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AI-Powered Notes Summarization and Quiz Generation System Using Generative AI

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Abstract: *The rapid growth of digital educational resources has increased the amount of information students need to understand, organize, and revise. Reviewing lengthy notes and preparing practice questions manually can consume considerable time and effort. This research presents AI StudyMate, a web-based educational assistant developed to support students through automated study-note summarization and multiple-choice question (MCQ) generation.*

The application provides an interactive interface through which students can enter study material as text or upload text-based PDF documents. The system extracts readable content from PDF files, processes the input, and sends appropriate prompts to a cloud-hosted large language model through the Groq API. The application generates structured summaries containing important concepts, definitions, key points, and conclusions. It also generates five medium-difficulty MCQs with four answer options, correct-answer information, and explanations.

AI StudyMate is implemented using Python, Streamlit, pypdf, and the configured model identifier openai/gpt-oss-20b. In addition to content generation, the application supports quiz attempts, automatic scoring, answer review, and summary downloads. The paper describes the system architecture, implementation, research methodology, evaluation metrics, limitations, and possible future improvements. Quantitative results are not reported because a completed experimental evaluation has not yet been conducted.

Keywords: Generative Artificial Intelligence, Large Language Models, AI in Education, Text Summarization, Quiz Generation, Python, Streamlit, Automated Assessment, Self-Learning.

I. INTRODUCTION

Education increasingly depends on digital resources such as online study materials, PDF notes, electronic textbooks, presentations, and learning platforms. Although these resources provide students with easy access to information, studying large amounts of content can become difficult, particularly during examination preparation.

Students frequently need to read lengthy notes, identify important concepts, understand definitions, prepare short revision material, and evaluate their knowledge through practice questions. These activities are important for learning but require time and effort. Preparing summaries and question sets manually may also become challenging when students have multiple subjects and limited preparation time.

Generative Artificial Intelligence (AI) and Large Language Models (LLMs) provide new possibilities for supporting educational activities. These models can process textual information, identify important ideas, generate concise explanations, and create questions based on supplied content. Such capabilities can assist students in organizing learning material and practicing concepts.

However, AI-generated content must be used carefully. Generated summaries may omit important facts, and questions may sometimes contain incorrect answers, ambiguous options, or information that is not present in the original notes. Therefore, an educational AI system should not only generate content but should also provide a simple interface, structured output, and opportunities for users to review generated information.

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AI StudyMate is developed to address these needs by combining note input, PDF text extraction, AI-powered summarization, quiz generation, and interactive assessment within a single web-based application.
The system is designed to make study material easier to review and help students test their understanding. It provides a practical application of generative AI in education without requiring users to understand the technical processes involved in language-model generation.

A. Background

Traditional study methods generally require students to read complete notes, manually prepare summaries, and create their own practice questions. While these methods can be effective, they may require additional time and effort.
AI-assisted learning tools can support these activities by automating repetitive tasks and providing learning resources based on the content supplied by students. The usefulness of such tools depends on the accuracy of generated information, quality of questions, simplicity of interaction, and reliability of the application.

B. Motivation

The motivation behind AI StudyMate is to create an accessible educational tool that can assist students during everyday study and examination preparation.
The project focuses on the following needs:

- Reducing the time required to prepare revision summaries. Organizing lengthy study material into readable sections. Creating practice questions from existing notes.
- Supporting active learning through interactive quizzes. Providing immediate feedback on quiz performance.
- Making AI-based educational assistance accessible through a simple interface.

C. Scope of the Project

The current application focuses on text-based educational material. Users can paste notes or upload selectable-text PDFs. The system can generate summaries or quizzes, display generated content, and allow students to attempt quizzes.
The project does not currently provide OCR for scanned documents, permanent student accounts, long-term progress tracking, or a verified educational-outcome measurement system.

II. PROBLEM STATEMENT

Students often work with large amounts of study material that must be understood and revised within limited time. Preparing concise summaries and practice questions manually requires additional effort and may make revision less convenient.
Existing study workflows often involve multiple activities and tools, including reading documents, writing notes, preparing questions, checking answers, and reviewing mistakes.
The problem addressed by AI StudyMate is the absence of a simple, integrated workflow that allows students to transform their existing study notes into concise summaries and practice quizzes through an accessible interface.
The proposed application aims to simplify this process by using a generative AI model to assist with summarization and question generation while providing an interactive quiz environment.

III. OBJECTIVES

The primary objective of AI StudyMate is to develop an AI-based study assistant that supports students in understanding and revising educational material.
The specific objectives are:

- To develop a user-friendly web-based educational application.
- To allow students to enter study notes directly into the application.

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- To support uploading text-based PDF study documents. To extract readable text from uploaded PDFs.
- To generate structured summaries using a large language model. To highlight important concepts, definitions, and key ideas.
- To generate multiple-choice questions from supplied study material. To provide four answer options for each generated question.
- To support interactive quiz attempts and answer submission. To calculate quiz scores automatically.
- To display correct answers and explanations after quiz submission. To allow students to download generated summaries.
- To provide a foundation for future improvements in AI-based personalized learning.

IV. RELATED WORK AND RESEARCH CONTEXT

Artificial intelligence has become an important area of research in educational technology. Natural Language Processing (NLP), machine learning, neural networks, and large language models are being applied to tasks such as information extraction, text summarization, conversational assistance, content generation, and automated assessment.

A. Large Language Models

Large Language Models are AI systems trained on extensive textual data to understand and generate natural language. They can respond to instructions, explain concepts, summarize content, and generate text based on contextual information.

Transformer-based architectures have contributed significantly to the development of modern language models. Their attention mechanisms allow models to process relationships between words and information within a sequence.

AI StudyMate uses a hosted language model to process educational notes and generate requested learning material.

B. Automatic Text Summarization

Text summarization aims to reduce lengthy text into a shorter form while preserving its important information and meaning.

A useful summary should:

- Preserve important concepts. Maintain factual accuracy.
- Avoid unnecessary repetition.
- Present information in understandable language. Retain the central meaning of the original material.
- AI StudyMate uses prompt-based summarization to organize student notes into a structured summary containing a title, introduction, key concepts, definitions, important points, and conclusion.

C. Automated Question Generation

Automatic question generation is a process of creating questions from source content using computational techniques. Educational question-generation systems can support self-assessment by creating practice questions from reading material. MCQs are especially useful because they allow learners to select answers and receive structured feedback.

The quiz-generation process in AI StudyMate requests five medium-difficulty MCQs from the supplied notes. Each question includes four options, an answer index, and an explanation.

D. AI-Based Learning Assistance

AI-based educational systems can provide assistance through personalized explanations, automated content generation, and interactive learning activities.

AI StudyMate focuses on a practical combination of summarization and self-assessment. It does not replace teachers or textbooks. Instead, it provides an additional tool that students can use to review material and identify topics that may require further study.

E. Research Gap and Project Contribution

Many students use separate resources for reading, summarizing, and practicing questions. The process of moving between these activities can make study preparation less organized.

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AI StudyMate brings the following functions into one application:

- Study material input.
- PDF text extraction.
- AI-generated summaries.
- AI-generated MCQs.
- Interactive quiz submission. Score calculation.
- Answer explanations.
- Summary downloading.

The contribution of this project is the integration of these functions into a simple web-based learning workflow. The project presents an implemented prototype rather than claiming the development of a new language model or a proven improvement in academic performance.

V. PROPOSED SYSTEM

AI StudyMate is a web-based educational assistant designed to process study notes and generate learning resources through a hosted generative AI model.

The application accepts input from the student in two forms: directly pasted text or a text-based PDF document. After validating the input, the application prepares the appropriate prompt and sends a request to the Groq API.

Depending on the student's selection, the application generates either a study summary or an MCQ quiz.

The generated summary is displayed on the interface and can be downloaded as a text file. Generated quiz questions are presented through the quiz interface, where students can select answers and submit their attempts.

A. Main Modules

1. Dashboard Module

The dashboard serves as the main entry point for the application. It allows users to access different functions and select the required learning activity.

2. Input Module

This module accepts study material from the student. Users can paste textual notes or upload PDF documents.

3. PDF Processing Module

The PDF-processing module extracts selectable text from uploaded documents using the pypdf library. The extracted content is prepared for further processing.

4. AI Summary Module

This module sends summarization instructions and study notes to the AI model. It receives and displays the generated summary in a structured format.

5. Quiz Generation Module

This module creates MCQs based on the provided notes. The generated quiz contains five questions, each with four options and an explanation.

6. Quiz Practice Module

Students can interact with the generated questions, select answer options, submit their responses, and review their results.

7. Score and Feedback Module

This module compares selected answers with the generated answer keys and calculates the quiz score. After submission, the application displays the answers and explanations.

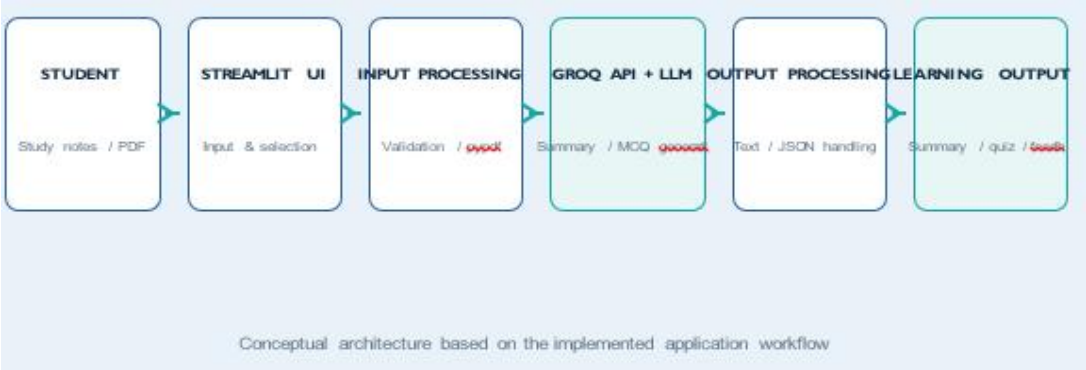
8. Download Module

The download functionality allows students to save the generated summary as a plain-text file for offline revision.

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VI. SYSTEM ARCHITECTURE

The system follows a modular architecture in which the user interface, input-processing logic, AI communication, output-processing logic, and quiz interaction work together.



A. Architectural Components

User Interface Layer

The interface is developed using Streamlit. It provides input fields, file upload controls, navigation, generation buttons, summary display, quiz controls, and feedback.

Input Processing Layer

This layer receives text or uploaded PDF files. It validates input, extracts PDF content where required, and prepares the source material.

Prompt Construction Layer

The application constructs prompts according to the selected operation. The summary prompt requests organized revision material, while the quiz prompt requests structured MCQs.

AI Processing Layer

The application communicates with the hosted Groq chat-completions API using the configured model identifier. The model processes the supplied notes and generates the requested response.

Output Processing Layer

The response is received and processed by the application. Summary responses are displayed as text. Quiz responses are parsed as JSON and checked for expected structure.

Interaction Layer

The quiz interaction layer allows students to select options, submit answers, view scores, and review explanations.

B. System Architecture Flow

Student → Streamlit Interface → Input Processing → Prompt Construction → Groq API → AI Response → Output Processing → Summary or Quiz → Student Interaction

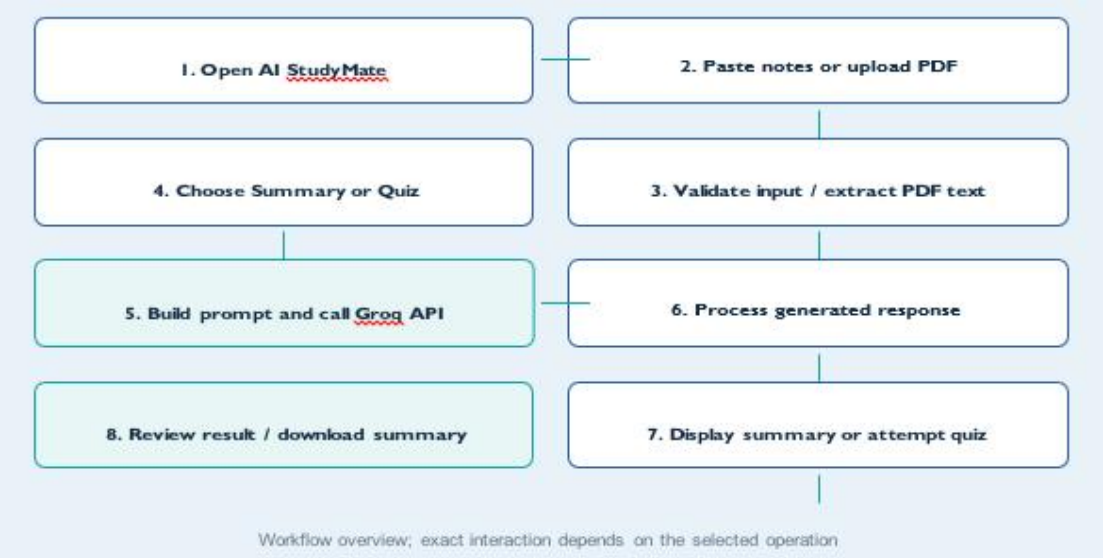
C. Data Flow

The data flow begins when the student supplies study material. The input is validated and prepared before it is sent to the AI model.

The generated response returns to the application, where it is processed and displayed. In summary mode, the content is presented for revision and download. In quiz mode, the student attempts the generated questions and receives feedback after submission.

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VII. SYSTEM WORKFLOW



The application follows a sequence of operations from input collection to result presentation.

• Step 1: Open Application

The student opens the AI StudyMate application through the Streamlit interface.

• Step 2: Provide Study Material

The student either pastes notes into the text area or uploads a PDF file containing selectable text.

• Step 3: Validate Input

The system checks whether input is available and whether the uploaded document meets the configured size restrictions.

• Step 4: Extract PDF Text

If a PDF is uploaded, the system extracts text from its pages using pypdf. Documents without selectable text may not produce usable extracted content.

• Step 5: Select Operation

The student selects one of the available operations:

Generate Summary Generate Quiz

• Step 6: Construct Prompt

The application combines the selected instruction with the supplied study material to prepare a prompt for the language model.

• Step 7: Send AI Request

The application sends the request to the Groq API using the configured model.

• Step 8: Process AI Response

The response is received and processed according to the selected operation.

• Step 9: Display Result

The summary or quiz is displayed on the Streamlit interface.

• Step 10: Student Interaction

For a summary, the student reviews or downloads the generated content. For a quiz, the student selects answers and submits the quiz.

• Step 11: Generate Feedback

The application calculates the quiz score and displays the correct answers and explanations.

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VIII. PDF PROCESSING AND INPUT MANAGEMENT

PDF documents are widely used for academic notes, learning resources, and study materials. AI StudyMate provides a PDF upload facility to reduce the need for students to manually copy and paste information.

A. PDF Upload

The user can select a PDF document from their device and upload it through the application interface.

B. File Size Validation

The application checks the uploaded file size. PDFs larger than 10 MB are rejected according to the configured restriction.

This limit helps control the amount of data processed by the application and avoids unnecessarily large uploads.

C. Text Extraction

The application uses PdfReader from the pypdf library to read the PDF and extract available text from its pages.

The extracted page content is combined into a text input that can be used by the summarization or quiz-generation process.

D. Text-Length Management

To manage the size of input sent to the AI model, the extracted text is limited to the first 30,000 characters.

This restriction allows the application to process the available material within its configured input limit. However, information appearing beyond the truncation point may not be included in the AI-generated output.

E. Input Validation

The system checks whether usable text is available. If the PDF does not contain selectable text, the application warns the user.

Scanned documents containing images of text are not automatically converted into readable text because OCR functionality is not implemented in the current version.

IX. AI-BASED SUMMARIZATION

The summarization module is one of the primary features of AI StudyMate. It converts lengthy educational notes into organized revision material.

A. Summarization Process

The summarization process consists of the following operations:

Collect the study notes from the user. Validate the supplied text.

Prepare the summarization prompt. Send the prompt to the Groq API. Receive the generated response.

Display the summary to the student.

Allow the student to download the summary.

B. Summary Structure

The summarization prompt requests a structured response containing:

A suitable title.

A short introduction. Important concepts. Definitions.

Key ideas in bullet-point format. A short conclusion.

This organization helps students read the generated material section by section rather than reviewing an unstructured block of text.

C. Source-Grounded Generation

The prompt instructs the model to use the supplied notes as the factual source and avoid inventing facts.

Although this instruction helps guide the generation process, it cannot guarantee that every statement in the summary is factually correct. Students should verify important information against their original notes or trusted learning resources.

D. Summary Download

The generated summary can be downloaded as a plain-text file. This feature supports offline reading and allows students to keep a separate revision document.

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X. AUTOMATED QUIZ GENERATION

The quiz-generation module transforms supplied study material into interactive multiple-choice questions.

A. Quiz Generation

When the student selects Generate Quiz, the application prepares a prompt requesting five medium-difficulty MCQs from the supplied notes.

The generated questions are intended to assess understanding of concepts and important details present in the study material.

B. MCQ Structure

Each generated question is expected to contain:

Question text.

Four answer options.

Correct-answer index.

Explanation of the correct answer.

The answer index is represented using a zero-based numbering system, meaning the first option corresponds to index 0.

C. JSON Response

The application requests quiz content in JSON format. JSON provides a structured representation that can be processed by the program.

The application parses the generated response and checks basic structural requirements, including the expected number of questions, required field types, option count, and answer-index range.

D. Validation

The application performs structural validation to ensure that the generated quiz follows the expected format.

However, structural validation alone cannot guarantee that:

The question is factually correct. The declared answer is correct. The distractors are meaningful.

The question has only one defensible answer.

The question is completely supported by the original notes.

These aspects require further semantic validation or human review.

E. Educational Importance

MCQs provide a convenient way for students to evaluate their understanding after reading a summary or original study material.

Quiz practice encourages active recall, helps learners recognize areas that may need additional revision, and provides an opportunity to review concepts through answer explanations.

XI. QUIZ INTERACTION AND SCORE CALCULATION

AI StudyMate includes an interactive quiz-practice feature that allows students to answer the generated MCQs.

A. Answer Selection

Students read each question and select one of the four answer options provided by the system.

B. Quiz Submission

After selecting their answers, students submit the quiz for evaluation.

C. Score Calculation

The system compares the selected answer index with the generated correct-answer index for each question.

The score is calculated based on the number of correct answers. Score Formula:

Score Percentage = (Number of Correct Answers / Total Number of Questions) × 100

For a quiz containing five questions, each correct answer contributes 20 percentage points to the total score.

D. Feedback

After submission, the application displays the quiz score, correct answers, and explanations. This allows students to identify incorrect responses and revisit the related concepts.

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E. Try Again

The Try Again functionality allows students to reset the submitted quiz state and attempt the quiz again.

The current application uses Streamlit session state for managing quiz information. Long-term quiz history and persistent student performance records are not implemented.

XII. TECHNOLOGY STACK AND IMPLEMENTATION

The application is implemented using Python-based technologies and a hosted AI service.

Technology	Purpose
Python	Core application programming language
Streamlit	Web interface and application dashboard
pypdf	PDF reading and text extraction
Groq API	Hosted AI model communication
Requests	HTTP communication with the API
JSON	Structured quiz response processing
Streamlit Session State	Temporary application and quiz state
TXT Export	Downloading generated summaries

A. Python

Python is used to implement the application logic, handle user input, process files, communicate with the API, and manage the quiz workflow.

Its libraries and simple syntax make it suitable for developing AI-based application prototypes.

B. Streamlit

Streamlit is used to create the web-based interface. It allows the application to provide interactive components without requiring a separate frontend framework.

The dashboard includes study material input, PDF upload, summary generation, quiz generation, result display, and quiz interaction.

C. pypdf

The pypdf library is used to read uploaded PDF files and extract selectable text.

D. Groq API

The Groq API provides access to a hosted language model for text generation. The application sends prompts and study material through API requests and receives generated responses.

E. Configured Model

The supplied implementation uses the model identifier:

openai/gpt-oss-20b

The model is used for generating summaries and quizzes based on the input material.

F. Requests

The Requests library is used for communication with the API endpoint. It sends the required request data and receives the model response.

G. JSON Processing

JSON is used to represent generated quiz data in a structured format. The application processes the JSON response to retrieve questions, options, answer indices, and explanations.

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H. Session State

Streamlit session state stores application information during the active session, including notes, summaries, quiz content, and submission-related state.

It supports interaction without requiring a permanent database in the current implementation.

I. API Configuration

The application uses the GROQ_API_KEY environment variable to provide API credentials. The configured generation temperature is 0.2, and the HTTP request timeout is 120 seconds.

API availability, response time, usage limits, and service behavior depend on the external provider.

XIII. RESEARCH METHODOLOGY

This section defines a proposed evaluation methodology for examining the quality and reliability of AI StudyMate.

The methodology is designed to evaluate generated summaries, generated quiz questions, response time, and the consistency of outputs.

The evaluation has not yet been completed. The following procedures describe how the system may be assessed in future testing.

A. Research Questions

RQ1: How accurately do AI-generated summaries preserve the important facts and concepts contained in the supplied study notes?

RQ2: What proportion of generated MCQs have a single defensible correct answer that is supported by the original notes?

RQ3: How do the length and subject area of study material affect summary quality, quiz quality, and generation time?

B. Proposed Dataset

A proposed evaluation dataset may contain 20–30 study-note samples from at least three subject areas. The samples should include different text lengths:

Short notes.

Medium-length notes.

Long notes.

The source material should preferably be consented educational material or openly licensed content. For each sample, the evaluation records may include:

Original study notes. Generated summary. Generated quiz.

Model configuration.

Summary generation time.

Quiz generation time.

Reviewer feedback.

Identified errors or unsupported content.

The proposed dataset size is a future evaluation target and should not be interpreted as completed data collection.

C. Evaluation Metrics

1. Summary Factual Correctness

Measures whether factual statements in the generated summary are supported by the original study notes.

2. Summary Concept Coverage

Measures the proportion of important reference concepts included in the generated summary.

3. MCQ Answer-Key Correctness

Measures the proportion of generated questions for which the declared correct answer is verified as accurate.

4. MCQ Single-Answer Validity

Measures whether each question has exactly one defensible correct answer.

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5. MCQ Source Grounding

Measures whether generated questions can be answered using the original supplied notes.

6. Generation Latency

Measures the time taken for the application to receive the generated response from the AI service. Mean and median response times may be reported.

7. Reviewer Agreement

Measures the consistency between reviewers evaluating generated summaries and quizzes. Percentage agreement or Cohen's kappa may be used for suitable categorical ratings.

D. Experimental Procedure

The proposed evaluation procedure is as follows:

Select educational note samples from the dataset. Organize samples according to subject and text length. Submit each sample to AI StudyMate.

Generate summaries and quizzes using a fixed model configuration. Record generation time for each operation.

Prepare the generated outputs for human review.

Ask reviewers to evaluate summaries and MCQs using a common rubric.

Request reviewers to identify source passages supporting factual claims and answers. Calculate the evaluation metrics.

Analyze errors, disagreements, and patterns across note lengths and subject areas.

A subset of prompts may be repeated to examine output variability. Where possible, AI-generated outputs may be compared with manually prepared summaries or instructor-authored MCQs.

XIV. RESULTS AND DISCUSSION

The application source code was reviewed for the described workflow, but a completed experimental dataset, independently reviewed AI outputs, and recorded performance measurements were not available for this research paper.

Therefore, numerical performance results are not presented in this section. The following table is intended to be completed after actual evaluation.

Evaluation Measure	Result
Number of evaluated note samples	To be recorded
Summary factual correctness	To be calculated
Summary concept coverage	To be calculated
MCQ answer-key correctness	To be calculated
MCQ single-answer validity	To be calculated
MCQ source grounding	To be calculated
Mean generation response time	To be measured
Reviewer agreement	To be calculated
Major observed errors	To be documented

A. Expected Observations

During testing, researchers may examine whether the generated summaries preserve important information across different note lengths.

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Short notes may be easier to summarize without losing important concepts, whereas longer notes may contain more information that requires careful selection and organization.

Quiz evaluation may identify questions with ambiguous answer choices, incorrect answer keys, or content not supported by the original notes.

B. Reliability Considerations

The application depends on an external AI service. API availability, request failures, response formatting, and generation time may affect usability.

The JSON validation process checks structural requirements but does not independently verify the factual correctness of generated questions.

C. Interpretation of Results

A successful demonstration of the application indicates that its workflow can be used to generate summaries and quizzes under the tested conditions. It does not independently establish improvement in student learning outcomes.

Educational effectiveness requires a separate evaluation involving learners, appropriate comparison methods, and recorded study outcomes.

XV. LIMITATIONS

AI StudyMate provides useful educational assistance but has several limitations in its current implementation.

A. Internet Dependency

The application requires internet access to communicate with the hosted AI service. Without an available connection, generation requests may not complete.

B. Third-Party API Dependency

The system depends on the external provider's service availability, usage limits, response time, and API behavior.

C. Scanned PDF Limitation

The current application extracts selectable text from PDF documents. Scanned pages containing text as images are not processed using OCR.

D. Input Truncation

The application limits extracted text to 30,000 characters. Important information beyond the limit may be excluded from the AI request.

E. AI Output Accuracy

Generated summaries and quizzes may contain errors, omissions, unsupported claims, or ambiguous questions. Generated material should be reviewed before being used as a definitive study resource.

F. Basic Quiz Validation

The quiz validator checks JSON structure and basic fields. It does not provide complete semantic verification of the question, answer, or explanation.

G. Fixed Quiz Configuration

The current dashboard flow uses five medium-difficulty questions. User-controlled quiz length and difficulty are not available in the described implementation.

H. Temporary Data Storage

Application data is managed using Streamlit session state. Persistent accounts, long-term quiz history, and permanent performance analytics are not implemented.

I. Evaluation Limitation

No controlled study or completed quantitative evaluation is available to establish the application's effect on student academic performance or learning outcomes.

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XVI. FUTURE WORK

Several improvements can be considered to enhance the functionality, reliability, and educational value of AI StudyMate.

A. OCR-Based PDF Support

OCR can be added to extract text from scanned documents and image-based PDFs, extending support beyond selectable-text documents.

B. Multilingual Support

Future versions may support summaries and quizzes in multiple languages to make the application more accessible to students with different language preferences.

C. Adjustable Quiz Settings

Students may be provided with options to select quiz length and difficulty level according to their learning requirements.

D. Improved Answer Validation

Additional validation techniques can be introduced to verify the correctness of answer keys, improve distractor quality, and identify questions with multiple possible answers.

E. Source-Based Explanations

The application may highlight source passages corresponding to summary statements and quiz answers, helping students verify generated content.

F. User Accounts and Learning History

A database-based storage system may be introduced to maintain user profiles, quiz attempts, scores, and learning progress over time.

G. Personalized Learning

Future development may explore adapting questions according to the learner's previous mistakes, performance, and areas of difficulty.

H. Experimental Evaluation

A structured study may be conducted with students to evaluate usability, summary quality, question quality, time savings, and learning outcomes.

XVII. CONCLUSION

AI StudyMate is a web-based educational assistant that integrates study-note input, PDF text extraction, AI-powered summarization, automated multiple-choice question generation, and interactive quiz evaluation.

The application provides a convenient workflow in which students can submit study material, generate organized revision summaries, create practice quizzes, attempt questions, and review their performance.

The project demonstrates the practical use of Python, Streamlit, PDF processing, and hosted generative AI technology within an educational application. Its focus is on integrating useful learning-support functions into a single, accessible interface.

Although the system offers a practical approach to AI-assisted study preparation, its generated content requires verification. Further testing is needed to evaluate factual correctness, concept coverage, question validity, response time, and educational effectiveness.

Future development may improve the system through OCR, multilingual functionality, personalized quizzes, stronger semantic validation, persistent learning history, and formal student-based evaluation.

AI StudyMate therefore provides a foundation for exploring the role of generative AI in educational revision and self-assessment.

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