# LearnHub – Your Center for Skill Enhancement

# (MERN)

## Project Details

**Project Title:**
**LearnHub – Your Center for Skill Enhancement**

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**Semester:** 7th
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## Project Overview:

### LearnHub – Your Center for Skill Enhancement

**LearnHub** is a comprehensive full-stack **Online Learning Platform (OLP)** built to make quality education more **accessible**, **engaging**, and **adaptable** for learners across all backgrounds. Whether you're a student seeking new skills, a

teacher aiming to share knowledge, or an administrator managing learning infrastructure, LearnHub provides a unified and intuitive digital environment to support all aspects of modern education.

The platform empowers students to browse and enroll in a diverse range of courses, learn at their own pace, track their progress, and earn industryrecognized certificates. It also enables educators to effortlessly create and manage course content.

Technically, LearnHub is developed using a robust **client-server architecture**. The **frontend** is built with **React.js**, offering a dynamic and responsive user interface enhanced with libraries like **Material UI** and **Bootstrap**. The **backend** leverages **Node.js** with the **Express.js** framework, while **MongoDB** serves as the primary NoSQL database, ensuring scalability, performance, and seamless data management.

The platform supports **three distinct user roles**:

- **Students:** Enroll in and complete courses, join live sessions, and receive certifications.
- **Teachers:** Create, update, and manage course content and monitor student engagement.
- **Admins:** Oversee the platform's operations, handle user management, and ensure policy enforcement.

✅ **Key Features:**

- Secure authentication and role-based access control
- Course creation, enrollment, and real-time progress tracking
- Interactive tools like discussion forums, comments, and live webinars
- Digital certification upon course completion
- Mobile-friendly and desktop-responsive design
- Payment integration for premium course access
- Scalable backend for handling high traffic and data volumes

LearnHub delivers a **scalable**, **modular**, and **feature-rich** solution tailored to the evolving demands of online education. It not only supports academic institutions and private educators but also aligns with the growing trend of selfpaced and remote learning in today's digital era.

# Architecture:

## Frontend Architecture – LearnHub Technology Stack:

The frontend of LearnHub is developed using a modern and modular tech stack to ensure performance, scalability, and a smooth user experience:

- React.js 18 – For building dynamic and responsive user interfaces
- Vite – Fast build tool and development server
- React Router v6 – For seamless client-side routing
- Tailwind CSS – Utility-first CSS framework for efficient styling
- Lucide React – Lightweight icon library for consistent UI elements
- Context API – For managing global application state (authentication, courses, etc.)

### Architecture Pattern:

The frontend follows a component-based and context-driven architecture. This promotes clean separation of concerns, reusability, and ease of testing.

Component Hierarchy

```
App.jsx
├── AuthProvider (Context API)
└── Router
    └── AppContent
        ├── Navbar
        └── Routes
            └── PrivateRoute
                └── Page Components
```

- App.jsx is the entry point of the application.
- AuthProvider wraps the application and provides authentication and user data via React Context.
- Router handles the application's navigation structure.
- PrivateRoute restricts access to authenticated pages based on roles.

### State Management – AuthContext

The AuthContext.jsx file manages global application state and provides all necessary methods to interact with backend APIs. It covers user authentication, course handling, and enrollment logic.

```
AuthContext.jsx
├── User State
│   ├── user: User | null
│   ├── loading: boolean
│   ├── courses: Course[]
│   ├── enrollments: Enrollment[]
│   └── certificates: Certificate[]
│
├── Authentication Methods
│   ├── login(email, password)
│   ├── register(userData)
│   ├── logout()
│   └── updateProfile(userData)
│
├── Course Methods
│   ├── getCourses()
│   ├── createCourse(courseData)
│   ├── updateCourse(courseId, courseData)
│   ├── deleteCourse(courseId)
│   └── getTeacherCourses()
│
└── Enrollment Methods
    ├── enrollInCourse(courseId)
    ├── getUserEnrollments()
    ├── markCourseCompleted(courseId)
    └── isEnrolledInCourse(courseId)
```

**Frontend Highlights**

- Single Source of Truth: All user/course/enrollment states are centralized in AuthContext
- Reusable Components: Navbar, Layouts, Forms, and Cards follow modular structure
- Secure Routing: Authenticated and role-based access using PrivateRoute
- Responsive Design: Tailwind CSS ensures mobile and desktop compatibility
- Seamless Integration: Axios used for RESTful API calls with backend services

This architecture supports a maintainable, scalable, and interactive user experience across different devices and user roles.

**Backend Architecture – LearnHub Technology Stack:**

The backend of LearnHub is built using modern, scalable technologies to ensure fast, secure, and maintainable development:

Node.js – Runtime environment for executing JavaScript server-side
Express.js – Minimal and flexible web application framework
MongoDB – NoSQL database for scalable data storage
Mongoose – ODM (Object Data Modeling) library for MongoDB JWT (JSON Web Token) – Stateless user authentication bcryptjs – Password hashing for secure credential storage multer – Middleware for handling file uploads (images, videos, documents) cors – Enables cross-origin requests for frontend-backend communication

## Architecture Pattern

The backend follows a layered architecture pattern with clearly separated concerns for middleware, routing, database operations, and error handling. This improves modularity, scalability, and maintainability.

### 🗂 Server Structure

```
server.js
├── Middleware Layer
│   ├── rateLimit()       → Request throttling
│   ├── cors()            → CORS configuration
│   ├── express.json()    → JSON body parser
│   └── express.urlencoded() → Form data parser
│
├── Database Connection
│   ├── Mongoose connection to MongoDB
│   └── Error handling and auto-reconnection logic
│
├── Route Registration
│   ├── /api/auth         → Authentication (login/register)
│   ├── /api/users        → User management (roles, profiles)
│   ├── /api/courses      → Course creation, editing, listing
│   ├── /api/enrollments  → Enrollment logic and tracking
│   ├── /api/certificates → Certification generation and records
│   ├── /api/dashboard    → User and admin dashboard data
│   ├── /api/upload       → File uploads (using Multer & Cloudinary)
│   ├── /api/search       → Course/content search features |
└── Error Handling
    ├── Global error handler middleware
    └── 404 Not Found route handler
```

This backend architecture ensures:

- Secure and stateless authentication using JWT

- Modular API design for easy extension and maintenance
- Robust error handling for improved reliability
- Scalable database interactions through Mongoose models
- Efficient media/file management via Multer

Together with the frontend, this server-side structure powers LearnHub's dynamic e-learning ecosystem and ensures a seamless experience for all users.

Let me know if you want to include database schema diagrams or API endpoint documentation next.

# LearnHub – Project Setup Instructions

## LearnHub – Quick Setup Guide Prerequisites

Install the following before starting:

- Node.js (v16+) → `node --version`
- MongoDB (Local) **or** MongoDB Atlas (Cloud)
- Git → `git --version`
- VS Code (Recommended)

### Installation Steps

*Clone the Repository* `bash` **git clone <repository-url> cd learnhub-project** ***Backend Setup*** `bash` **cd backend npm install**

Create `.env` file and add

```
MONGODB_URI=your-mongo-uri
PORT=5000
JWT_SECRET=your-secret
FRONTEND_URL=http://localhost:5173 CLOUDINARY_CLOUD_NAME=...
CLOUDINARY_API_KEY=...
CLOUDINARY_API_SECRET=...
```

**Start server:**

`bash` `npm run dev` ***Frontend Setup*** `bash`

```
cd frontend
npm install
npm run dev
```

## Verification

- Backend: http://localhost:5000/api/health → `{ status: "OK" }`
  Frontend: http://localhost:5173
- MongoDB: Check terminal for "✅ Connected to MongoDB"

## Common Issues

| Problem | Fix |
|---|---|
| Port in use | Change `PORT` in `.env` |
| CORS errors | Ensure `FRONTEND_URL` is set correctly |
| MongoDB not connecting | Check URI or IP whitelist in MongoDB Atlas |
| JWT errors | Set `JWT_SECRET` in `.env` and restart server |

## Build for Production

```bash
cd frontend
npm run build

cd backend
npm start
You're all set!
LearnHub now ready on:is
```

- **Backend → http://localhost:5000**
- **Frontend → http://localhost:5173**

# LearnHub– Running Guide

## Prerequisites

Ensure the following are completed before running the app:

- Node.js is installed
- MongoDB is running (local or Atlas)
- All dependencies are installed
- Environment variables are correctly configured in .env

## ▶️ Start the Application

### *Step 1: Start Backend*

```
bash cd backend
npm run dev
```

**Verify**:

- Console should show ✅ `Connected to MongoDB`
- Also: `Server running on port 5000`

### *Step 2: Start Frontend* `bash cd frontend npm run dev`

**Verify**:

- App should open at: http://localhost:5173

### *Step 3: Access the App*

Open your browser and visit:
http://localhost:5173
Register or log in to begin using LearnHub.

## Useful Commands

**Backend** `bash cd backend`

```
npm run dev        # Start dev server npm
start          # Start production server npm
run seed       # Seed database (optional)
```

**Frontend**

```bash
cd frontend
npm run dev        # Start dev server npm
run build     # Build for production
```

### ❌ *Stop Servers*

Press Ctrl + C in the terminal running

# LearnHub API – Quick Reference

**Base URL:** http://localhost:5000/api
**Authentication:** Bearer Token (JWT)
**Roles:** `user` (student), `teacher`, `admin`

# Authentication Endpoints

- `POST /auth/register` – Register user
- `POST /auth/login` – Login and get JWT
- `POST /auth/logout` – Logout (client-side token removal)
- `POST /auth/refresh` – Refresh JWT token **User Management**

- GET /users/profile – Get current user profile
- PUT /users/profile – Update user profile
- GET /users – Admin: Get all users (with filters/pagination)

## Course Management

- `GET /courses` – List all courses (filters supported)
- `GET /courses/:id` – Get course by ID
- `POST /courses` – Create course (teacher/admin)
- `PUT /courses/:id` – Update course
- `DELETE /courses/:id` – Delete course
- `GET /courses/teacher/my-courses` – Teacher's course list

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## Enrollments

- POST /enrollments – Enroll in a course
- GET /enrollments/user – Get enrolled courses
- PUT /enrollments/:id/complete – Mark as completed
- PUT /enrollments/:id/progress – Update progress

### Certificates

- GET /certificates/user – List user's certificates
- POST /certificates/generate – Generate certificate
- GET /certificates/verify/:code – Verify certificate

## Dashboards

- `GET /dashboard/user` – User stats (learning progress)
- `GET /dashboard/teacher` – Teacher stats (revenue, courses)
- `GET /dashboard/admin` – Platform stats (users, growth)

### Search

- `GET /search/courses` – Search courses with filters

#### Required Environment Variables

- `MONGODB_URI`, `JWT_SECRET`, `JWT_EXPIRE`
- `FRONTEND_URL`, `CLOUDINARY_*`

# LEARNHUB AUTHENTICATION SYSTEM

## OVERVIEW

LearnHub uses a secure, token-based authentication system built with **JWT (JSON Web Tokens)**.
No sessions or cookies are used — authentication is fully stateless and handled via tokens.
All protected requests must include a valid JWT in the **Authorization** header.

## AUTHENTICATION FLOW SUMMARY

### USER REGISTRATION

- User fills and submits the registration form
- Backend validates all input fields
- Password is hashed using **bcrypt** (12 salt rounds)
- A **JWT token** is generated on successful registration
- Token is returned and stored in **localStorage** as `'learnhub_token'`

### USER LOGIN

- User submits email and password
- Backend checks if email exists and password matches (using bcrypt)
- On success, a JWT token is generated and returned
- Token is stored in **localStorage** as `'learnhub_token'`

### TOKEN VERIFICATION

- Frontend sends token in each protected request using the `Authorization` header
- Backend middleware validates the token's **signature and expiration**
- If valid, request proceeds and user data is attached to `req.user`

#### JWT TOKEN STRUCTURE & CONFIGURATION

{

"id": "user_id_here",

"iat": <issued_at_timestamp>,

"exp": <expiration_timestamp>

}

## ROLE-BASED AUTHORIZATION USER

### ROLES:

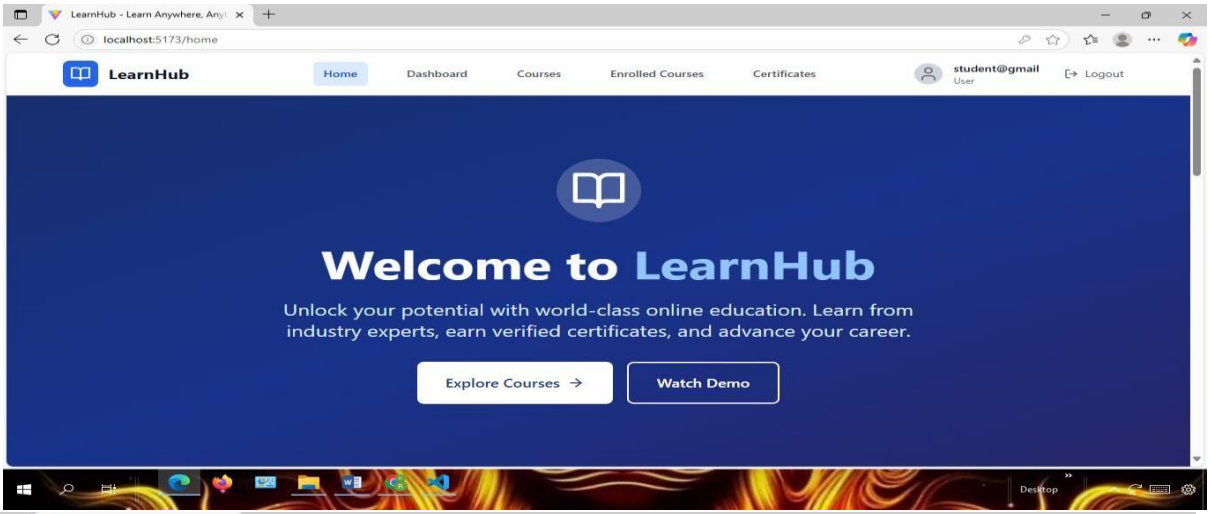
- `user` (Student): Can enroll in courses, access lessons, view certificates
- `teacher`: Can create/edit/delete courses, manage enrolled students
- `admin`: Full access to all data and user management

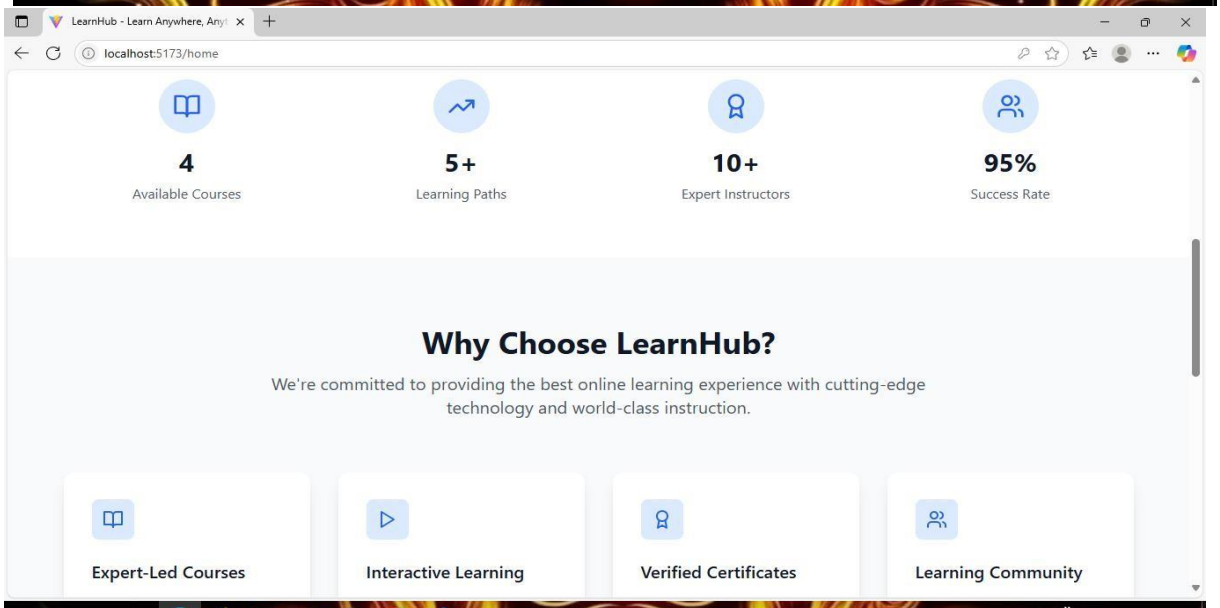
### MIDDLEWARE FUNCTIONS:

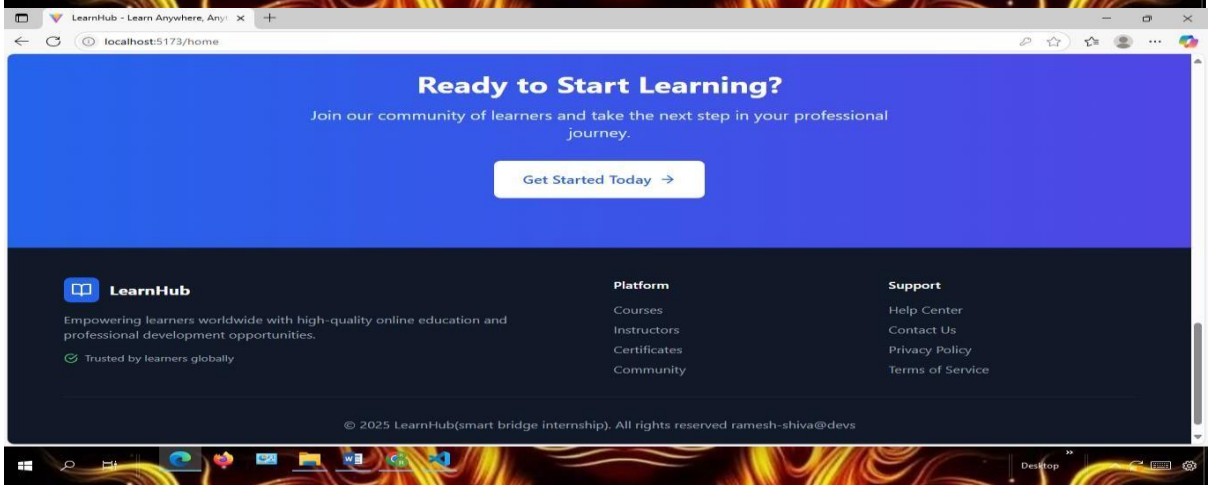
- `auth`: Verifies JWT and attaches user info to request
- `authorize(...roles)`: Ensures the user has at least one allowed role

# USER INTERFACE

## Home Page Overview:


LearnHub - Learn Anywhere, Anyt
localhost:5173/home
LearnHub
Home
Dashboard
Courses
Enrolled Courses
Certificates
student@gmail
User
Logout
Welcome to LearnHub
Unlock your potential with world-class online education. Learn from industry experts, earn verified certificates, and advance your career.
Explore Courses →
Watch Demo
Desktop


LearnHub - Learn Anywhere, Anyt
localhost:5173/home
4
Available Courses
5+
Learning Paths
10+
Expert Instructors
95%
Success Rate
Why Choose LearnHub?
We're committed to providing the best online learning experience with cutting-edge technology and world-class instruction.
Expert-Led Courses
Interactive Learning
Verified Certificates
Learning Community
Desktop


LearnHub - Learn Anywhere, Anyt
localhost:5173/home
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Join our community of learners and take the next step in your professional journey.
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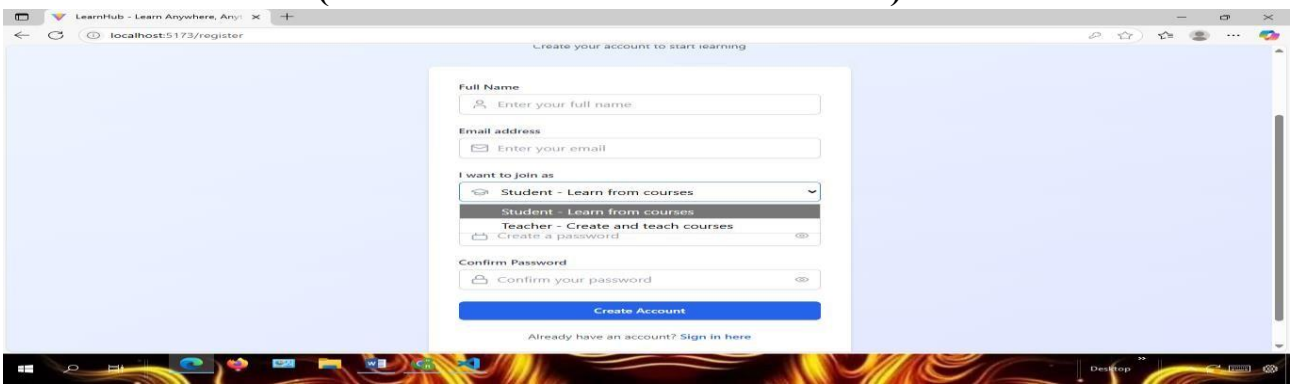
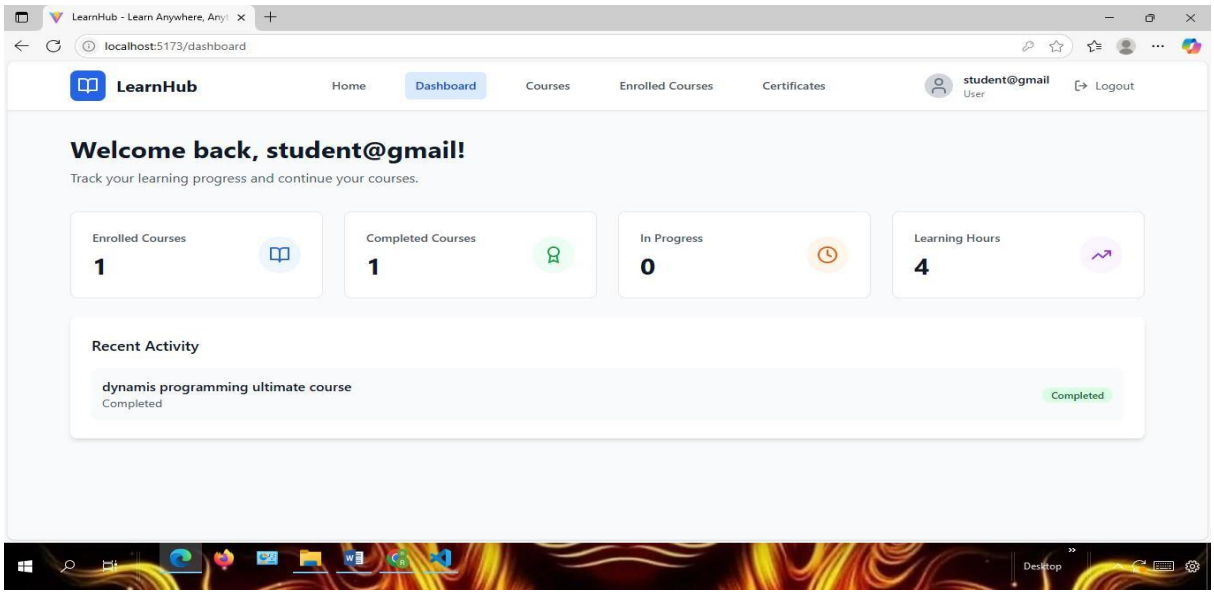
Desktop

## REGISTER PAGE : (common for Students and Teachers)



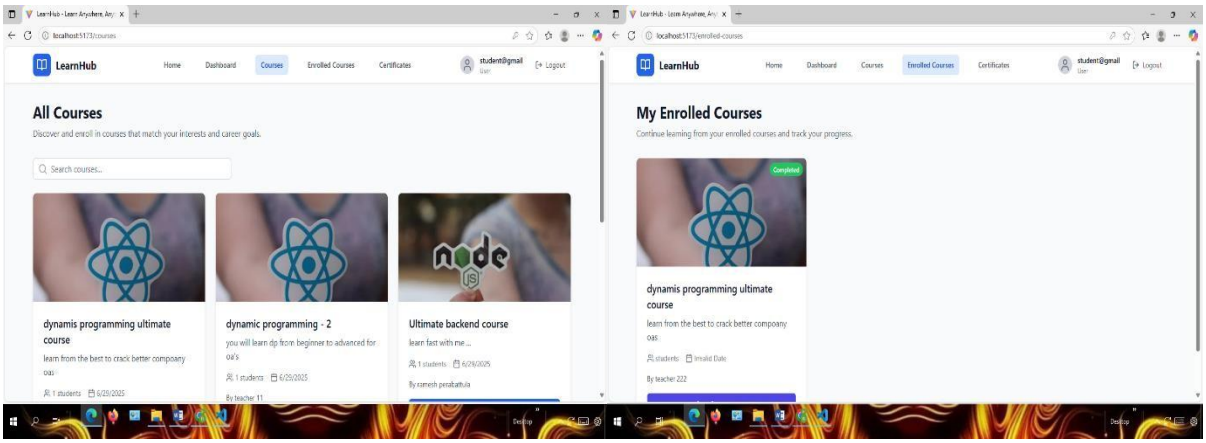

## LOGIN PAGE:


## Student Dashboard Overview:



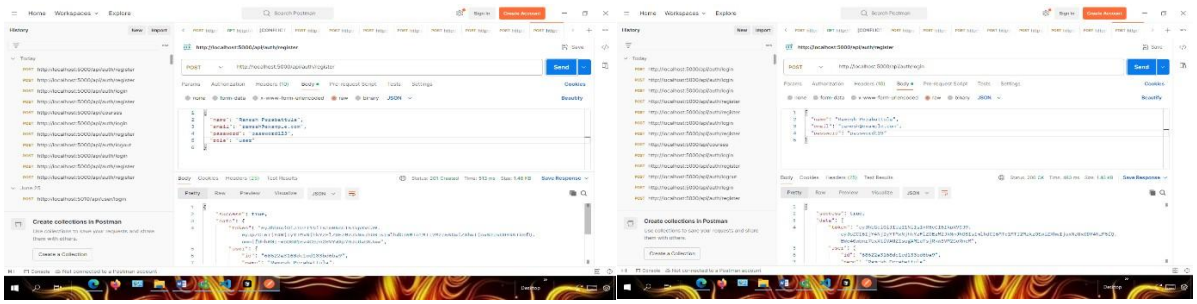
## Courses Tab Overview:

## Enrolled courses Tab Overview:

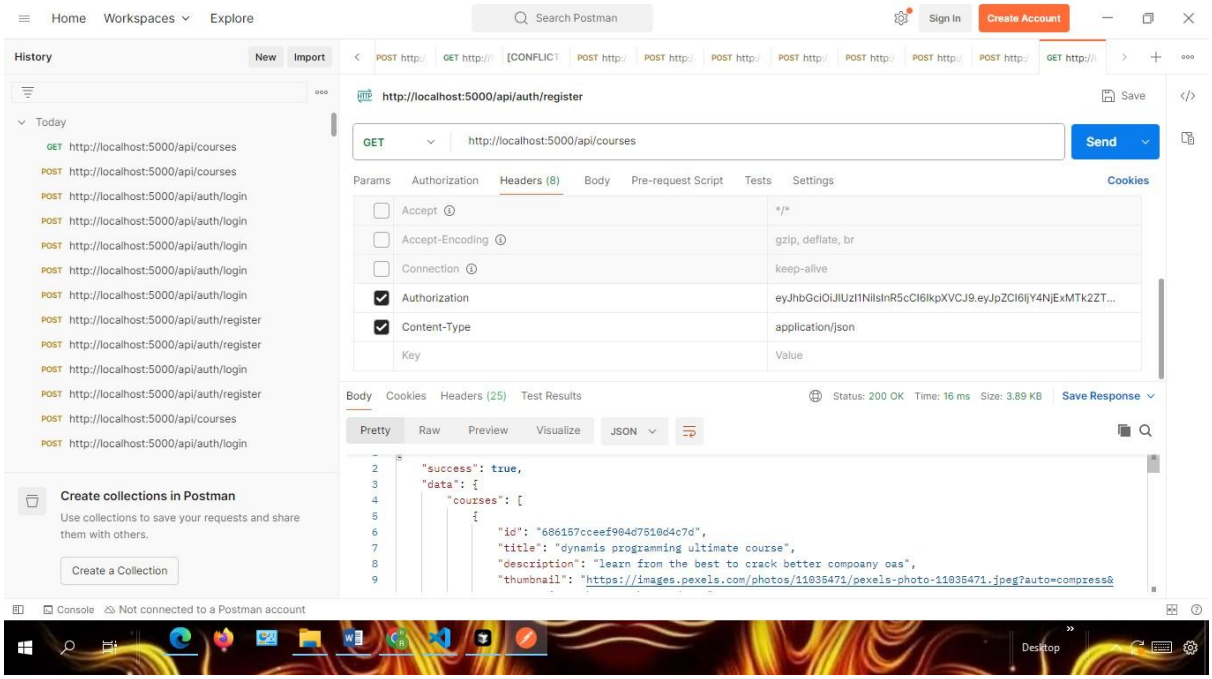


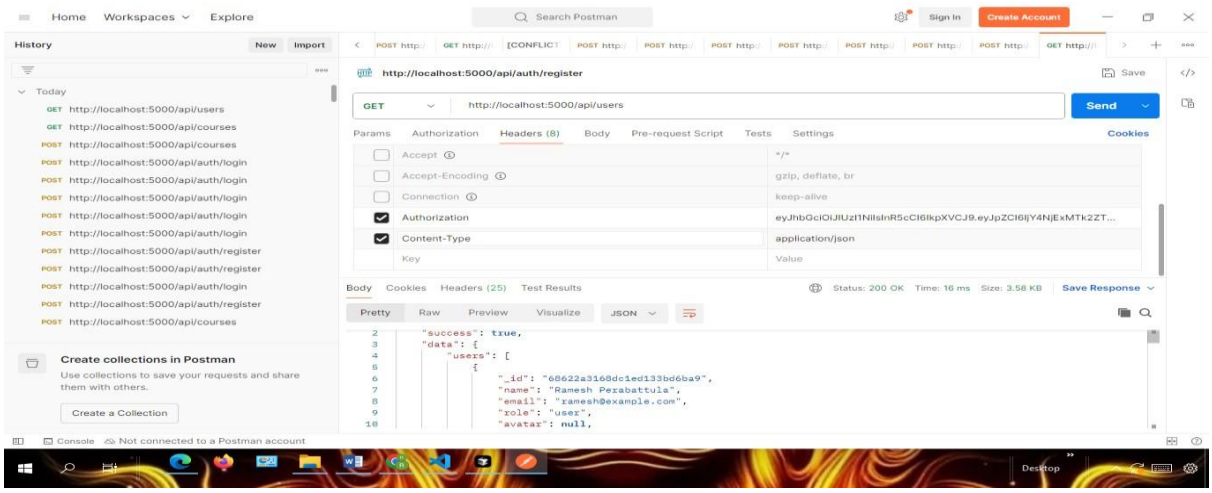

# API TESTING — POSTMAN TOOL

## Register & Login API Test (http://localhost:5000/api/auth/register or /login):



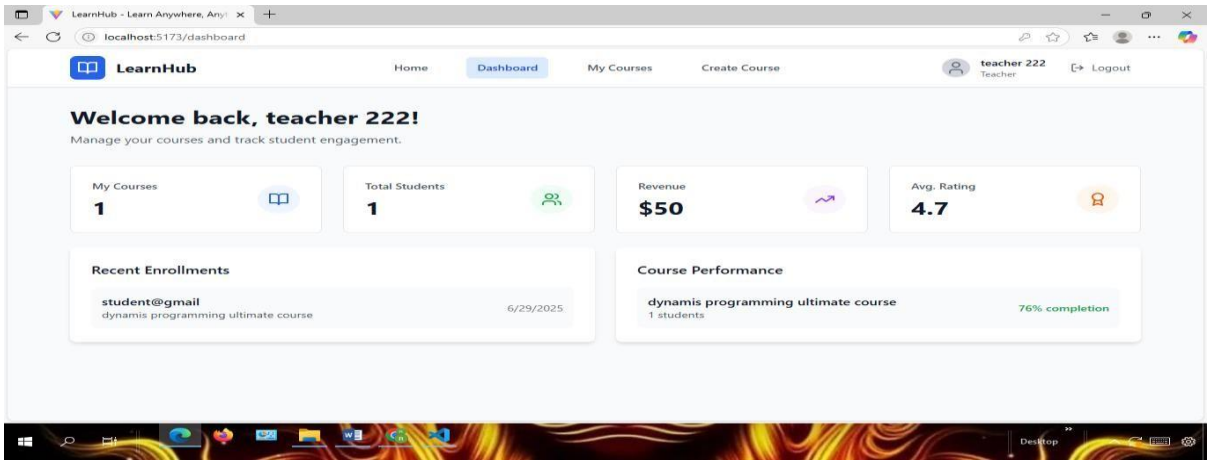
## Admin getAllCourses & getAllUsers API Test(http://localhost:5000/api/)



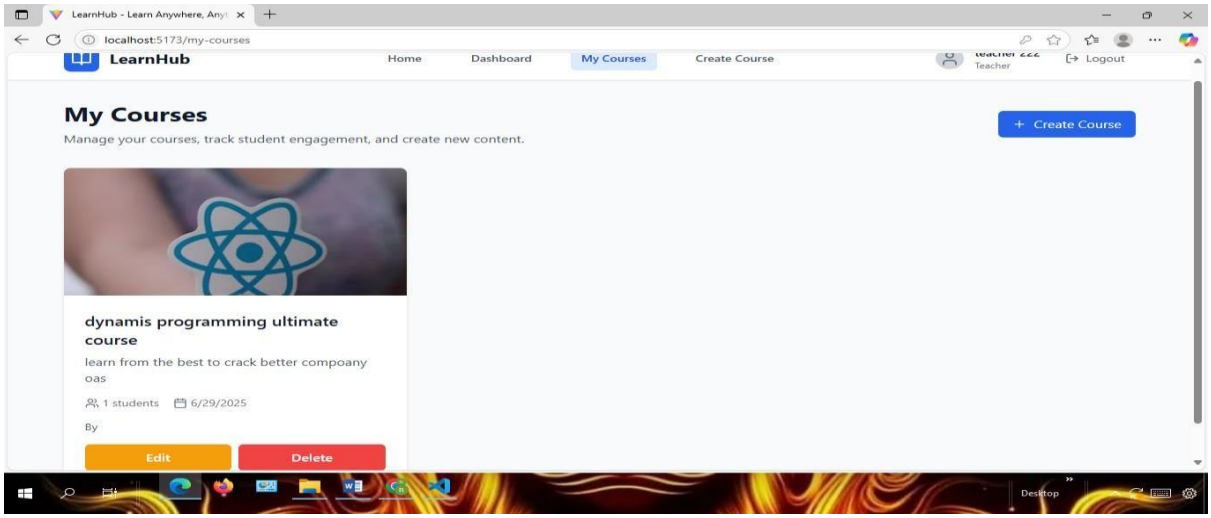



# SCREENSHOTS / DEMO SECTION

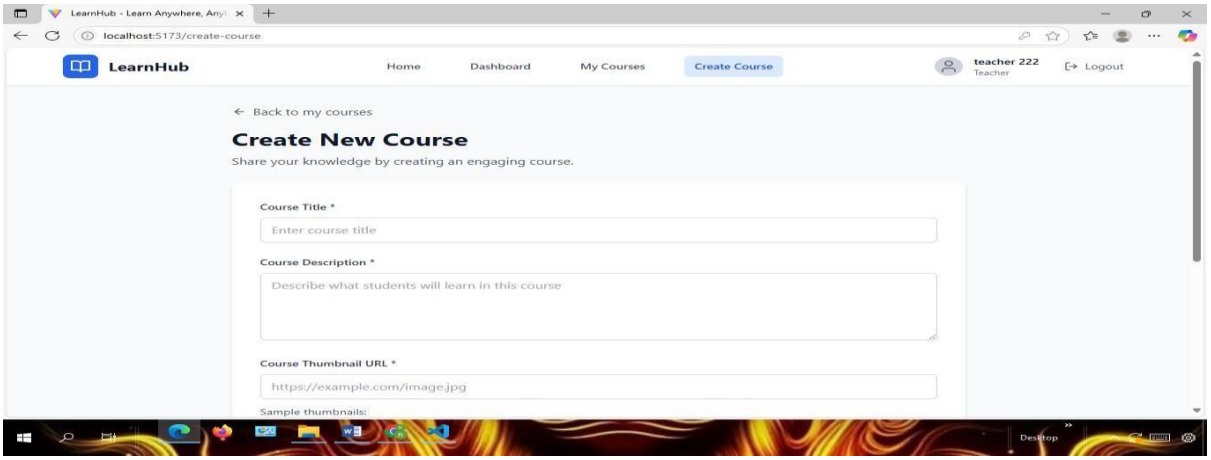
## Teacher Dashboard Overview:



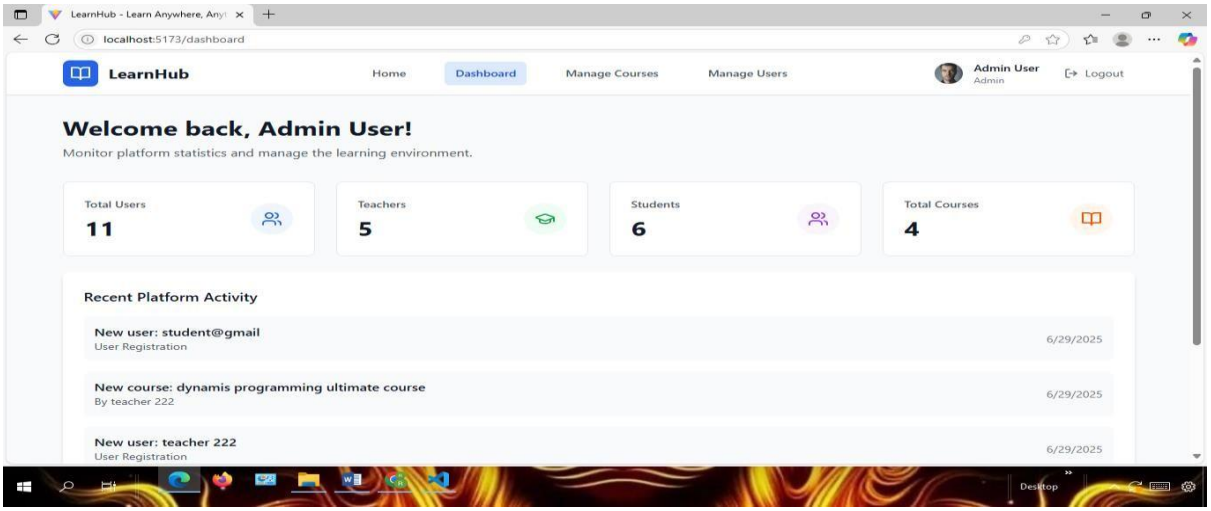

## Teacher My Couses Tab Overview:



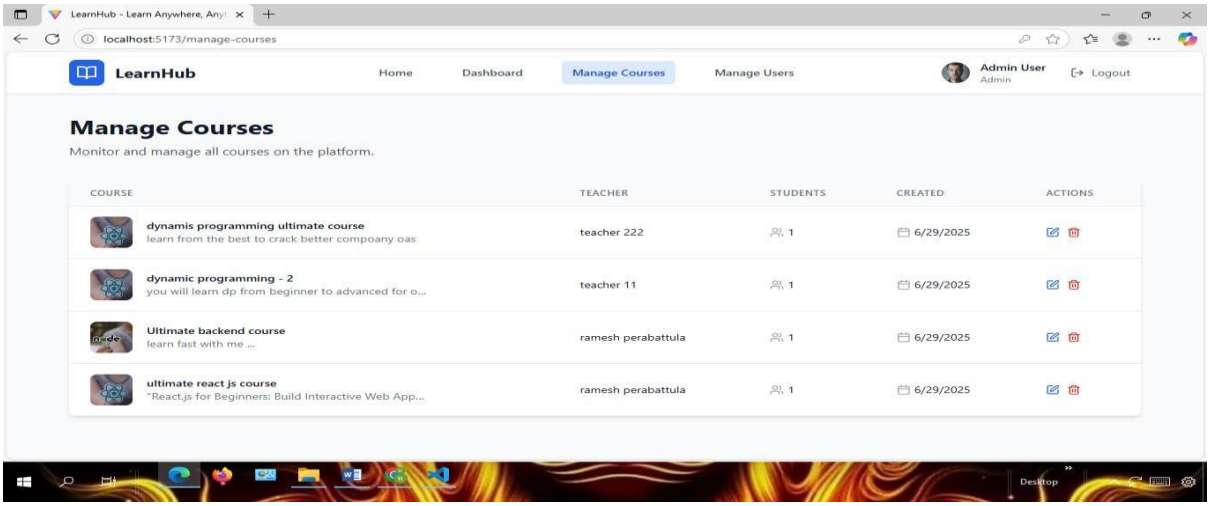

## Create Course Tab Overview:



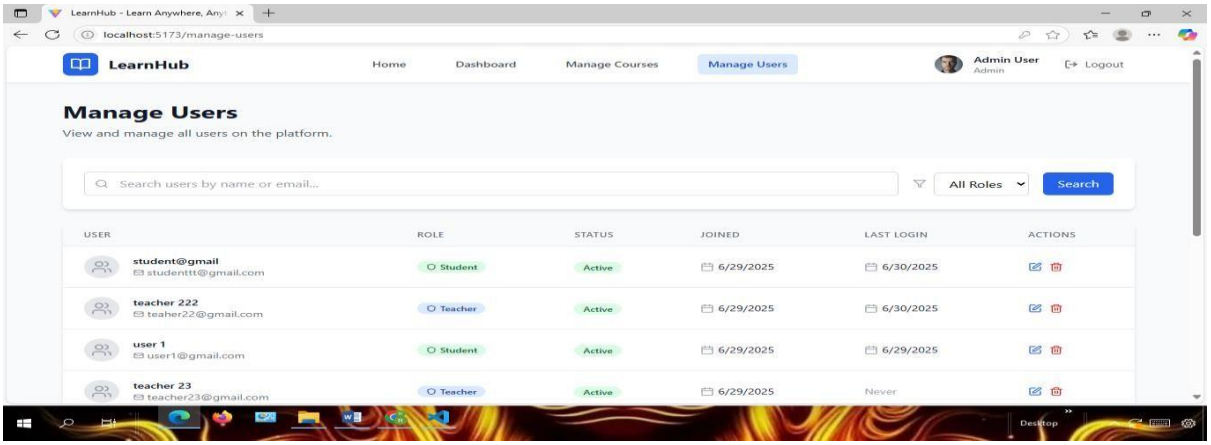

## Admin Dashboard Overview:




**Manage Courses Tab Overview** (Admin can perform Update and Delete operations):




**Manage Users Tab**(Admin can perform Update and delete Operations)




# LearnHub – Known Issues

## Frontend Issues

**1. Token Expiration**
JWT expires after 7 days; no auto-refresh. *Workaround:*
Re-login manually.

**2. File Upload Limit**
Max 10MB upload size; large videos fail.
*Workaround:* Compress files or use external links.

**3. Mobile Responsiveness**
Some pages not mobile-friendly.
*Workaround:* Use desktop for full features.

## Backend Issues

**4. Rate Limiting**
100 requests/15 mins may block active users. *Workaround:*
Add caching or increase limits.

**5. DB Connection Drops**
MongoDB may timeout when idle.
*Workaround:* Restart backend if needed.

**6. File Storage Dependency** Fails if Cloudinary is down.
*Workaround:* Ensure config or add fallback.

**7. Slow Data Loading**
No pagination; large datasets lag.
*Workaround:* Add pagination or lazy loading.
**8. Unoptimized Images**

Big images slow down pages.
*Workaround:* Compress before upload.

# FUTURE ENHANCEMENTS

## LearnHub – Future Enhancements

### 1. Authentication & Security

- Add OAuth, SSO, and MFA
- Granular role-based access
- Session timeout & audit logging
- Strong password rules

### 2. Course Management

- Multimedia content editor
- Course templates & version control
- Quizzes, prerequisites, and progress tracking
- Support for live webinars

### 3. User Experience

- AI-based course recommendations
- Personalized dashboards & adaptive learning
- Gamification and social features

### 4. Mobile Support

- Native iOS/Android apps
- Offline access & push notifications
- Progressive Web App (PWA) support

### 5. Analytics & Reporting

- Dashboards for all roles
- Custom reports and exports
- Predictive analytics for at-risk learners

### 6. Live Learning

 Virtual classroom with chat, polls, and recording 
Integration with Zoom, Teams, etc.