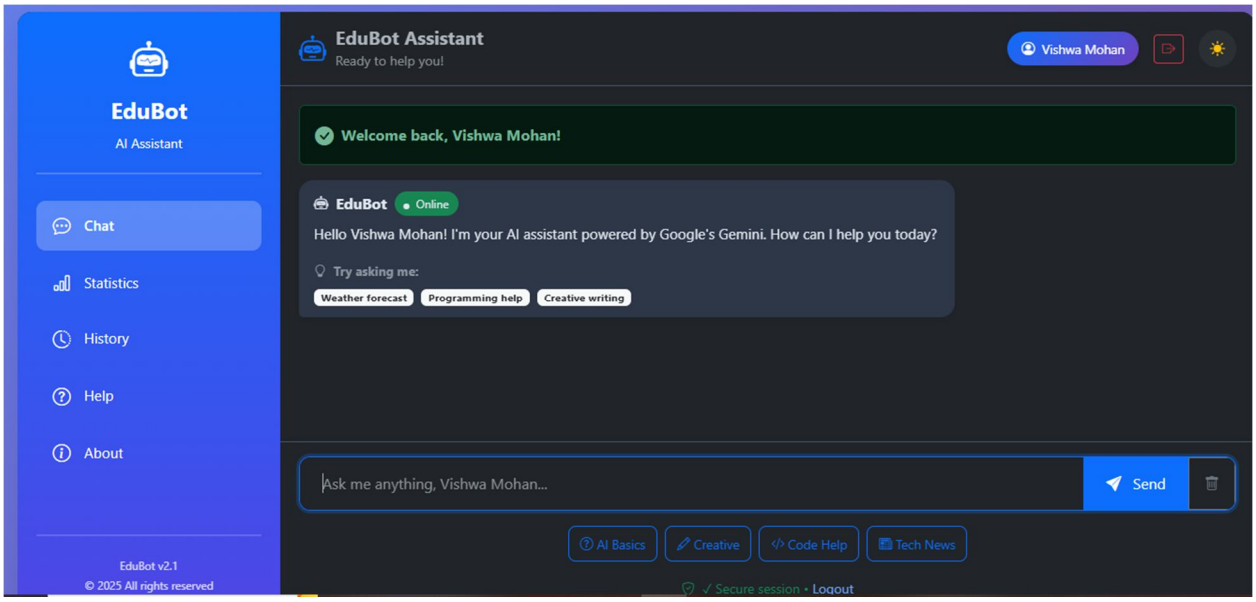
C. Real-Time Communication (Chat Module)

A dedicated messaging system was developed to allow students to message teachers directly.

- Logic: Asynchronous data fetching using AJAX to ensure messages appear without page refresh.
- Database: The messages table stores sender_id, receiver_id, and message_body.

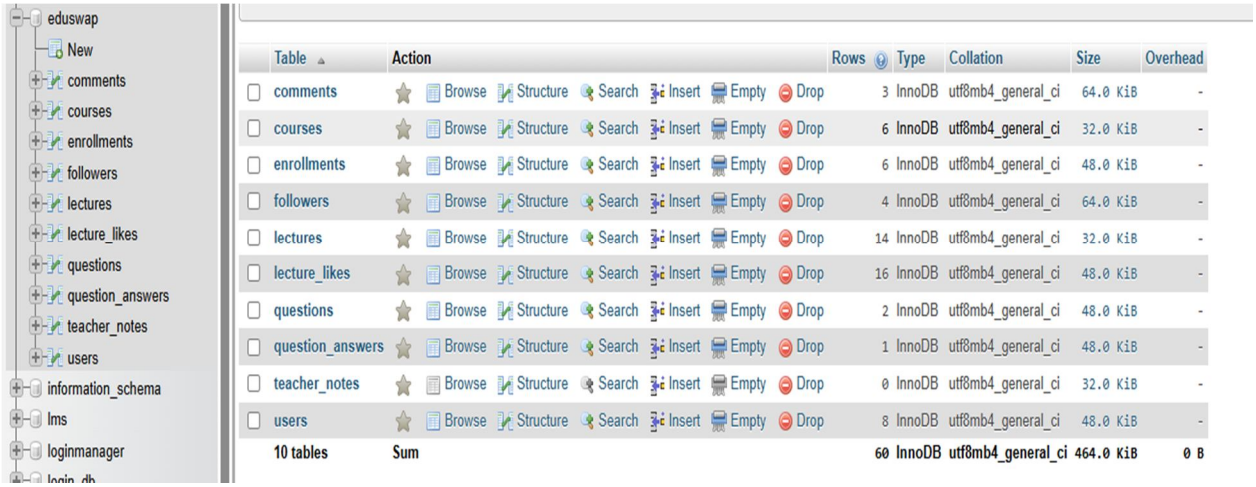
D. AI Assistant (EduBot) via Gemini API

EduBot serves as a bridge between the teacher's uploaded notes and the student's doubts. And EduBot uses a POST request to send user queries to the Google Gemini API. The response is then parsed and displayed in the chatbot.php interface. This allows students to get instant explanations for complex topics covered in the lectures.



V. DATABASE DESIGN AND DATA INTEGRITY

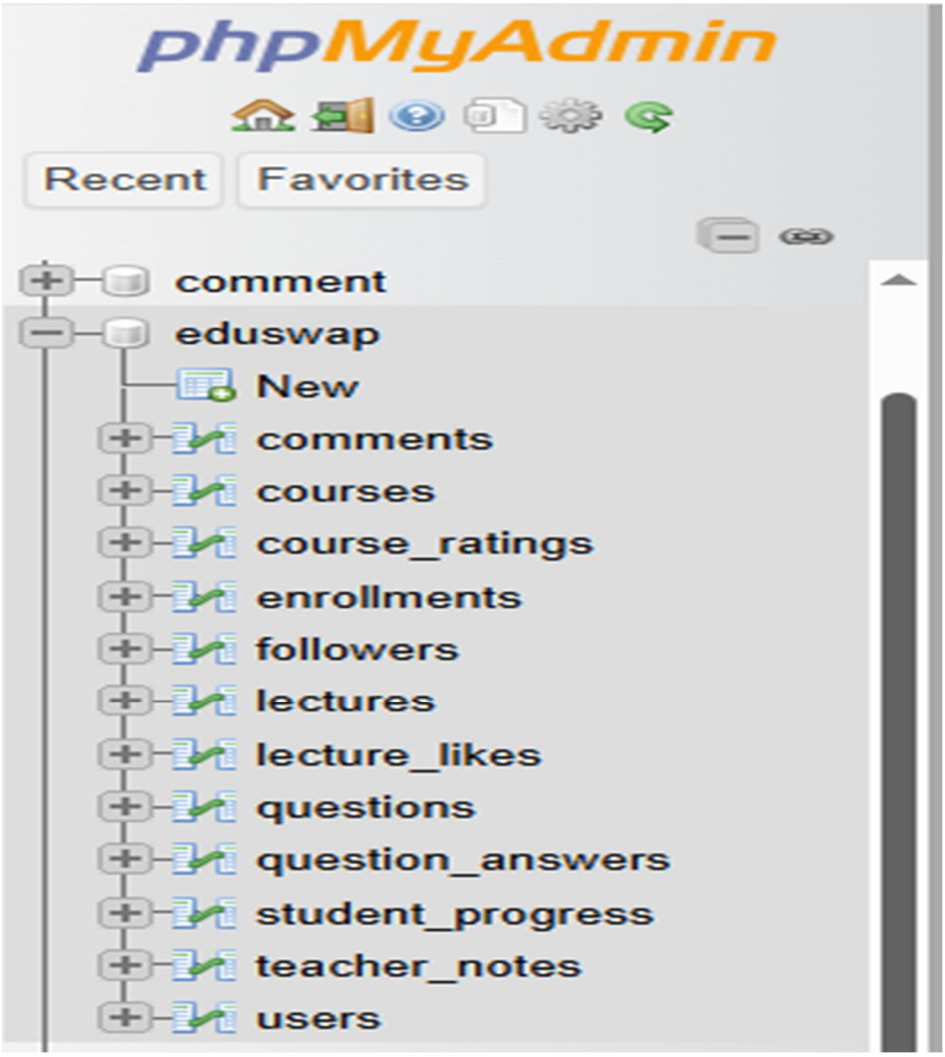
The database schema is the backbone of EduSwap. It features 10 interconnected tables designed for high performance. The database eduswap is highly normalized to ensure no data redundancy.



Key Tables Explained:

1. Users: Stores hashed credentials and role types (Admin/Teacher/Student).
2. Followers: A relational table mapping student IDs to teacher IDs to enable the "Follow" feature.
3. Lectures & Notes: Stores video links and the associated PDF/Text notes for each course.
4. Questions & Answers: A forum-style table where students post doubts and teachers/AI respond.

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VI. METHODOLOGY & TESTING RESULT

The project followed the Agile Development Model.

1) Unit Testing: Each PHP module (Login, Upload, Delete) was tested individually.
2) Security Testing: Verified that unauthorized users cannot access the /admin folder via URL manipulation.
3) API Testing: Verified the latency and accuracy of Gemini AI responses.

Test Category	Description	Performance
Login Security	SQL Injection & Brute Force	Successful Prevention
API Latency	Gemini API Response Time	Avg 1.2 Seconds
Concurrency	Multiple users chatting	Stable

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Responsiveness	Mobile, Tablet, Desktop	Fully Responsive
Parameter	Tool Used	Result
Backend	PHP 8.1 / PDO	Stable
Database	MySQL (12 Tables)	Optimized
AI Processing	Google Gemini API	< 1.5s Response
UI	Bootstrap 5 & CSS3	Fully Responsive

VII. FUTURE SCOPE

The current implementation of EduSwap serves as a robust prototype for the future of education. Future enhancements include:

1) ML-Based Recommendation Engine: Implementing "Collaborative Filtering" to suggest educators to students based on their previous learning patterns and interests.
2) Payment Gateways: For paid Courses launched by educator
3) Live Classes & Doubt Session : this platform will also provide a environment where teachers can communicate with students at real time.
4) Gamification: Introducing a token-based economy where students earn "EduCoins" for helping peers in the Q&A section, which can be redeemed for premium content.

VIII. CONCLUSION

EduSwap successfully bridges the gap between social networking and academic learning. Through this research, we have demonstrated that a "Follower-based" model is more effective for long-term engagement than traditional transactional models. By leveraging PHP-PDO for high-level security and Google Gemini AI for immediate doubt resolution, we have created a scalable, secure, and highly interactive learning environment.

The inclusion of a real-time chat module further humanizes the digital experience, allowing for genuine mentorship. As AI continues to evolve, platforms like EduSwap will become the standard for personalized, accessible, and community-driven education worldwide.

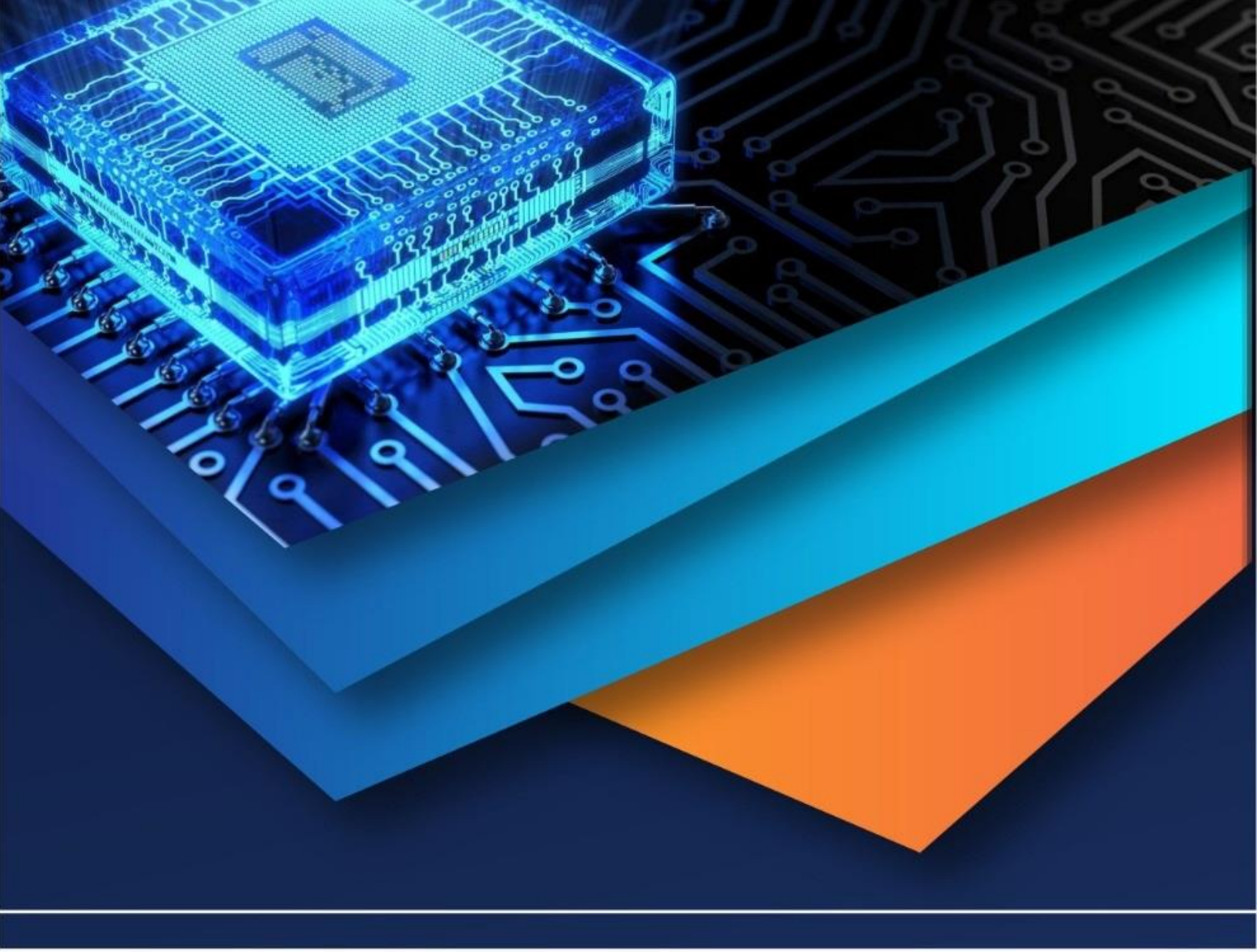
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