I. General Field Introduction (Education & Technology)

In Philippine higher education, digital learning materials—such as e-books, online modules, and electronic resources—are becoming increasingly integral to academic instruction and study. A 2022 study assessing e-learning readiness across government and private HEIs found that both faculty and students are adapting to digital instruction, though they still face challenges related to training, infrastructure, and awareness of tools (Lucero et al., 2022). Complementing this, an empirical investigation into university students' usage of electronic resources revealed that half of respondents "always" use these materials for research tasks, indicating their importance in academic engagement (Rosales, 2021). Together, these findings highlight a significant trend toward digital adoption in Philippine higher education, albeit with practical limitations that still need to be addressed.

https://www.researchgate.net/publication/358604030_Assessment_of_E-Learning_Readiness_of_Faculty_Members_and_Students_in_the_Government_and_Private_Higher_Education_Institutions_in_the_Philippines

https://rsisinternational.org/journals/ijriss/articles/an-empirical-study-on-knowledge-access-and-utilization-of-electronic-resources-by-university-students-in-philippines

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III. Narrow Down to Problem: Lecture Note Utilization

Despite advancements in educational technology and AI-driven tools, a **persistent problem remains unaddressed**: the absence of personalized, context-aware support for students studying lecture notes independently. While universities provide digital materials like e-books and online modules, these resources are often static and lack interactive features to address real-time comprehension gaps (Wang et al., 2023). This limitation is critical: students studying complex topics without immediate, contextual assistance can experience reduced understanding and retention, ultimately affecting their academic performance (Wang et al., 2023).

https://pmc.ncbi.nlm.nih.gov/articles/PMC9825070

IV. Related Works and Limitations

Educational chatbots often fall short due to their limited design scope and lack of deep content integration, which can restrict their ability to provide accurate and meaningful assistance. These limitations not only affect the quality of responses but also impact student motivation and reliability of the learning process (Huang, 2024). While some systems demonstrate improvements in engagement and social presence, their effectiveness is often hindered by poor contextual understanding and inability to adapt to dynamic academic needs (Hew 2022). Additionally, generative AI-based chatbots, despite their potential for more natural interactions, frequently exhibit hallucinations—producing information that sounds correct but is factually inaccurate. Recent studies recommend integrating retrieval-based grounding methods, such as Retrieval-Augmented Generation (RAG), to minimize these errors and enhance accuracy in educational contexts (Rawte et al., 2024)

https://www.researchgate.net/publication/377081841_A_Comprehensive_Survey_of_Hallucination_Mitigation_Techniques_in_Large_Language_Models

https://www.researchgate.net/publication/363415641_Using_chatbots_to_support_student_goal_setting_and_social_presence_in_fully_online_activities_learner_engagement_and_perceptions

https://www.frontiersin.org/journals/education/articles/10.3389/feduc.2023.1175715/full

https://www.researchgate.net/publication/382829159_How_chatbots_support_student_motivation_in_learningA_scoping_review

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V. Research Gap

Although both generative AI and retrieval-based models have shown promise in natural language processing and question-answering tasks, very few studies have investigated their combined use—specifically for enhancing lecture note–based learning in higher education. Traditional academic chatbots tend to rely either on static, pre-defined responses or purely generative systems, limiting their contextual accuracy and adaptability to specific course content. Retrieval-Augmented Generation (RAG), which integrates retrieval mechanisms with generative AI, has emerged as a robust solution to mitigate hallucinations and boost factual consistency. However, its application in educational settings—especially for delivering personalized, lecture-grounded study support—remains significantly underexplored (Swacha & Gracel, 2025). While preliminary implementations suggest RAG's potential in improving feedback and support, the broader integration of RAG into systems tailored for lecture materials is yet to be realized (Jacobs & Jaschke, 2024).

https://www.researchgate.net/publication/390700272_Retrieval-Augmented_Generation_RAG_Chatbots_for_Education_A_Survey_of_Applications

https://arxiv.org/html/2405.06681v1

VI. Proposed Solution Preview

This study proposes the integration of **Retrieval-Augmented Generation (RAG)**, a hybrid approach that combines the retrieval of relevant context from a predefined knowledge base with generative AI models to produce accurate, context-aware responses. Unlike traditional generative models that rely solely on learned patterns, RAG mitigates **hallucination** by grounding responses in verified content, such as lecture notes and course materials (Lewis et al., 2020). This makes it particularly suitable for academic environments where factual accuracy and relevance are critical. Despite its effectiveness in other domains, RAG remains underutilized in educational applications—particularly for enhancing student learning through **lecture-based question answering** (Swacha & Gracel, 2024).

Our approach seeks to bridge this gap by developing a RAG-powered academic assistant optimized for higher education. Specifically, the system will implement **improved text chunking strategies** to maintain semantic coherence, adopt **advanced retrieval techniques** for precise content matching, and **optimize both retrieval and prompt construction** to ensure high-quality, context-rich answers. These enhancements aim to deliver personalized, accurate, and grounded responses that directly support student learning from actual lecture materials.

https://arxiv.org/abs/2005.11401

https://arxiv.org/html/2405.06681v1

(ETO YUNG SINUNDAN KONG FLOW PRE)

I. General Field Introduction (Education & Technology)

- Start with the **importance of education** in personal and societal development.
- Emphasize the **role of technology in education** (e.g., e-learning, digital transformation in classrooms).

- Cite studies showing that **digital tools improve accessibility and engagement** in learning.
- Mention the **growing need for personalized learning** to cater to diverse student needs.

III. Narrow Down to Problem: Lecture Note Utilization

- Explain how **lecture notes remain a primary learning resource**, but students face challenges:
    - Unstructured and lengthy notes make searching for specific topics difficult.
    - Students spend more time finding information than understanding concepts.
- Mention **traditional search methods** (keyword-based) and their limitations.
- Point out the **gap in personalized, context-aware assistance** for reviewing notes.

IV. Related Works and Limitations

- Briefly discuss **existing approaches for academic chatbots**:
    - FAQ-based bots → Limited to pre-defined questions.
    - Keyword search → Lacks understanding of context and semantics.
    - Generative AI (e.g., GPT) → Can answer but prone to hallucinations without context.
- State **limitations of current solutions**:
    - No deep integration with student lecture materials.
    - Lack of retrieval mechanism combined with generation.
    - Context loss and inaccurate answers.

V. Research Gap

- Although generative AI and retrieval models exist, **few studies integrate both for lecture note-based learning**.

- **Current RAG systems are underutilized in education**, especially for personalized study support.

VI. Proposed Solution Preview

- Introduce the concept of **Retrieval-Augmented Generation (RAG)**:
    - Combines **retrieval of relevant content** with **language generation for contextual answers**.
- Explain why RAG is suitable:
    - Reduces hallucination.
    - Ensures answers are grounded in lecture notes.
- State **this approach has not yet been widely applied in enhancing student learning from school lecture notes**.