DEVELOPING AND VALIDATING AN AI-DRIVEN ADAPTIVE LEARNING SYSTEM FOR MEDICAL TERMINOLOGY ACQUISITION AND RETENTION IN A NON-ENGLISH SPEAKING MEDICAL UNIVERSITY CONTEXT

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ANNOTATION

This study explores the development of an AI-driven adaptive learning system for improving medical terminology acquisition among medical students in non-English speaking environments. The research proposes integrating machine learning and natural language processing tools into EMP curricula and evaluates their effectiveness in enhancing vocabulary retention, communicative competence, and personalized learning outcomes.

Keywords: Medical English, ESP, artificial intelligence in education, machine learning, adaptive learning systems, medical terminology, NLP, intelligent tutoring systems, language learning technologies, medical education.

INTRODUCTION

The application of machine learning (ML) in teaching English for Specific Purposes (ESP), particularly English for Medical Purposes (EMP), represents an emerging interdisciplinary field combining computational linguistics, educational technology, and medical education. These technologies aim to enhance language acquisition and professional communication skills among medical students and healthcare professionals.

Medical English plays a critical role in global healthcare communication. It enables access to international scientific literature, participation in global medical conferences, and the exchange of clinical knowledge across linguistic boundaries. However, teaching medical English presents several challenges, including the complexity of medical terminology, rapid developments in medical science, and the necessity for accurate interdisciplinary communication.

Traditional ESP teaching methods often struggle to address these challenges effectively. In particular, medical students studying in non-English speaking countries face difficulties in mastering specialized vocabulary and maintaining long-term retention of terminology.

Artificial intelligence and machine learning offer promising solutions for addressing these limitations. AI-based educational technologies can provide personalized learning environments, automated feedback, and adaptive learning pathways based on student performance. Generative AI models, including large language models like ChatGPT, enable interactive dialogue-based learning, automated feedback generation, and contextualized vocabulary practice, thereby increasing student engagement with complex medical terminology.

Recent research highlights the potential of ML-driven systems to support vocabulary acquisition, pronunciation training, and writing assessment in medical English. Despite these advances, there remains a limited number of studies focusing on the integration and validation of such technologies within specific EMP curricula in non-English speaking medical universities. Therefore, the present study aims to explore the development and validation of an AI-driven adaptive learning system designed to improve medical terminology acquisition and retention among medical students.

The novelty of the present research lies in the development of an integrated AI-driven adaptive learning system specifically tailored for English for Medical Purposes (EMP) in non-English speaking medical universities. Unlike previous studies that focus primarily on isolated applications of artificial intelligence in language learning, this study proposes an complex approach of combining machine learning algorithms, Natural Language Processing (NLP), and domain-specific medical corpora within a unified educational framework.

The study presents a conceptual AI-driven adaptive learning system rather than a fully developed or implemented digital platform. The research is primarily theoretical and design-oriented, with a proposed framework for future empirical validation. The functioning of the model is described at the architectural level and includes several key components:

- the development of a specialized corpus of medical English texts (textbooks, research articles, and clinical case studies);
- the application of Natural Language Processing (NLP) techniques to identify and analyze medical terminology;
- the use of machine learning algorithms to track student performance, including error patterns, learning pace, and repetition frequency;
- the generation of personalized learning pathways based on individual learner data;
- the provision of automated, real-time feedback on vocabulary usage, grammar, and professional communication.

However, the article does not describe a specific software implementation or an existing platform, which indicates that the system is currently at the design stage.

Therefore, the study proposes a theoretically grounded model with a defined structure and functional mechanisms, along with a suggested methodology for its future empirical evaluation (e.g., pre- and post-testing, as well as qualitative data collection methods).

MAIN BODY

Machine learning technologies are increasingly applied in ESP education to enhance the effectiveness of language instruction. These systems can analyze large datasets of student performance and adapt instructional strategies to individual learning needs.

One of the most promising applications is adaptive learning systems. These systems analyze learners' progress, learning styles, and error patterns in order to provide personalized educational content. Such an approach allows students to focus on specific areas of difficulty and improves overall learning outcomes.

Another important application involves automated feedback and assessment. AI-powered tools can evaluate grammar, vocabulary usage, and discourse coherence

in medical contexts. Immediate feedback enables students to correct mistakes and reinforce correct language patterns.

NLP technologies, such as named entity recognition (NER), part-of-speech tagging, and domain-specific corpus analysis, play a crucial role in extracting and structuring medical terminology from authentic clinical and academic texts. NLP systems can process clinical documentation and research articles, identifying key medical terms and linguistic structures. These capabilities make it possible to create realistic language exercises based on authentic medical discourse.

Intelligent Tutoring Systems represent another innovative approach to AI-supported language learning. These systems simulate human tutoring by providing interactive practice tasks, guided explanations, and adaptive feedback. In the context of medical English, such systems can support the development of professional communication skills in clinical settings.

Predictive analytics also contributes to the improvement of educational outcomes. By analyzing student performance data, ML algorithms can predict learning difficulties and recommend targeted interventions. This proactive approach allows instructors to address specific problems such as vocabulary acquisition or comprehension of medical texts.

Data-driven learning tools further enhance students' engagement with authentic language materials. Platforms utilizing corpus analysis techniques allow learners to explore patterns of language use in real medical texts, thereby improving both vocabulary knowledge and contextual understanding.

The proposed research focuses on the development of an adaptive learning system specifically designed for medical terminology training in a non-English speaking medical university environment.

METHODOLOGY

This study adopts a mixed-methods research design combining quantitative and qualitative approaches to evaluate the effectiveness of the proposed AI-driven adaptive learning system in teaching medical terminology.

The study sample is expected of 60 first- and second-year medical students from a non-English speaking medical university. The participants are randomly divided into two groups: an experimental group (n = 30), which uses the AI-based adaptive learning system, and a control group (n = 30), which follows traditional EMP instruction methods.

The research is projected over a period of 8 weeks, during which both groups study the same medical English content, focusing on terminology related to anatomy, physiology, and clinical communication.

The instruments used in the study include:

Pre-test and post-test assessments to measure vocabulary acquisition and retention;

AI-based learning platform (prototype system) providing adaptive exercises, automated feedback, and personalized learning pathways;

Questionnaires to evaluate student engagement and satisfaction;

Interview protocols for collecting qualitative feedback from students and instructors.

Data collection methods include:

quantitative analysis of test scores (pre- and post-tests);

system-generated learning analytics (error rates, repetition frequency, learning progress);

qualitative data from semi-structured interviews and student surveys.

Data analysis is performed using descriptive and inferential statistics (e.g., t-tests) to compare the performance of the experimental and control groups. Qualitative data are analyzed using thematic analysis to identify patterns in user experience and perceived effectiveness.

HYPOTHETICAL RESULTS OF THE STUDY

The implementation of the proposed AI-driven adaptive learning system is expected to demonstrate significant improvements in medical terminology acquisition among students. Based on pre- and post-test comparisons, students using the adaptive system would likely show higher vocabulary retention rates compared to those обучающиеся традиционными методами.

It is anticipated that the experimental group may achieve an increase of approximately 20–30% in terminology retention scores, particularly in long-term memory assessments. Additionally, improvements in reading comprehension of medical texts and accuracy in the use of professional vocabulary are expected. The system's real-time feedback mechanism is likely to contribute to a reduction in lexical and grammatical errors in written tasks, especially in clinically oriented communication. Students may also demonstrate increased confidence in using medical English in both written and oral contexts.

Qualitative data (interviews and feedback) would likely indicate high levels of student engagement and satisfaction due to the personalized learning pathways and interactive nature of the system. Instructors may report improved monitoring of student progress and more efficient identification of learning difficulties.

Furthermore, predictive analytics within the system may successfully identify at-risk students, allowing for early intervention and targeted support.

Overall, the results would suggest that AI-driven adaptive learning systems have strong potential to enhance the effectiveness of EMP instruction in non-English speaking medical universities.

CONCLUSION

Advanced AI technologies, including transformer-based language models such as ChatGPT, Natural Language Processing (NLP) tools, and corpus-based analysis systems, offer effective solutions for addressing these limitations in medical English education.

AI-based educational technologies, particularly intelligent tutoring systems and adaptive learning platforms powered by machine learning algorithms, can generate personalized learning environments by analyzing student performance data, error patterns, and learning trajectories.

The development of domain-specific NLP models and specialized medical language corpora further enhances the effectiveness of these technologies. However, successful implementation requires careful consideration of ethical issues, data privacy, and teacher training.

Future research should focus on validating AI-based learning systems through empirical studies and exploring their integration into existing medical curricula. Such

efforts will contribute to the modernization of medical English education and better prepare future healthcare professionals for global communication.

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