

GenAI-Based Classroom Assistant Chatbot

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Abstract - Education accessibility remains one of the key global challenges, particularly in rural and under-resourced areas where students often lack timely academic support. Existing learning platforms are frequently disjointed, with limited AI-driven personalization, poor multilingual support, and no structured reuse of learner data. These limitations lead to slower learning progress, reduced engagement, and inconsistent academic growth.

This project presents a GenAI-Based Classroom Assistant Chatbot that integrates advanced Generative AI (GenAI), Machine Learning (ML), and Natural Language Processing (NLP) to deliver real-time, intelligent, and inclusive academic assistance. The system introduces multiple modules including:

- **Doubt Solver** – AI-powered subject query resolution through natural language input.
- **Academic Chatbot** – 24/7 conversational tutor for concept explanation and guidance.
- **AI Mentor** – Personalized study recommendations and progress tracking.
- **Student Digital Twin** – A reusable academic profile storing performance and learning history for continuous improvement.

The platform is built using Flask (backend), React (frontend), MySQL (database), and Ollama Phi AI models for content generation and interactive responses. It is optimized for low-bandwidth environments, supports multiple languages, and ensures scalability for institution-wide deployment.

By providing intelligent tutoring, multilingual communication, personalized feedback, and secure academic data management, this project highlights how GenAI can transform education, enhance accessibility, and enable data-driven learning for students and educators alike.

This comprehensive system aims to offer scalable, adaptive, and learner-friendly digital education solutions, addressing the evolving demand for smart classroom technologies.

Keywords: Classroom Assistant Chatbot, AI Tutor, Student Management System, Personalized Learning,

Academic Analytics, Education Technology, Multilingual NLP, Data Security, Responsive UI Design, Digital Learning Solutions.

1. INTRODUCTION

In today's world, educational systems face increasing challenges in delivering timely, affordable, and high-quality learning support, particularly for students in rural and underprivileged areas. Millions of learners struggle with limited access to expert teachers, delayed academic assistance, language barriers that restrict comprehension, and the repetitive process of re-entering academic details during every evaluation. These challenges not only affect student performance but also increase the burden on educators, who often work with incomplete learner information, leading to inefficiency, reduced engagement, and poor learning continuity.

Traditional classroom models rely heavily on manual teaching and isolated digital tools, which fail to integrate personalized doubt-solving, intelligent feedback, and real-time academic guidance into a unified platform. With the rise of **Generative Artificial Intelligence (GenAI)**, **Machine Learning (ML)**, and **Natural Language Processing (NLP)**, it is now possible to build intelligent educational assistants that can bridge these gaps by offering interactive learning support, automated concept explanation, and personalized study recommendations. The **GenAI-Based Classroom Assistant Chatbot** is designed to overcome these limitations through integrated modules such as a **Doubt Solver** for instant academic query resolution, an **Academic Chatbot** for 24/7 tutoring, an **AI Mentor** for adaptive learning suggestions, and a **Student Digital Twin** that securely stores and reuses academic performance data for continuous improvement.

By combining generative AI models, cloud-based systems, and a user-friendly multilingual interface, the platform ensures that students can access personalized learning assistance anytime and anywhere, while also helping teachers with accurate analytics and data-driven insights. This project ultimately aims to demonstrate how AI-powered academic solutions can transform classroom learning, reduce barriers, improve accessibility, and promote

smarter education through continuous monitoring and adaptive feedback.

The growing need for intelligent education tools highlights the demand for a unified digital assistant that can provide multiple academic services without requiring students to switch between different applications or repeatedly input their details. Existing e-learning systems mainly focus on content delivery, while most AI-based learning apps handle only question answering or test preparation in isolation, failing to provide a comprehensive educational experience. Moreover, many platforms lack multilingual interaction, making them less accessible to diverse learners in multilingual nations like India. The proposed **GenAI-Based Classroom Assistant Chatbot** stands out by integrating doubt resolution, interactive tutoring, performance tracking, and personalized mentoring within a single ecosystem, while also introducing a **Student Digital Twin** that stores, updates, and reuses learner data to minimize redundancy and improve continuity. By leveraging machine learning algorithms, natural language processing, and scalable cloud infrastructure, the chatbot ensures faster learning assistance, customized academic insights, and responsive multilingual support even in low-connectivity environments. This holistic solution has the potential to reduce educational disparity, empower students with proactive learning insights, and assist teachers in delivering efficient, data-driven education, thereby reshaping the modern academic landscape.

2. EXISTING SYSTEM

Traditional classroom systems rely on manual methods for student enrollment, session scheduling, performance tracking, and teacher-student communication. These processes are often time-consuming, inefficient, and prone to human errors, making it difficult for educators to provide timely and quality learning support. Students face challenges such as delayed responses, lack of transparency, and limited access to teachers, especially in rural or underserved institutions.

1. Manual Student Registration and Record Management

Student details are maintained manually, often on paper, making it difficult to track and retrieve academic data.

Storing physical records increases the risk of data loss, duplication, and inefficiency in updating information.

2. Limited Digital Session Scheduling

Class and doubt sessions are mostly handled offline or through direct communication, leading to confusion and delays.

Students often have to meet teachers physically to confirm timings, increasing waiting times and reducing flexibility.

3. Lack of Online Mentorship and Guidance

Traditional systems provide no or very limited options for virtual mentoring or AI-driven tutoring.

Students in remote areas have to rely on self-study or travel long distances to seek help, which slows learning progress.

4. Inefficient Communication and Transparency Issues

Students face delays in receiving updates on class schedules, grades, or announcements.

Lack of a centralized communication system creates confusion and dissatisfaction for both students and teachers.

Limitations of the Existing System

Time-Consuming: Manual operations slow down academic processes and increase workload for educators.

Error-Prone: Human-based data entry and scheduling lead to inaccuracies and inconsistencies.

Lack of Integration: No centralized system for managing classes, student records, and performance reports.

Poor Learning Experience: Delayed communication, limited teacher access, and lack of digital services reduce student engagement.

3. PROPOSED SYSTEM

The **GenAI-Based Classroom Assistant Chatbot** offers a modernized and intelligent approach to delivering academic support. By integrating generative artificial intelligence, automation, and secure digital learning workflows, the system enhances efficiency, reduces manual teaching workload, and improves the overall experience for both students and educators. Unlike traditional education systems that depend on paperwork and isolated tools, this system automates key academic tasks such as student registration, class scheduling, progress tracking, online mentoring, and secure communication, thereby minimizing delays and inefficiencies in learning processes.

One of the major innovations of this system is its **AI-powered doubt-solving module**, which utilizes machine learning and natural language processing models to analyze student queries and provide instant explanations. Learners can receive immediate clarifications, personalized study recommendations, and guidance on relevant topics. This feature not only builds confidence and interest in learning but also allows teachers to focus on conceptual teaching rather than repetitive doubt resolution. By minimizing manual assessment at the early stage, educators can dedicate more time to improving content quality and personalized support, ultimately enhancing learning outcomes.

To further streamline the academic workflow, the system automates scheduling and class management. Instead of relying on manual coordination or message-based confirmations, the platform intelligently syncs available time slots with teacher schedules, reducing conflicts and missed sessions. Automated notifications and reminders are sent to both students and teachers, ensuring that lessons and discussions happen on time with improved consistency.

A key drawback of existing classroom systems is the lack of real-time transparency and feedback, which often discourages students. The proposed chatbot addresses this with continuous updates such as class reminders, performance feedback, assignment tracking, and report availability. This improves the overall learning experience, promotes engagement, and strengthens the bond between students and teachers through clear communication.

For teachers and administrators, the platform offers a centralized dashboard with an intuitive interface to manage student records, monitor attendance, and analyze academic progress. By utilizing AI-generated insights and analytics, educators can identify weak areas, predict performance trends, and personalize learning plans. Administrators benefit from centralized management of users, sessions, and reports, ensuring efficient and organized digital learning.

Built using **Python, React, Flask, and MySQL**, the system is scalable and adaptable to various educational environments, from schools to higher learning institutions. Its API integration capabilities enable seamless expansion, supporting the addition of AI-based recommendation engines, progress analyzers, and multilingual communication modules in the future.

By addressing key challenges such as inefficiency, lack of interactivity, and poor feedback loops, the GenAI-based chatbot sets a new benchmark in digital education. It empowers teachers with intelligent tools, enhances student engagement through automation and personalization, and ensures a smooth, secure, and effective learning process from start to finish.

Advantages of the Proposed System

Reduces Manual Work: Automates registration, scheduling, and record maintenance.

Enhances Learning Efficiency: Speeds up academic processes using AI-driven insights and automation.

Improves Student Experience: Provides instant feedback, real-time updates, and personalized tutoring.

Increases Transparency: Keeps students informed about schedules, grades, and feedback.

Supports Data-Driven Learning: Uses analytics to improve understanding, progress tracking, and academic planning.

By integrating GenAI and automation, the classroom chatbot overcomes the limitations of traditional education systems and sets a new standard for intelligent digital learning.

4. SYSTEM ARCHITECTURE

The **GenAI-Based Classroom Assistant Chatbot** is built on a modular and scalable architecture that integrates student management, session scheduling, online tutoring, and performance tracking into a unified platform. It consists of multiple layers that work together to ensure a seamless experience for students, teachers, and administrators. The system comprises a **User Interface Layer, Application Layer, AI & Analytics Module, Database Layer, and API & Integration Layer** to manage student records, sessions, assignments, and communication efficiently.

The **User Interface Layer** provides an interactive and responsive web-based platform designed for three primary users:

- **Students** – can register, book sessions, access academic history, and consult teachers online.
- **Teachers** – can manage schedules, view student performance, provide guidance, and conduct online tutoring sessions.
- **Administrators** – oversee system operations, manage user access, ensure security, and analyze academic data to improve efficiency.

The intuitive dashboard ensures ease of use by providing a well-structured view of academic services and real-time updates.

Workflow of the Classroom Chatbot

- **User Registration & Authentication** → Students and teachers register with secure login credentials and role-based access.
- **Session Booking** → Students schedule tutoring sessions with available teachers based on subjects and time slots.
- **Student Academic Records** → The system maintains performance history, assignments, and feedback securely in the database.
- **Online Tutoring & Chat Module** → Students consult teachers online through integrated video/voice/chat functionality.
- **Assignments & Progress Reports** → Teachers provide feedback, upload resources, and track academic progress accessible to students anytime.
- **Automated Notifications** → Students and teachers receive session reminders, assignment alerts, and performance updates via email/SMS.

Technologies Used:

- **Frontend:** HTML, CSS, JavaScript, React.js, Tailwind.
- **Backend:** Python (Flask).
- **Database:** MySQL (for storing user data, sessions, and academic records).
- **AI & Analytics:** Doubt-solving support, personalized learning recommendations, and performance analytics.
- **APIs & Integrations:** Email/SMS notification APIs, Video call APIs for online tutoring, and integration for learning resources.

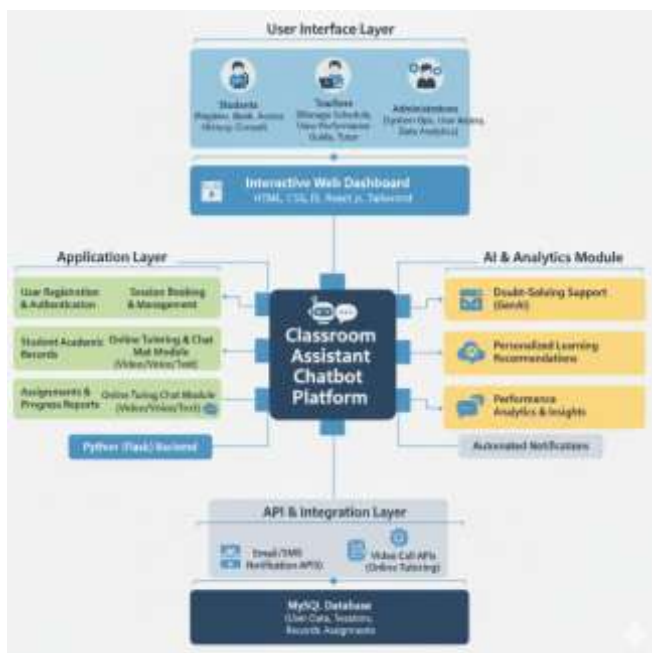


Fig 1. System Architecture

5. MODULES

The **GenAI-Based Classroom Assistant Chatbot** is structured into multiple functional modules, each designed to simplify and optimize different stages of academic support. These modules work together to improve efficiency, reduce manual workload, and provide a seamless experience for students, teachers, and administrators.

Signup Module:

Allows new users (students/teachers/admins) to register with details like name, email, phone number, and role. Form validation prevents duplicate accounts and ensures accuracy. Regularly check form validations, update password hashing libraries, and verify secure role-based redirection.

SignIn Module

Users log in using credentials, with JWT-based authentication. Students see their dashboard, while teachers and admins access their respective panels. Test login after updates, rotate JWT secrets, and monitor for suspicious login attempts.

Home Page Module

Displays quick access sections such as Doubt Solver, AI Mentor, Academic Chatbot, Student Dashboard, and multilingual support. Ensure dynamic content loads correctly, optimize responsiveness, and fix broken links after updates.

Student Registration & Management Module

This module allows students to create and manage their profiles by entering personal details, academic history, and contact information. It ensures data validation, prevents duplicate entries, and securely stores student records. Teachers and administrators can access updated student details for quick reference, improving learning efficiency.

Teacher Management Module

Teachers can register, update their subjects, availability, and session timings. The system provides a structured dashboard for managing sessions, reviewing student progress, and giving

guidance. Role-based access ensures that only authorized teachers can modify academic data.

Online Tutoring & Virtual Consultation Module

This innovative module enables live tutoring through secure video calls and chat. Students can connect with teachers remotely, ask questions, and receive study guidance digitally. This feature bridges the gap for learners in rural or remote areas, improving education accessibility.

Student Academic Records Module

A centralized database stores students' learning history, assignments, feedback, and progress reports. Teachers can quickly review student data for better guidance and continuity of learning. The system ensures data confidentiality and educational data compliance.

Assignments & Reports Module

Teachers can generate digital assignments and upload progress reports directly to the student's profile. Students can download or share these resources with peers or parents. Automated study reminders ensure consistent learning.

Notification & Alerts Module

This module sends real-time updates to students and teachers regarding sessions, assignments, feedback, and upcoming deadlines. Emergency alerts can also be triggered for urgent academic updates, ensuring timely intervention.

Learning Analytics & Dashboard Module

Administrators and teachers can track student trends, session frequency, performance outcomes, and overall platform usage. AI-powered analytics provide insights into learning gaps, subject trends, and resource utilization, enabling better academic decision-making.

User Management & Role-Based Access Module

This module ensures secure access to the system by assigning specific roles (students, teachers, administrators). Students can manage sessions and assignments, teachers can manage tutoring and feedback, and administrators oversee the overall platform operations.

Data Storage & Security Module

All student records, assignments, and communication logs are securely stored using encrypted databases. The system ensures compliance with educational data standards, protecting sensitive student information from unauthorized access.



Fig 2. Promotional Infographic of the Healthcare Website Platform

6. RESULT

The **GenAI-Based Classroom Assistant Chatbot** delivers an intelligent and accessible solution to overcome the limitations of traditional education systems by integrating doubt resolution, academic report analysis, AI tutoring, student digital profile management, and personalized learning recommendations into a single user-friendly system. By leveraging advanced generative AI, machine learning, and natural language processing techniques, the platform provides instant and accurate academic support for student queries, empowering learners to address doubts and study challenges in real time. The academic chatbot offers assistance in multiple languages, breaking communication barriers for regional and remote students, while the AI mentor generates personalized study plans that support adaptive learning. The student digital twin reduces redundancy by securely storing and reusing academic history, ensuring continuity of guidance across multiple sessions. With its cloud-based architecture, the system enables remote access, scalability, and cost-efficiency, while data-driven insights from student interactions support continuous improvement of tutoring and recommendations. Teachers and administrators benefit from complete student information at their fingertips, reducing workload and improving decision-making, while students gain affordable, reliable, and personalized academic support anytime and anywhere. Overall, this AI-powered platform enhances the learning experience with a focus on instant guidance, personalization, efficiency, and inclusivity, making quality education accessible to all.

7. CONCLUSION & FUTURE WORKS

In conclusion, our **GenAI-Based Classroom Assistant Chatbot** addresses the challenges of modern education by providing a unified system that combines doubt resolution, academic report interpretation, AI tutoring, personalized study planning, and student digital profile management. By integrating generative AI, natural language processing, and cloud technologies, the platform makes learning more accessible, personalized, and inclusive, especially for students in rural and under-resourced regions. It reduces

delays in academic support, eases the workload for teachers, and ensures continuity by securely storing and reusing student data across sessions. The system empowers students with accurate, real-time learning assistance and enhances decision-making for educators, improving overall academic outcomes. As education evolves, this AI-powered solution adapts to emerging technologies, learner demands, and digital learning challenges. Future work will focus on integrating performance tracking tools for continuous monitoring, advanced AI models for subject-specific tutoring, and live virtual classrooms for interactive learning. Additionally, the system can support predictive analytics for learning gaps, integration with IoT-enabled educational devices, and compliance with global data privacy standards. By continuously innovating, the platform will serve as a scalable and future-ready digital education ecosystem, ensuring improved learning outcomes and transforming education delivery worldwide.