

# LearnBuddy

## An AI-Powered Adaptive Learning Platform

Saurav Maske (10)  
Utsav Subedi (18)  
Aarju Tujale (19)  
Aakash Thakur (20)

Department of Computer Science and Engineering

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# Introduction

- LearnBuddy is an interactive educational web platform
- Designed to enhance mathematics learning
- Combines adaptive quizzes and an AI-powered chatbot
- Focuses on personalized learning experiences

# Problem Statement

- Traditional learning platforms are static
- Uses a single data set so there are not many unique questions
- Same difficulty level for all students
- Limited instant feedback
- Lack of step-by-step problem-solving guidance

# Proposed Solution

- Adaptive quiz system with dynamic difficulty
- AI chatbot for guided mathematical problem solving
- Secure authentication and progress tracking
- Responsive and user-friendly interface

# Key Features

- User authentication with OTP and JWT
- Adaptive quizzes with real-time evaluation
- AI chatbot with structured step-by-step solutions
- Chapter-wise progress tracking
- Mobile-friendly responsive design

# Technology Stack

## Frontend

- React (v19.2.3)
- React Router DOM
- CSS3

## Backend and Database

- Django
- Hugging Face Base Model and LoRA Adapter Training
- PostgreSQL

# Base Model: Qwen

**Qwen** is an opensource family of large language models by Alibaba, designed for chat, coding, reasoning, and multimodal which is more open and customizable.

## Why Qwen?

- It is a pretrained model that understands natural language
- Can give basic reasoning and perform mathematical calculation
- Easier to finetune based on adapters

# System Architecture

- Client–server architecture
- React frontend communicates with Django backend APIs
- Model Backend runs separately for optimisation purposes
- JWT-based authentication
- RESTful API design

# Authentication Flow

- ① User registration
- ② OTP email verification
- ③ Secure login
- ④ JWT token storage
- ⑤ Access to protected routes

# Authentication Flow Contd...

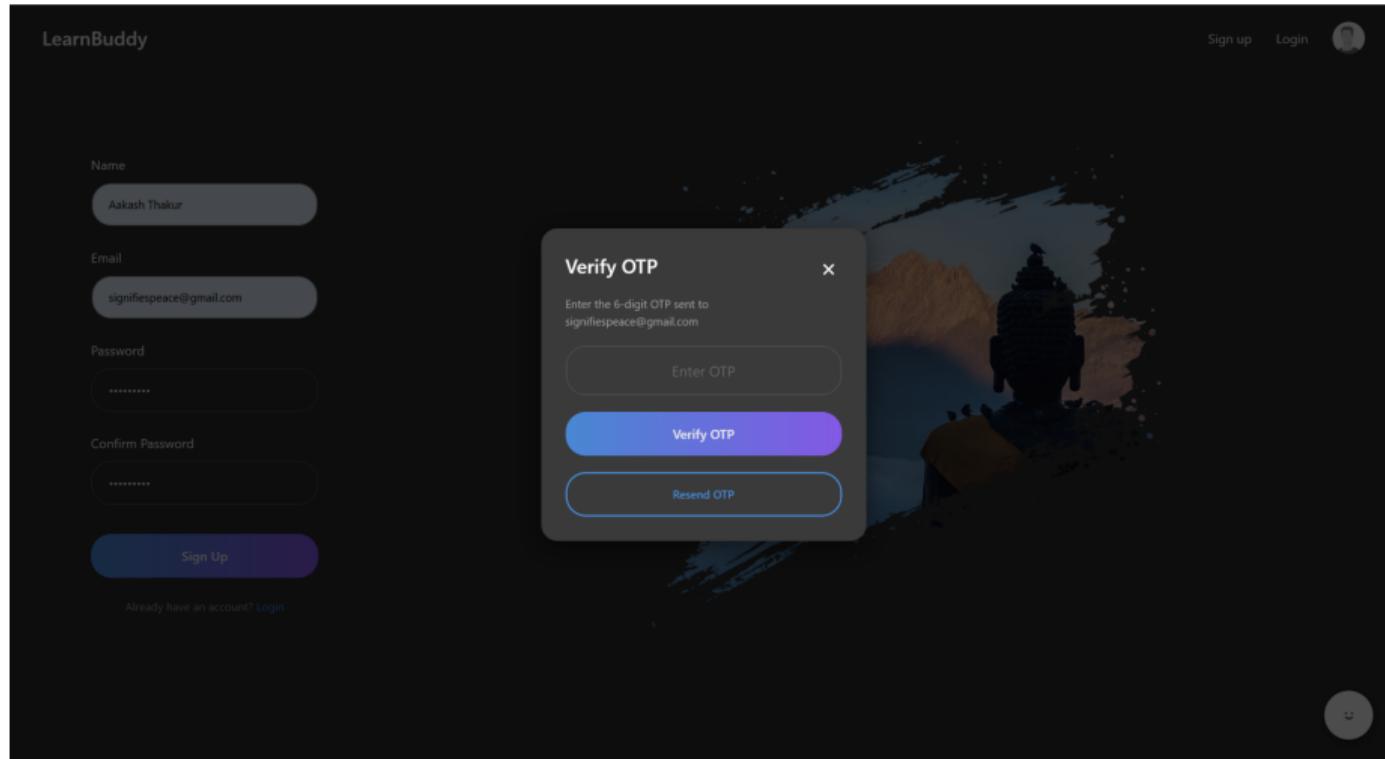


Figure: User Authentication

# Quiz System

- NEB based grade 10 mathematics topics
- Dynamic difficulty adjustment
- Real time answer validation
- Step-by-step solution viewing

- Accepts mathematical queries
- Routes questions based on chapter
- Provides:
  - Given data
  - Problem identification
  - Step-by-step solution
  - Final answer

# User Experience

- Clean and intuitive interface
- Visual feedback for answers
- Responsive UI

# User Experience Contd...

Simplify:  $(x^2 + 8x + 16) / (x + 4)$

A.  $x - 4$   
B.  $x^2 + 16$   
**C.  $x + 4$**   
D.  $x$

Wrong Answer

**Explanation:**

A: {tag: 'sign\_error', 'why': 'Wrong sign while factoring the trinomial.'}  
B: {tag: 'no\_factorization', 'why': 'Did not use  $(x+a)^2$  identity.'}  
C: Rewrite numerator as  $(x+a)^2$  and cancel the common factor  $(x+a)$ .  
D: {tag: 'partial\_cancel', 'why': 'Cancelled only x instead of the whole common factor.'}

[Solve](#) [Next Question](#)

**Answer**

**Given:**  $a=4$ ,  $b=8$ ,  $c=16$

**To Find:** Simplified form

$$\begin{aligned}x^2 + 8x + 16 &= (x + 4)^2 \\&= (x + 4)(x + 4) / (x + 4) \\&\text{Cancel common factor } (x + 4) \\&= x + 4\end{aligned}$$

**Final Answer:**  $x + 4$

Figure: User Interface

- Authentication APIs
- Quiz question and mcq options APIs
- Solution retrieval APIs
- Chatbot interaction API

- Unit testing for components
- Integration testing for user workflows
- Coverage report generation

# Testing Contd...

LearnBuddy server is running

## Model status

Device: cuda:0 If you see cuda:0 and adapters listed, loading worked.

## Loaded adapters

```
algebraic_fractions_v1
arithmetic_v1
growth_depr_v1
probability_v1
quadratic_v1
router_lora
sequence_series_v1
```

## Test adapters (MCQ + Solve)

### Endpoint

/api/mcq  
/api/mcq  
/api/solve  
/api/solve\_auto

### Chapter name (used to pick adapter)

Sequence and Series  
Make sure your router maps this chapter to the correct adapter.

### Difficulty (MCQ only)

2

Run

Clear output

Idle

## Response

### Parsed result

### Raw model output

## Limitations:

- Adaptive logic difficulty
- Chatbot
- Collaborative filtering
- Requires large memory usage and resources

# Achievements

- Developed an adapter based model that solves the NEB grade 10 mathematics mcqs
- Implemented a secure user authentication system using OTP verification and JWT tokens
- Developed a structured solution explanation system (given, to find, steps, final answer).
- A basic chatbot that answers the valid questions provided

# Future Enhancements

- Support for more subjects
- Teacher dashboard
- Advanced learning analytics
- Learning behaviour based question generation
- Content and collaboration based hybrid recommendation system
- Optimized Chatbot
- Mobile application

# Conclusion

- LearnBuddy makes quality education accessible to everyone through technology.
- Assists remote learners requiring flexible, self paced education
- Supplemental educational resources
- Scalable and extensible platform

# Thank You

Questions?