



Empowering Teachers in Multi-Grade Classrooms: A Google AI Sahayak System

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Abstract: This paper is about Sahayak, an AI teaching assistant to give teachers a leg up in India's under-funded, multi-grade classrooms. The system works with Google AI (Gemini, Vertex AI, and Firebase) to help with making content, dealing with different learning levels, heavy workloads, and getting access to info. Sahayak is meant to be a go-to, cloud-based helper that makes lesson planning easier, creates local content in native languages, and makes different worksheets for various grade levels. The method is iterative and modular, focusing on user design, being able to handle growth, working with low bandwidth, and sticking to ethical AI, including the Digital Personal Data Protection (DPDP) Act 2023. By cutting down on busywork and giving fast, learning stuff, Sahayak wants to make teaching better and help students do well.

Keywords: Artificial Intelligence (AI), Multi-Grade Teaching, EdTech, Gemini, Vertex AI, Content Differentiation, Localization, Teacher Empowerment, Firebase.

I. INTRODUCTION

Multi-grade teaching is normal in India, mostly in rural areas. It's a way to get basic education to everyone. But, teachers in these spots deal with pressure. They have to handle big, mixed-level classes without enough stuff and spend time on tasks that aren't teaching. So, teachers are overworked, which gets in the way of making custom teaching tools or teaching kids based on what they need.

Sahayak aims to fix this by giving AI support. The main goals are:

- * Empowerment: Give AI tools
- * Personalization: Make content for each kid
- * Localization: Can Create content in a local languages as well.
- * Narrow gaps: Lessen the impact of not having enough resources.

II. RELATED WORK AND BACKGROUND

This idea is based on research that says AI in education can be done with the needed design.

Sr.No	Paper Summary (Key Finding)	Relevance to Sahayak
1	A study goes over AI uses in education, confirming content creation and personalization	Says content creation and personalization.
2	An AI review shows benefits (like adaptive learning) and rules.	Gives proof for adaptive stuff and ethics.
3	Studies show ways to measure reading using computers, mixing speech tech	Confirms Sahayak's plan for audio tests.
4	Adaptive learning gets people involved when it matches student profiles.	Supports Sahayak's different worksheets and ways to learn.
5	A way to use computers to read and understand layouts from textbooks.	Supports putting textbook images into computers to make a worksheets.
6	Articles mention AI for learning local languages, saying TTS/ASR works with those languages.	Shows that Sahayak's content in many languages can works.



III. SYSTEM DESIGN AND METHODOLOGY

3.1 Foundational Architecture

Sahayak is built as a cloud-native application, with an optimization for low-resource environments. The design pattern is modular with three interdependent layers:

1. Frontend (Teacher/Student Interface): An easy-to-use layer to enter requests (text, audio, image) and display generated output.
2. Backend (Google Cloud/Firebase): The core processing unit responsible for coordinating calls to different AI models, data management, and user authentication. Deployment targets include Firebase App Hosting and Cloud Run.
3. AI Services Layer: The key element that bridges sophisticated Google AI services, such as Vertex AI, Gemini models (e.g., Gemini 1.5 Pro), Cloud Vision API, and Speech-to-Text API.

Gemini is the main generative AI model, with intrinsic multimodal functionality (converting images such as textbook pages to create textual outputs) and strong multilinguality (handling Indian languages such as Marathi, Hindi, and Gujarati for content and Text-to-Speech (TTS)).

3.2 Data Flow and Processing Pipeline

1. Handling of Input: Inputs from users (text, voice, image) are received. Voice input is translated into text by Vertex AI Speech-to-Text. Image input (pages of textbooks) is processed using Optical Character Recognition (OCR) through Google Cloud Vision API or Document AI.
2. AI Processing: The processed inputs are passed as carefully designed prompts to the relevant Gemini models through Vertex AI.
3. Output Generation: The necessary outputs (textual, basic images/charts, or audio responses through TTS) are produced by Gemini.
4. Feedback Loop: Teachers mark the produced content, and this is utilized to fine-tune the base AI models and streamline prompt engineering techniques for ongoing improvement.

IV. CORE FEATURES AND IMPLEMENTATION

Sahayak emphasizes four fundamental functionalities to directly assist multi-grade teachers:

4.1 Hyper-Local and Culturally Relevant Content Generation

Function: Teachers ask for content (e.g., a narrative describing types of soils) in their local language (e.g., Marathi) through text or voice.

Implementation: Gemini 1.5 Pro reads the request and executes it based on prompt engineering for cultural relevance and pedagogical scaffolding. It produces the story natively in the specified language, with the choice of having it synthesized into spoken audio by Gemini's native TTS engine.

4.2 Differentiated Learning Materials from Textbook Images

Function: Educators upload textbook page images to create worksheets specifically for various grade levels within one classroom.

4.3 Instant Knowledge Base and Analogical Explanations

Function: Teachers enter challenging student queries (e.g., "Why is the sky blue?") in the native language.

Implementation: Gemini's deep reasoning engine produces short, clear explanations. Prompt engineering directs the AI to add easy-to-comprehend analogies and culturally specific examples to promote real conceptual knowledge.

4.4 Simple Visual Aid Design

Function: Helping teachers rapidly produce simple visuals (line drawings or charts) readily replicable on a blackboard.

Implementation: Text-to-image models such as Imagen on Vertex AI are being used. Prompt engineering emphasizes the aspect of clarity, minimalist design, and schematic representation compared to high fidelity to suit the practical limitations of a resource-constrained classroom.

Implementation: Cloud Vision/Document AI pulls out the text. Gemini processes the content and applies "minimally-lossy text simplification," carefully maintaining the meaning while improving clarity. Prompt engineering asks Gemini to create several versions of worksheets, modifying parameters such as Lexile scores or Depth of Knowledge (DOK) for differentiation.

**V.CONCLUSION AND FUTURE SCOPE**

Sahayak wants to be an AI platform that fixes the issues in India's multi-grade classrooms which can grow. Using Google Gemini, it can cut teacher work and make learning custom.

Next up is audio-based reading tests and AI for checking how well kids read. Keeping things working offline through storing data in Firebase is important for rural schools.

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