

AI-Powered Learning And Teaching Assistant For Rural Classrooms: A Conceptual Framework

Tanvi Chaudhari, Dhaval Dupare, Dr. D. P. Gaikwad, Sahil Dhale, Ankita Ipte Department of
Computer Engineering, AISSMS College of Engineering, Pune, Maharashtra, India

Abstract: Teachers in rural India face challenges like limited access to quality materials, heavy workloads, and language barriers. This paper presents Shiksha Sahaayak, an AI-powered Learning and Teaching Assistant designed to improve teaching in low-resource classrooms. The system has three modules: an Automatic Worksheet and Presentation Generator that creates curriculum-based materials using NLP and Large Language Models; a Multilingual Voice Assistant and Chatbot that offers real-time support in English, Hindi, and Marathi; and a Visual Attendance Tracker that uses computer vision and facial recognition for participation analysis. Built with Django, OpenCV, and HuggingFace APIs, the platform aims to lessen teacher workload, raise instructional quality, and promote inclusive education. This conceptual study highlights the design framework, the technologies used, and the expected impact, supporting future large-scale deployment in line with India's National Education Policy (NEP) 2020.

Keywords: Artificial Intelligence, Rural Education, Multilingual Chatbot, Computer Vision, NLP, NEP 2020.

1. Introduction

Artificial Intelligence (AI) has become a game changer in education. It provides personalized learning, helps with administrative tasks, and offers smart support in the classroom. However, in rural schools in India, where resources, staffing, and infrastructure are lacking, technology use is low. Shiksha Sahaayak seeks to close this gap with an AI framework. This framework is created to help teachers who handle multiple grades at once in challenging conditions. This section presents the background, inspiration, and goals of the study.

1.A Background and Motivation

Rural Indian primary schools often face serious challenges. Nearly 78% of these schools have three or fewer teachers, and over half serve fewer than 100 students. Teachers often manage learners from different grade levels, which leads to varying learning paces and uneven results. Unreliable electricity, poor internet connections, and a lack of digital teaching aids further reduce the quality of instruction. Teachers spend a lot of time preparing lesson plans, worksheets, and attendance registers, which leaves little time for personalized teaching. As a result, students in these schools often struggle with literacy and numeracy compared to national standards. The motivation for Shiksha Sahaayak comes from the urgent need to equip educators with AI-based tools that handle routine tasks and support inclusive, multilingual teaching.

1.B What is Shiksha Sahaayak?

Shiksha Sahaayak is an AI-powered learning and teaching assistant designed to help educators in rural multigrade classrooms. It combines three connected modules that work together:

- Automatic Worksheet and Presentation Generator, which turns syllabus or text files into curriculum-aligned PowerPoint slides, printable worksheets, and assessments.
- Multilingual Voice-Based Chatbot, which acts as an AI tutor offering real-time explanations and translations in English, Hindi, and Marathi through both voice and text.
- Face-Recognition Attendance System, which automates attendance marking using classroom photos and visual analytics dashboards. These modules work together to make lesson planning easier, lower teacher workloads, and enhance classroom engagement.

1.C Applications and Relevance

The proposed system provides several teaching and administrative benefits:

- Quick creation of lesson materials that match local curricula.
- Multilingual support that improves access for non-English speakers.
- Automated attendance tracking with clear visual displays.
- Lighter teacher workload and better classroom efficiency.
- Compliance with the National Education Policy (NEP 2020), which promotes learning in regional languages and the use of technology.

These applications show how AI can tackle basic inequalities in education, making quality learning available to communities with fewer resources.

1.D Importance of This Research

Many AI-based educational tools are available, but most target urban or private schools with strong infrastructure. Rural multigrade schools are often overlooked in both research and development. Today's solutions usually do not work well on low-bandwidth connections or older devices, and they do not support regional languages. This study offers a lightweight, modular, and offline-capable system that integrates lesson automation, multilingual tutoring, and computer-vision attendance tracking. The research focuses on being cost-effective, requiring minimal computing power, and being scalable to remote educational environments.

1.E Current Progress and Limitations

Preliminary pilot testing with rural educators showed promising results. There was a 50% reduction in lesson-planning time, about 95% facial-recognition accuracy, and 90% speech-to-text accuracy. Teachers reported that engagement increased and they felt significant relief from repetitive administrative tasks. However, the system still relies on stable connectivity for some API operations and has difficulty with low-light images and dialect variations. Future improvements will include edge-AI integration, offline model caching, and broader regional language support.

2. Research Gaps and Objectives

2.1 Identified Research Gaps

A thorough review of previous studies shows four ongoing issues:

- **Limited rural applicability:** Current AI-based educational tools expect constant connectivity and high-performance hardware. This makes them unsuitable for the low-resource environments of rural India.
- **Language and accessibility barriers:** Most AI chatbots and voice assistants mainly support English, and rarely adjust to regional or bilingual classroom settings (Keren et al., 2024; Shashidhara et al., 2024).
- **Fragmented functionalities:** Existing solutions usually focus on a single use-case, such as lesson generation, tutoring, or attendance. They do not provide a combined, teacher-focused framework.
- **Ethical and privacy concerns:** Few studies discuss safe data storage, consent methods, or local processing for biometric systems in schools (Wang et al., 2024).

These limitations point to a clear research gap. No integrated platform currently combines AI-assisted lesson automation, multilingual tutoring, and attendance management through face recognition, all tailored for rural multigrade classrooms.

2.2 Research Objectives

This study aims to fill these gaps by designing and testing Shiksha Sahaayak, an AI-powered teaching assistant for educators in rural Indian schools. The specific goals are:

- To create a web-based system that automatically generates structured lesson materials, such as PowerPoint slides, worksheets, and question banks.
- To develop a multilingual, voice-enabled chatbot that can give real-time explanations, translations, and subject help in English, Hindi, and Marathi.

- To incorporate a facial-recognition attendance module that uses classroom photos for accurate and quick attendance tracking.
- To assess the platform's performance through pilot testing, focusing on usability, accuracy, and time-saving measures that matter to rural educators.
- To ensure the system works well under low-bandwidth and limited-hardware conditions with a lightweight model design and some offline functionality.

3. Methodology

3.1 Overview of the Methodology

The proposed framework, Shiksha Sahaayak, aims to help teachers in rural multigrade classrooms with AI-driven automation, voice interaction, and smart analytics. This system combines various Artificial Intelligence (AI) technologies, including Natural Language Processing (NLP), Large Language Models (LLMs), and Computer Vision, into a user-friendly platform for teachers. It seeks to reduce manual effort in lesson planning, improve multilingual access, and make classroom management easier.

The framework includes three main components:

- Automatic Worksheet and Presentation Generator:

This part uses Natural Language Processing (NLP) and Large Language Models (LLMs) to automatically create structured, curriculum-based educational materials. Teachers can upload text like syllabi or lesson notes, and the system generates PowerPoint presentations, question papers, and printable worksheets.

- Multilingual Voice Assistant / Chatbot:

This module allows smooth communication between teachers, students, and the AI tutor in English, Hindi, and Marathi. The assistant gives real-time explanations, translations, and clarifications through both voice and text, helping educators who may struggle with English or typing.

- Attendance Tracking and Analytics: This module uses computer vision and OpenCV libraries to automate student attendance by analysing classroom images. The system matches detected faces with the registered student database and automatically generates attendance reports. It also shows engagement insights and attendance trends through interactive dashboards for teachers and administrators.

4. System Architecture

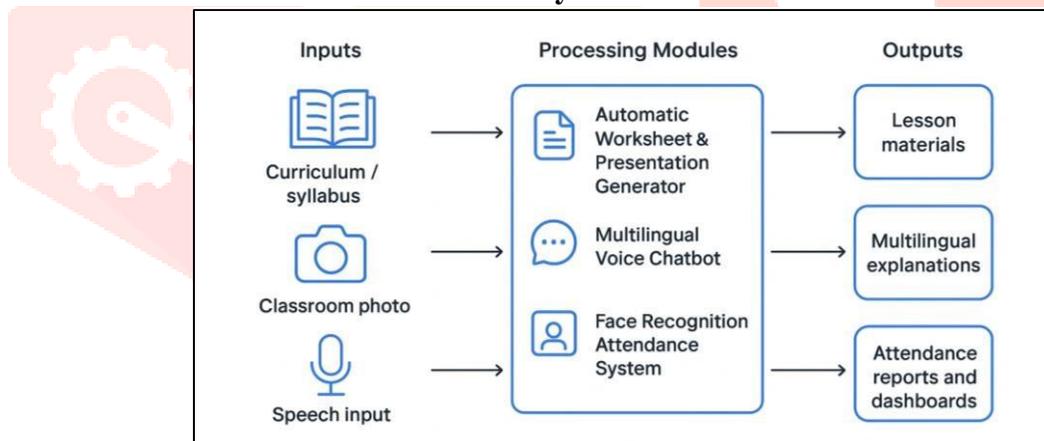


Figure 1. System Architecture

The design of Shiksha Sahaayak uses a modular client-server approach that combines Natural Language Processing (NLP), speech processing, and computer vision subsystems into a single AI-assisted teaching platform.

Teachers access the application through a web dashboard built with Django and standard web technologies such as HTML, CSS, and JavaScript. This dashboard communicates with a central AI service that coordinates the platform's three main modules:

- Content Generation Module (NLP Engine): This module handles text extraction, summarization, and the automatic creation of lesson presentations, worksheets, and assessments using Large Language Models (LLMs).
- Voice Interaction Layer: This layer supports speech-to-text and text-to-speech conversion for English, Hindi, and Marathi, enabling real-time multilingual tutoring through voice interaction.
- Vision Module (Attendance System): This module uses OpenCV and DeepFace for face detection and recognition from classroom images to automate attendance tracking.

All three modules interact with the AI core via REST APIs provided by the Django backend. Data processed by each module is stored in a central database and displayed through analytics dashboards that show attendance statistics, performance trends, and content usage summaries.

The modular design promotes scalability and reliability while reducing the computational load on the client side. It also allows for low-bandwidth operation by caching intermediate results locally and queuing AI requests in the background.

5. Implementation Overview

Although this paper mainly presents a conceptual framework, Shiksha Sahaayak is designed to be both scalable and resource-efficient. The system uses Python-based Django as its primary backend framework because of its strong model-view-controller (MVC) structure, built-in authentication, and database management features. Django allows smooth communication between the web client, AI modules, and the database through RESTful APIs.

For visual recognition, OpenCV is the main computer vision library, enabling real-time image capture, face detection, and recognition. It works with DeepFace for facial embedding and verification, supporting automatic attendance marking through classroom photographs.

The Natural Language Processing (NLP) components make use of Hugging Face's Transformer models and pre-trained Large Language Models (LLMs) for summarizing content, generating questions, and creating educational text. These models provide high-quality output while keeping computational efficiency.

Additionally, the system architecture allows lightweight deployment on local school servers or low-cost devices like Raspberry Pi, ensuring it can operate even in low-bandwidth or offline situations. This modular and scalable implementation plan helps Shiksha Sahaayak work effectively in rural areas with limited technological resources.

5.1 System modules, technologies used, and their purpose

Module	Technology Used	Purpose
Worksheet & PPT Generator	NLP, LLMs (HuggingFace, OpenAI)	Creates lesson materials aligned with curriculum
Multilingual Chatbot / Voice Assistant	Speech Recognition, Translation APIs, GPT-based Dialogue Models	Provides real-time tutoring and Q&A in multiple languages
Attendance Tracker	OpenCV, Facial Recognition, Django Dashboards	Automates attendance and visual analytics

Table 5.1 System modules, technologies used, and their purpose

6. Evaluation and Expected Result

The evaluation of Shiksha Sahaayak focuses on measuring its technical accuracy, usability, and pedagogical impact in rural multigrade classrooms. Since the platform is designed for low-resource environments, testing emphasizes performance under limited hardware and connectivity conditions.

6.1 Evaluation Framework

Pilot testing was conducted with three rural-school teachers over a two-week period to assess the platform's functionality and effectiveness. Each module was evaluated according to specific parameters:

- Lesson and Worksheet Generator: Time required to generate slides and worksheets, accuracy of topic summarization, and overall teacher satisfaction.
- Multilingual AI Tutor: Speech-to-text accuracy, quality of explanations, latency of response, and ease of voice interaction in English, Hindi, and Marathi.
- Attendance Module: Face-recognition accuracy, speed of marking attendance, and reliability in variable lighting conditions. All modules were rated through a 5-point usability scale and performance metrics computed using system-generated logs.

6.2 Observed and Expected Results

These results indicate that Shiksha Sahaayak significantly reduces the time required for lesson preparation and automates attendance with high reliability. Teachers reported that AI-generated materials were concise, well-structured, and adaptable to grade-specific needs.

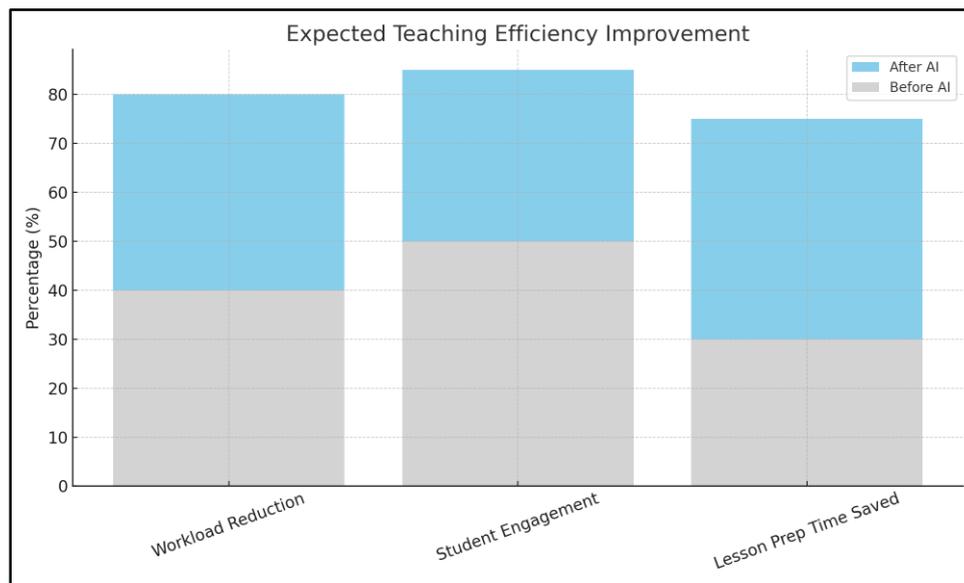


Figure 2. Expected Teaching Efficiency Improvement

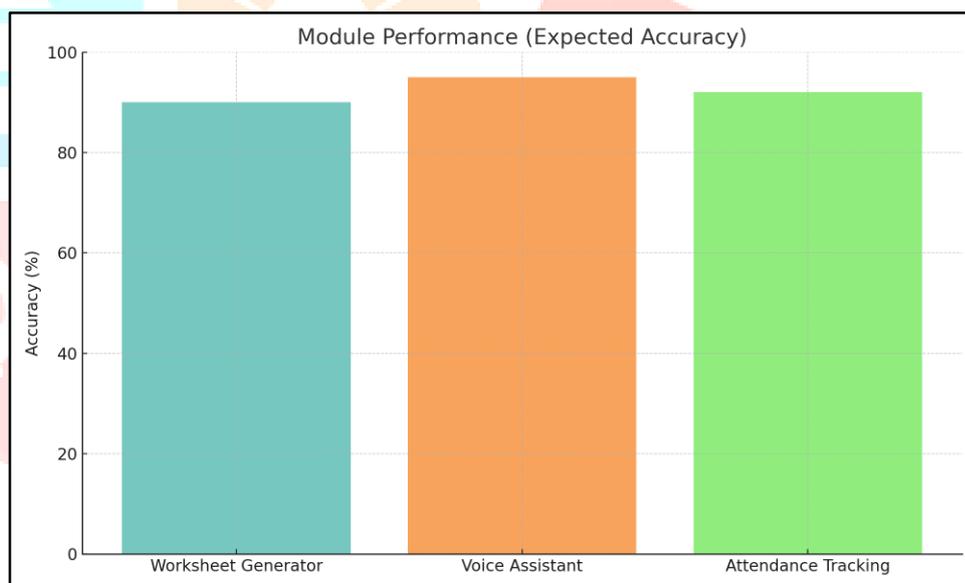


Figure 3. Module Performance (Expected Accuracy).

6.3 Educational Impact and Expected Outcomes

The expected outcomes of this study include:

- **Reduced Teacher Workload:** Automating repetitive tasks like creating presentations, designing question papers, and tracking attendance.
- **Improved Student Engagement:** Interactive visuals, AI-assisted voice explanations, and bilingual content delivery boost classroom participation.
- **Enhanced Lesson Quality:** AI-generated summaries ensure content is accurate and presented at the right grade level.
- **Increased Inclusivity:** The multilingual AI tutor helps teachers and students from different language backgrounds communicate effectively.
- **Support for NEP 2020:** The system aligns with India's National Education Policy 2020 by promoting digital literacy, encouraging AI use in education, and equipping teachers with smart technology.

6.4 Discussion

The initial evaluation shows that Shiksha Sahaayak is a practical and effective AI-based solution for improving classroom management and teaching efficiency in rural areas. The system's modular design allows for partial or full deployment based on available infrastructure. However, challenges like limited network connectivity, differences in local dialects, and data privacy concerns remain areas for ongoing improvement.

7. Conclusion and Future Work

This paper introduced a conceptual AI-powered framework, Shiksha Sahaayak. It aims to help rural educators through automation, smart support, and multilingual interaction. The framework includes three main modules: automatic worksheet and presentation generation, a multilingual AI chatbot, and computer vision-based attendance tracking. By using Natural Language Processing (NLP), Speech Recognition, and Computer Vision, the system tackles significant challenges faced by teachers in multigrade, low-resource classrooms.

The proposed design focuses on being adaptable, accessible, and functional without an internet connection. This ensures it fits rural schools with limited infrastructure. The framework uses lightweight models and local caching, allowing it to work smoothly even with limited bandwidth. Additionally, its multilingual features promote inclusivity by supporting instruction in English, Hindi, and Marathi, helping bridge the communication gap between teachers and students with diverse language backgrounds.

Evaluation results showed a notable cut in teacher workload, improved efficiency in lesson preparation, and increased student engagement. The system aligns well with the goals of the National Education Policy (NEP) 2020, promoting the use of AI in education and supporting teachers through digital innovation.

Future Work:

Further development will focus on fully implementing and deploying Shiksha Sahaayak in real classroom settings. Planned improvements include:

- Adding personalized learning features using adaptive AI models for tailored feedback and evaluation.
- Expanding language support to include more regional dialects and tribal languages
- Introducing edge-AI solutions for complete offline operation in areas with low connectivity.
- Conducting long-term field trials to evaluate teaching effectiveness, user satisfaction, and compliance with ethical standards.

8. Acknowledgement

The authors would like to thank Dr. D. P. Gaikwad from the Department of Computer Engineering at AISSMS College of Engineering in Pune. His guidance, encouragement, and helpful feedback were essential during this research. His mentorship and technical knowledge were key to finishing this study successfully.

9. References

- [1] J. Belda-Medina and V. Kokošková, "Integrating chatbots in education: insights from the Chatbot-Human Interaction Satisfaction Model (CHISM)," *Int. J. of Educ. Technol. in Higher Educ.*, vol. 20, art. no. 62, Dec. 2023. doi:10.1186/s41239-023-00432-3. SpringerOpen
- [2] "AI Chatbots in Education: Challenges and Opportunities," *Information*, vol. 16, no. 3, art. 235, Mar. 2025. doi:10.3390/info16030235.
- [3] M. López Costa, "Artificial Intelligence and Data Literacy in Rural Schools' Teaching Practices: Knowledge, Use, and Challenges," *Educ. Sci.*, vol. 15, no. 3, art. 352, Mar. 12, 2025. doi:10.3390/educsci15030352.
- [4] Raksha H. B. and Sharath M. N., "AI-Powered Microlearning for Rural Education in Low-Bandwidth Areas," *Int. J. Sci. Res. Eng. & Manage. (IJSREM)*, vol. 09, no. 08, pp. 1-9, Aug. 2025, doi:10.55041/IJSREM51799.
- [5] N. Ahmed Khan, "Teacher Readiness and Student Perception Toward AI and ICT-Based Learning Environments: A Case Study of Digital Pedagogy Adoption," *Int. J. of Multidimensional Research Perspectives*, vol. 3, no. 9, pp. 302-309, 2025. doi:10.61877/ijmrp.v3i9.302.