Teachmate – A Smart Learning Solution Using Rag

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Abstract -. TeachMate is an AI-enhanced learning platform developed to render interactions in the study process more lively and simpler. Leveraging the Retrieval-Augmented Generation (RAG) using Python, it can automatically condense the vital information from study resources into the optimal personalized outcomes in summaries, and quizzes demanded by an individual learner. The application, recognizing different learning styles, will help users remember things and understand concepts rather well. In the present-day digital landscape, TeachMate furnishes an effortless and personalized learning work, supporting multiple file formats and having integration with Quizlet, to make learning more effective and entertaining.

***Key Words*:** AI-powered learning, RAG, Python, Personalized learning, Quizlet, Adaptive learning,

1. INTRODUCTION

Studying can be a daunting task as a significant amount of information is presented to students, requiring them to create their own study materials. Teachmate handle this task in a more systematic which is helpful and efficient manner which makes it easy. The AI learning platform operates on the principle of retrieval-augmented generation (rag). To ensure students get the most out of their study materials, it automatically extracts summarized information and turns it into quizzes that can be used to prepare for exams.

Teachmate addresses the issue by creating interactive quizzes specifically tailored to reinforce the user's knowledge. This ensures that students' learning outcomes align with the curriculum and that they are assessed on specific topics that require focused attention. In addition to reading notes and textbooks, interactive tests aid students in comprehending concepts more effectively.

Provides detailed quizzes through resource descriptions and immediate feedback to assist users in the area. The success of exam preparation, self-evaluation, and knowledge reinforcement relies heavily on this function, particularly.

Teachmate will become one of the major players in the digital learning space as due to growing AI creates content from a user's specific source to provide students with a room for further learning, reducing preparation time. This is essential as it is an improvement in student time and process time and resources as user input and creating learning materials.

2. LITERATURE SURVEY

[1] Hardmacher and Glenn (2025) worked on learning systems in the formation of AI which was personalized which eventually connected to universities. This focuses primarily on the role of adaptive models in improving individual experience and adaptability. Their research found that AI significantly improves which helps learning outcomes by dynamically adjusting content based on learning progress, cognitive patterns, and performance metrics. The study also pointed out the scalability of such systems in addressing diverse learning needs across large student populations.

[2] Zheng et al. (2024) actually explored Retrieval-Augmented Generation (RAG)-based educational question-answering systems, where the focus was on knowledge retrieval mechanisms from domain-specific repositories, which creates a speciality for specification. Her research showed significant improvements in both the contextual relevance of answers in the KS 12 learning environment. By integrating the delay model, the system was able to provide a more accurate and explainable curriculum-oriented response, especially in the sciences and humanities, which helped students.

[3] Maity, Deroy, and Sarkar (2025) took into consideration, experimented with integration and work of RAG models and contextual models, experimenting with automated questions in an educational setting, resulting in efficient learning. Their results showed that hybrid AI models not only improve question making and consistency, but also adapt the difficulty of generated questions to specific modules for students. In other words, the model personalizes it. This makes them particularly effective for formative assessments and intelligent tutoring systems.

[4] Katiyar et al. (2024) assessed AI-driven adaptive learning platforms and their impact on student motivation, engagement, and cognitive development. The study found that personalized AI learning environments significantly improve students' time-on-task and concept mastery rates. Gamification elements powered by adaptive algorithms further contributed to increased learner motivation and reduced dropout rates.

[5] Wahid and Khan (2024) have actually investigated the enhanced AI-controlled user profile technique on e-learning platforms and demonstrated the effectiveness of optimizing engagement with educational content tailored to individual learning preferences.This study showed how real-time

behavioral analysis combined with natural language processing can identify learners' intentions, a key aspect of personalized emotional states, and content preferences that provide choices and enable highly personalized learning strategies.

YEAR	AUTHORS	TOOL	DATASET	ACCURACY
2025	Hardaker & Glenn	Adaptive AI Learning Systems	Higher Education (University Learners)	87%
2024	Zheng et al.	RAG-based QA	K-12 Curriculum Data	91%
2025	Maity, Deroy & Sarkar	RAG + ICL Hybrid Models	Educational Textbooks	89.5%
2024	Katiyar et al.	Adaptive Learning Platforms	Various e-learning Platforms	85%
2024	Wahid & Khan	AI-based User Profiling	E-learning Platform Behavior Logs	90%

Table -1: Comparison between existing research

3. OBJECTIVES

Adjustable Quiz Creation -
Quizzes using a user's textbook, PDF, or other research documents as source material are created with a content-aware assessment approach by the RAG AI model.

Framework Of Quiz's Questions' Volume Selection - Every individual has the ability to personally streamline the quizzes by having a set number of questions added to be observed within a particular session.

Exhaustive And Comprehensive Answer Explanation - If a failure occurs, students will receive a discussion of all the answers marked. In combination with other response options, this improves your understanding of why the arguments provided are correct or why you should not select the remaining answers.

Tailored Experience For Each User -
These flexible guidelines allow users to upload custom content that acts as a resource for self-defined learning

Natural Language Interface -
Use the RAG-AI model to understand and analyze complex input data for quiz production.

5. PROPOSED SYSTEM

An AI-powered quiz tool called TeachMate, whose main aim is to transform study materials into assessments. Users may provide users with notes, research, or textbooks. This is handled by Langchain, which allows you to create related quiz questions. The retrieval-augmented generation (RAG) method is used for correcting with critical information obtained from the working of ChromaDB, a vector database designed for storing and retrieving processed text.

The procedure provides specific definitions and immediate responses to help individuals enhance their instructional encounters and issues. TeachMate is deployed across cloud platforms like AWS, GCP, and Eruku to keep performance as well as accessibility consistent without disruption. We provide teachers, students and learners with a great experience using this platform to review and improve their understanding through education.

5.1. ANALYSIS/FRAMEWORK/ALGORITHM

5.1.1. ALGORITHM

User Upload Source: RESTEAM LIT for study materials such as PDF, text, or uploads of already-researched workers.

Document processing: Process the uploaded document to separate the legible text from formatting, images and other special characters, in order for good representation of data.

Storage and Access: The extracted content is converted to embeddings vectorized into chromadobs for quick access to related data, but quiz questions are created side by side.

Quiz Generation: Analyze core concepts together with senddoc and Langchain & Google Gemini, create MCs, fill out leaf questions, and deal with you with uploaded research materials.

User Interactions: The Streamlit interface shows the Quiz dynamically generated to the user that can attempt questions, also, select an answer and submit the response.

Feedback and Rating: The system evaluates user responses with answers to get immediate feedback, learn to enhance and meet detailed explanations to remove misunderstandings.

Track Progress: User performance is pursued and analyzed to identify improvements when using future tests and optimize data for previous errors.

Cloud Preparation: The entire system is provided and launched on a cloud platform like AWS to provide scalability, reliability, and easy communication between front-end and back-end classes/activities using APIs.

5.1.2. SYSTEM ARCHITECTURE

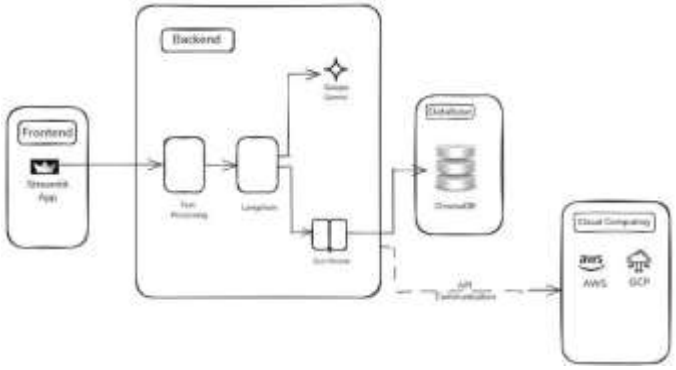

Fig -1: Architecture of TeachMate

5.2. SYSTEM DESIGN

The TeachMate design adopts a hybrid Agile methodology, fused with Microservices Architecture, to guarantee scalability and flexibility.

The design work begins with a load of requirements. This starts with research on RAG models and implementations and applications to explain core characteristics such as documents.

A system architecture consists of a frontend (serving the user with the capabilities to interact with quizzes, upload content, and check progress, microservices in the backend responsible for document processing

AI content search, learning path generation, and quiz creation, as well as databases.

FrontEnd: This stage is obvious to those who can connected with the client to transfer the document.

Streamlit: Offers web interface for clients to transfer ponder materials and take quizzes. It is an adaptable trait which makes it simple for clients to transfer materials.

Backend Preparing: This stage is covered up generally from the clients, and the total prepare takes put there.

Python: A standard programming language for data processing, primarily used for AI and ML projects.

LangChain Handles all the AI-driven text processing, question generation, and context understanding.

Google Gemini: Used to better the quiz generation, and generation of explanations as AI model.

Database and Memory: Memory is a key element to ensuring user information is stored

ChromaDB : Vector database to index + efficiently search over the processed text

Provisioning and Facilitating: This arrangement is fundamentally valuable for clients who have get to to a cloud-safe environment

APIS and Integration: Communication between the backend and frontend is essential which helps build the application

Minimally invasive communication between frontend and backend using the REST APIs.

So, this is the system design for our project TeachMate which helped us build and design the project.

5.2.1. FLOWCHART

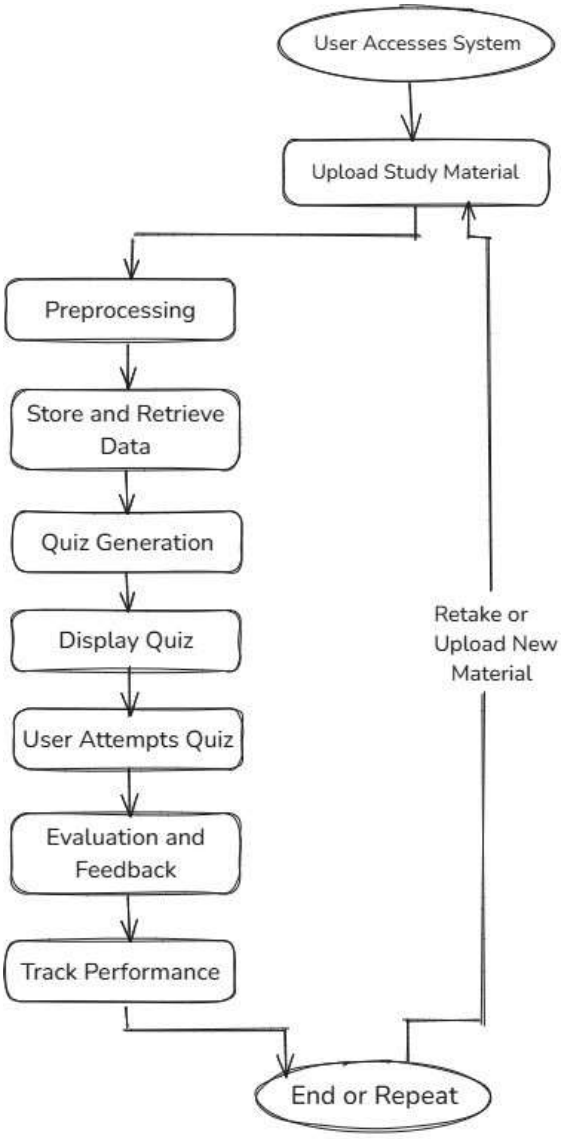

Fig-2: Flowchart of TeachMate

5.3. METHODOLOGY

Their research indicates problems with study techniques such as manual notetaking, lack of interactive content, and retention thereof, all of which create challenges for effective learning. Features that belong to interest include uploading documents to automate and personalize interdisciplinary learning, as well as quizzes generated by AI.

While an initial scan or electronic text document preparation could employ OCR-based implementation, the use of NLP-based techniques could then provide extraction of major concepts, definitions, and other important information.

Document upload, fold-Substance allows you to define tests from extracts that have already been collected from NLP yield. The same thing in the group guarantees real-time progress, quiz adaptation, and study material according to student performance and learning modes.

Teachmates is defined to be as the systematic approach to transforming research material into engaging quizzes. Here it defines the content that users can upload (photos, simple text, or study material) via a smooth user interface. Then, with the system extracting & pre-processing the text after eliminating specific symbols as well as formatting inconsistencies.

Vector embeddings of the clean-content are stored in ChromaDB after it is shaped sufficiently, allowing for speedy retrieval when required. Instead, the AI quiz generation module based on LangChain and Google Gemini reads through the content to generate deep questions (yes / no or multiple answer) as well as thorough outputs that match the original study materials used for purposes of assessment.

The users can then answer the quiz by going through the interface mapping answers to options and submitting responses for evaluation. The system judges the responses right away offering actionable feedback and explanations so that learners can learn faster. User power is recorded and inspected to assist users in future quizzes on what they do and have to score.

The whole system deployed on cloud platforms such as AWS, GCP or Heroku to provide a smooth operation, scalability and communication between parts when needed. The methodology used in the project ensures that teachers provide students with an efficient, interactive, personalized experience in learning, which is an lifelong learning.

6. RESULTS AND DISCUSSION

The TeachMate project produces (useful) study objects by processing uploaded documents. It automatically builds quizzes on questions and answers, flashcards for fast review and summaries for quick glance. Users can monitor improvements when points and cases are completed. The system also provides insight into AI-based costs and provides opportunities to define learning goals. It is purpose built tool to make studying easy, fun and a bit structured.

Fig-4: Setting number of questions for quiz

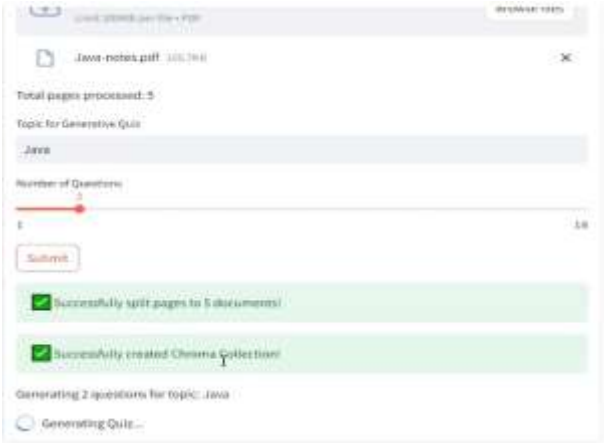

Fig-5: Generating Quiz

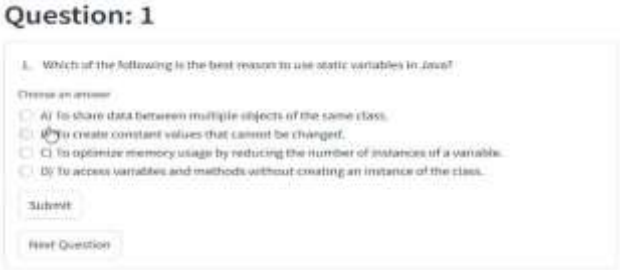

Fig-6: Quiz generated from Doc

Fig-7: PDF upload section

7. CONCLUSIONS

Teachmate is an innovative app that helps students develop better study habits. Carrying out the extraction of important information from school study materials to generate quizzes, it saves students from painstakingly taking notes. This will allow you to devote every second to learning and understanding the concepts, while minimizing waste of organizing time.

The flexibility of the study method is, indeed, TeachMate's chief merit. In contrast to fixed forms of research, it depends on the level and style of learning each student who is insured to ensure that all materials are presented to the learner at the present time when it is needed. Automation for quiz generation, immediate answers, AI control input, integration into tools such as ANKI and Quizlet is exciting and engaging.

Besides its convenience, TeachMate works to improve the efficiency of learning. Pursuing research results encourages students to stay on the way and on time using gamified elements. Being cloud-based allows for students to access their study materials from just any universal device at any time, while TeachMate is a wonderful support throughout the forever-modern learning experience.

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