AWAITS: AN ACADEMIC WRITING AI TUTORING SYSTEM WITH RETRIEVAL AUGMENTED GENERATION FOR SUPPORTING COGNITIVE SKILLS

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ABSTRACT

Background

Recognizing the challenges students often encounter in navigating extensive course materials or other academic resources to identify useful information is crucial to their academic success [1]. The sheer volume of academic content available for topics or subjects can be overwhelming and time consuming for both teachers and students seeking precise information for their pedagogical inquiries. This challenge is particularly pronounced among first-year university students, especially those grappling with the nuances of academic writing, which can be even more daunting for non-native English speakers [2].

While Artificial Intelligence (AI)-enabled technologies are advancing at a rapid rate, there is a notable gap in the ability of educators to keep pace with these innovations [3]. Many educators often find it difficult to integrate AI tools into their existing curriculums, often due to a lack of sufficient training and support in using these technologies [10]. This disconnect not only dampens the effectiveness of AI tools but also affects the overall pedagogical process for both educators and learners, as there is a missed opportunity to utilize these advanced technologies to their full potential [4]

To address these challenges, this project introduces the Academic Writing AI Tutoring System (AWAITS) that supports both educators and students with their cognitive skills [5]. AWAITS will be built upon an existing academic chatbot, known as “CHAT4-ISP” which is an educational system that leverages Generative AI (GenAI) capabilities to support students in academic writing such as grammar, syntactic and semantic structure of submitted articles [6].

ISBN: 978-91-8082-142-1

Research Gap / Motivation

The emergence of GenAI offers promising opportunities for personalized learning [1], but integrating GenAI into education presents challenges. These challenges encompass ensuring fairness, addressing ethical concerns, and managing occasional errone outputs. These flawed or erroneous outputs may be due to factors linked to incomplete training data, flawed algorithmic design, or unforeseen environmental influences [7]. GenAI-enabled chatbots often suffer from hallucination issues, which can impede their effectiveness in supporting students' cognitive skills. Overcoming these challenges requires addressing and mitigating these hallucination effects to enhance the reliability and educational value of AI-powered chatbots. To reduce hallucinations, this study will be leveraging Retrieval Augmented Generation (RAG) technologies which combine retrieval-based and generative models to produce more accurate and contextually relevant responses by focusing on referencing provided documents as a reliable source of information [8] [9].

Research Aim

The primary objective of this study is to develop a proof-of concept system called AWAITS. The system will enhance critical thinking, and cognitive skills in academic writing for students. This initiative will also be tailored to equip students and educators with essential 21st-century skills by preparing them for a competitive labor market. AWAITS will be evaluated through systematic interventions across various educational levels, including secondary and tertiary institutions, to demonstrate its effectiveness and potential for broader educational adoption.

Study Design

The study will integrate both technical evaluation and user experience analysis by employing a two-phase experimental design to assess the use of RAG technology within educational AI-enabled chatbots. The initial phase (controlled analysis phase) will conduct a controlled experiment to determine the technical functionality of RAG feature in the AWAITS system compared to a standard version CHAT4-ISP. Both versions, (CHAT4-ISP and AWAITS) will be subjected to the same set of queries in a controlled experiment in a Question-and-Answer (Q&A) format. This approach allows a direct comparison of system features to reference and utilize external information, focusing on the enhancement provided by the RAG technology.

Following the technical assessment, the second phase transitions to an emphasis on real-world user interaction. In this phase, educators and students will engage actively with both versions, providing feedback on their experience. This user-centric approach is designed to assess the practical usability and educational value of the system. Feedback from this phase will capture subjective assessments and personal reactions, offering insights into user behavior, preferences, and overall satisfaction with the system.

Initial Findings

The initial pilot study on CHAT4-ISP has yielded promising outcomes, demonstrating the substantial potential of AI in providing valuable support within academic settings. It was also noticed that the system has proven beneficial for both educators and students by offering teacher-like suggestions and improvements. Students have utilized these AI-generated recommendations to enhance their work, while educators have been able to streamline their feedback process by leveraging the AI as an initial feedback loop before providing their own input. This approach has enabled teachers to save time, allowing them to focus on more personalized guidance and instruction. Overall, the integration of AI has shown promising potential in augmenting the learning experience for both students and educators [6].

Future Expectations and Outcomes

Development and testing of AWAITS is expected to further establish its readiness for broader implementation and adoption. The ultimate goal is to create an affordable, user-friendly, and effective educational tool that can be deployed in schools to enhance the learning process by providing real-time academic support. By emphasizing RAG technology, the study aims to improve the reliability and effectiveness of the system, further supporting educators and students in their tertiary endeavors.

Keywords: AI, Education, Chatbots, Hallucination, Academic Writing, RAG

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