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Designing AI-integrated e-book for English for specific purposes (ESP) in health science education

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ABSTRACT

This research formulates and tests an AI-integrated e-book to increase English for Specific Purposes (ESP) learning by health science students in order to enhance speaking performance. Conventional ESP materials in health sciences are typically static and non-interactive, limiting opportunities for real-time communicative practice. Using a Research and Development (R&D) design, the project followed four stages: (1) needs analysis involving students, lecturers, and curriculum stakeholders; (2) design and development of AI-integrated e-book; (3) implementation and testing with 58 students through pre- and post-tests; and (4) evaluation and refinement after reflection questionnaires. Fifty-eight health science students completed pre- and post-tests, measured for the fluency, pronunciation, vocabulary, grammar, and content/coherence. The findings revealed a strong demand for AI-integrated ESP materials in need analyses, a notable enhancement in speaking ability (pre-test M = 11.71, post-test M = 19.22; $p < .001$), with improvements noted in all performance areas. Feedback from reflections showed significant satisfaction, emphasizing advantages like accessibility, content relevance, and motivation, while students pointed out issues with internet stability and chatbot constraints. These results validate the benefits of AI integrated e-book into ESP education and provide actionable insights for ESP teachers, curriculum planners, and organizations aiming to integrate interactive AI resources in healthcare education teaching materials.

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1. Introduction

Artificial Intelligence (AI) and English for Specific Purposes (ESP) education has been more imperative than ever in this digital age, spearheading the Sustainable Development Goals (SDG 4: Quality Education) by creating inclusive, equitable, and innovative materials for learning. The speed and power of innovation in AI technologies like adaptive learning, NLP chatbots, and speech recognition bring unmatched promise to improve language learning experiences, especially in some fields like health sciences (Haryani, 2025). Against this context, the present study seeks to design and validate an AI-powered interactive e-book for health science students to deliver more adaptive, interactive, and efficient ESP training.

ESP, as Hutchinson (2017) suggest, is all about addressing specific learning needs of learners, and therefore is a good area to apply AI. Existing literature suggests that ESP learners possess positive

attitudes toward AI-based tools, and assign greater motivation for and efficiency in learning (Abimanto & Mahendro, 2023; Zawacki-Richter et al., 2019). For example, studies show that AI-based adaptive learning systems are capable of adapting content presentation as per the level of learners' proficiency, thus creating increased interest (Rong et al., 2021). Besides, AI chatbots have been shown to enhance oral communication skills via real-time practice conversation (Subiyantoro et al., 2023). However, with these encouraging accounts, deployment of AI for ESP material production in medicine is still fairly limited, remaining susceptible to shortages in specialized resources and scope for maneuver in meeting individual learners' needs (Chang et al., 2023).

Traditional ESP learning methodologies, especially medicine English, have been considered very uninspiring, contextually incomplete, and unable to cater to the different learner profiles (Tapalova & Zhiyenbayeva, 2022). The deficits of traditional learning materials necessitate the development of new ones in place that can bridge the gap between theory and practice. Interactive e-books supplemented with AI are an excellent option for multimedia embedding, real-time feedback, and dynamic adjustments based on learner progress (Halkiopoulos & Gkintoni, 2024). Previous studies have indicated the possibilities of AI chatbots in language acquisition (Hapsari & Wu, 2022), but few have explored their application in medical ESP.

Drawing on past research studies in 2023 and 2024, where the application of AI by Indonesian ESP lecturers was investigated (Du & Gao, 2022; Chuang et al., 2022), the current study suggest a new hybrid of adaptive learning, NLP-driven chatbots, and speech recognition in an independent interactive e-book format. This mixture would increase students' mastery of medical English vocabulary and communication skills at high interest rates. In contrast to past research that mainly focused on static e-books or general AI tools, this study suggests a domain-specific AI-fortified learning tool measured by both quantitative and qualitative means (Oktafiani et al., 2021).

The originality of this study is in its focused optimization of AI for use in the generation of interactive health sciences e-books with the goal of bridging some content specialization and adaptive delivery gaps. The designed model not only promises to enhance language learning outcomes but also helps to revolutionize learners' experience with ESP materials, making learning more context-specific, relevant, and engaging.

Recent research has shown that combining interactive e-books with higher-order thinking skills (HOTS) tasks can greatly improve learner involvement and mastery of content, especially in science disciplines (Sianturi et al., 2021). Intelligent assistants powered by AI for personalized and adaptive learning have demonstrated significant potential in customizing instruction to meet the specific needs of individual learners (Sianturi et al., 2021; Goel, 2020; Adamu & Awwalu, 2019). In the realm of ESP, the integration of bilingual curricula and AI-fueled collaborative learning approaches has been noted to enhance both language proficiency and cooperation (Asrifan et al., 2025). Progress in generative AI has notably enhanced the creation of customized intelligent tutoring systems (Maity & Deroy, 2024), whereas the AI in Education 5.0 framework provides a thorough model for adaptive learning settings (Yamamoto et al., 2024). Systematic reviews emphasize the efficacy of AI-driven adaptive e-learning in health education (Fontaine et al., 2019; Komolafe et al., 2025) and the promise of virtual patient simulation tools in medical (Gellner et al., 2025). Additionally, personalized learning methods (Das, 2025), and advanced interactive multimedia systems for e-healthcare (Yamamoto et al., 2024) offer chances for further improvement of AI-driven ESP teaching resources.

Although many studies have investigated the role of artificial intelligence in education, some studies have approached it in a fragmented manner. For instance, prior works on AI chatbots emphasize their potential to reduce speaking anxiety and promote engagement (Hapsari & Wu, 2022), while others have demonstrated the value of adaptive learning systems in personalizing instruction (Tapalova & Zhiyenbayeva, 2022). Nevertheless, these studies often focus on a single AI feature in isolation, such as chatbots or adaptive platforms, rather than integrating multiple AI capabilities into a cohesive learning resource. Likewise, recent studies on ESP e-learning materials highlight the effectiveness of interactive e-books (Sianturi et al., 2021), though many do not include AI-based feedback or real-time engagement.

An additional gap exists within the realm of health sciences ESP. Although AI's role in education has been extensively examined in general EFL or higher education contexts (Gutiérrez, 2023; Wangdi, 2024), studies specifically focusing on English for health professionals are still limited. Current ESP research often emphasizes needs analysis or traditional materials (Haryani, 2025; Šokčević, 2024), yet

there is limited exploration of AI-augmented approaches that integrate domain-specific terminology, clinical communication tasks, and tailored practice. This research fills that void by developing and experimentally evaluating an AI-driven interactive e-book for ESP in health sciences, combining adaptive learning, NLP-driven chatbots, and speech recognition into one platform. This approach not only confirms the efficacy of AI for ESP education but also shows how these advancements can meet the requirements of stakeholders, such as students, curriculum designers, and ESP instructors

In this regard, this study responds to three research questions:

1. How can an interactive e-book using AI be designed and developed for health science ESP students?
2. To what extent is the e-book effective in developing learners' professional English capabilities?
3. What are the problems and solutions involved in utilizing AI with health science ESP content?

2. Method

2.1. Research Design

The research utilized a research and development (R&D) instructional technology approach to conceptualize and pilot test an AI-based interactive e-book for ESP learning of health science students. The design commonly used in instructional technology to produce and validate learning innovations mentioned by Gall & Borg in Farhana et al (2021) and Sugiyono in Buhari (2019). The process followed five main stages: (1) needs analysis, (2) design and development, (3) implementation and testing, and (4) evaluation and refinement, adapted from established R&D frameworks and recent applications in AI-enhanced ESP learning (Sianturi et al., 2021)

2.2. Participants

The respondents involved fifty-eight students studying in Faculty of health science in Universitas Madani, who were purposively sampled based on prior experience in ESP courses.

The participants consisted of 58 health science students from Universitas Madani who were actively enrolled in English for Specific Purposes (ESP) courses. They represented multiple study programs and academic levels: Diploma in Pharmacy (n = 12; semesters 2, 4, and 6), Diploma in Midwifery (n = 5; semester 6), Bachelor of Nursing (n = 35; semesters 2, 4, 6, and 8), and Nursing Profession Program (n = 5; semester 2). This distribution ensured variation across both disciplinary backgrounds and levels of study, ranging from early to advanced semesters.

Such purposive sampling was considered appropriate because the selected students were those most directly exposed to ESP instruction in their curriculum and thus were the most relevant population for testing the AI-integrated e-book since they were able to participate in the research after hospital practice session finished. Thos who could not participate were mostly at the hospital for clinical practice.

2.3. Sampling Technique

A purposive sampling method was used, concentrating on students who were currently enrolled in ESP classes and had just finished their hospital practicum. This group was chosen due to their availability throughout the study period and because they represented the most pertinent population to offer insights on the incorporation of AI into healthcare ESP education. Students from the Faculty of Health Sciences were not included as they were still completing their practicum placements until the end of August, which made their involvement unfeasible. The criteria for including students were: (1) being enrolled in one of the three health science programs (Nursing, Midwifery, Pharmacy), (2) being available to take both the pre-test and post-test assessments, and (3) agreeing to provide informed consent. Curriculum stakeholders and ESP instructors were involved due to their positions in curriculum development and the implementation of ESP programs.

2.4. The Data Collection Instruments

The data were collected through student needs analysis questionnaire, pre- and post-tests for learning outcome, and feedback questionnaire to obtain qualitative feedback on the application of the AI-integrated interactive e-book. (scores, descriptive statistics, inferential tests) and qualitative

insights (themes from reflections) to comprehensively evaluate the effectiveness and usability of the constructed learning object. The data were collected during the research during June – August 2025.

2.5. Needs Analysis

The needs analysis stage collected data from curriculum stakeholders, ESP lecturers, and health science students using questionnaires to identify learning problems, desired content, and potential AI features for ESP (Du & Gao, 2022). The design and development phase adopted iterative prototyping, integrating adaptive learning, NLP-based medical chatbots, and speech recognition, which were reviewed by ESP experts and instructional designers for content validity and usability (Asrifan et al., 2025; Maity & Deroy, 2024).

2.6. Design and Development

Development was guided by an iterative prototyping methodology from initial content creation starting with needs analysis, through AI-function integration, and repeated usability testing iterations. Expert evaluators—constituting ESP lecturers, instructional designers, and healthcare professionals—tested the e-book for accuracy of content, language suitability, and usability. Feedback at every level of testing was used to develop more accurate interface design, enhance AI response, and guarantee fluid interaction between students and the system

The AI-enhanced e-book was tailored to address English for Specific Purposes (ESP) health sciences students' learning requirements. The material was taken from a health-science-oriented ESP course syllabus and supplemented with natural medical dialogues, words, and clinical situations to render it functional in real working settings. The end product, accessed via link http://bit.ly/pdf-apple, combines three principal AI-facilitated features:

Adaptive Learning – The system dynamically adjusts the level of difficulty in content as per students' current performance so that higher and lower performing students both face challenges and support commensurate with their level.

Natural Language Processing (NLP) Chatbot – Students can practice real-time, AI-supported medical communication in English, including simulation of patient encounter, case presentation, and healthcare consultation.

Speech Recognition – This functionality gives real-time pronunciation feedback, allowing students to practice their medical English speech skills with clinical vocabulary and role-playing simulations.

Dual AI Interaction Modes

Chat Session: Students can type questions or prompts related to the e-book content in a real-time chat box. This feature supports open-ended discussions, especially for writing practice, vocabulary clarification, and grammar checking.

Voice Chat Session: Students can converse naturally with AI using either Indonesian or English. When used in English, AI responds in a native-speaker accent, serving as a speaking partner for pronunciation modeling. AI also provides corrective feedback when students' pronunciation is inaccurate, making it a valuable tool for oral fluency and confidence building.

The design process took an iterative prototype process, starting with needs analysis, ESP content writing, addition of AI capabilities, and cycles of subject matter expert testing. Reviewers from ESP lecturers, health science faculty members, and instruction designers examined the e-book in content accuracy, language appropriateness, technical ease of use, and AI response. Interface redesigning, AI functionalities, and learning support tool enhancements were informed at each iteration, with the ultimate output optimized for ESP instruction in health sciences.

2.7. Implementation and Testing

The execution stage commenced with giving a pre-test to identify baseline ESP ability of students in health science settings. After the test, students received a guided tutorial session during which the researchers showed them how to use the AI-enhanced e-book. The briefing consisted of an e-book setup introduction, description of each element, and a live simulation of learning using AI through a model unit of the e-book.

Through simulation, the students and researchers replicated using AI functionalities—Chat Session for text chat and Voice Chat Session for voice practice—according to the materials presented for learning. Students demonstrated how AI is utilized to review material, rehearse pronunciation, rehearse medical communication role-play, and get automated feedback.

Following orientation, students were presented with a couple of weeks of self-study through the e-book integrated with AI. To assist them round the clock, there was an online forum for discussion where students could ask questions, exchange experiences, and pose challenges encountered in utilizing the e-book. The researchers assisted in monitoring the group by offering explanations and constructing problem-solving forums that are both related to learning content and technical utilization of AI features.

Students took a post-test at the conclusion of the instructional period to assess their learning progress and a user satisfaction survey to assess their motivation, perceived value, and overall experience with the AI-driven e-book. These results gave both quantitative and qualitative assessments of the effectiveness of the implementation.

Pre-test was given to establish students' baseline ESP competence. Interactive AI-powered e-book was implemented on a designated instructional period. Post-test and user satisfaction survey were given to ascertain learning gains and motivation.

2.8. Data Analysis

Quantitative data were analyzed statistically, and qualitative data were coded and thematic analysis adhering to Braun and Clarke's six-phase method in Taylor (2024). Responses were read multiple times for familiarity, then meaningful segments were systematically coded. Codes were subsequently categorized into possible themes, which were examined and polished to guarantee consistency. Pre-test and post-test quantitative data were compared with paired t-tests to check for statistical significance using 23 version of SPSS (Statistical Package for the Social Sciences). The open-ended reflection responses' qualitative data were examined through thematic analysis. Themes were identified and labeled, and corresponding quotes were chosen to exemplify each one. The researcher performed the analysis, and a senior lecturer was involved in peer debriefing to improve credibility. Emerging themes featured "flexibility in access," "technical challenges like internet instability," and "suggestions for more diverse multimedia resources."

2.9. Evaluation and Refinement

Students were provided with a guided questionnaire to gather their views, experiences, and suggestions on utilizing the interactive e-book powered by AI. The questionnaire had closed-ended and open-ended questions to measure usability judgment, entertainment, and learning support evaluations and obtain qualitative feedback for improvement.

The data gathered were analyzed to identify frequent themes, the strengths, and weaknesses. These were used as input in fine-tuning the AI-included e-book, e.g., in content presentation modification, flexibility of AI functionality, and designing the user interface.

2.10. Ethical Issues

The Ethical clearance was obtained from the institutional ethics committee. Participants were provided with informed consent and assured regarding confidentiality and voluntary participation. The research utilized a research and development (R&D) instructional technology approach to conceptualize and pilot test an AI-based interactive e-book for ESP learning of health science students. Proof of ethical clearance of KEPK/UMP/170/VII/2025 can be provided upon request.

3. Finding and Discussion

3.1. Findings

1) Needs Analysis

Needs analysis phase required three respondent groups namely health science students (n=58), members of curriculum division (n=10), and ESP lecturers (n=3) to ascertain priorities, challenges, and readiness for AI-mediated interactive e-books. Data were analyzed descriptively using 23 version of SPSS, and findings are presented in descriptive statistic Table 1.

Table 1. Descriptive analysis of the need for AI integration in English for Specific Purposes (ESP) for healthcare

	N	Mean	Median	Minimum	Maximum	SD	IQR
Students' Need Analysis Score	58	20.86	21	6	25	3.21	4
Stakeholder of Curriculum and ESP teachers Need Analysis Score	13	21.05	21	16	25	2.16	1.50

The Need Analysis data from students (N = 58) revealed a mean score of 20.86 with a median of 21, a score range of 6–25, and a standard deviation of 3.21. The distribution was negatively skewed (left-skewed) and leptokurtic (high kurtosis), indicating that most respondents obtained relatively high scores concentrated around the mean. This suggests that the majority of students perceived a strong need for integrating AI into English for Specific Purposes (ESP) learning in healthcare.

The Need Analysis data from curriculum and ESP lecturers (N = 13) showed a mean score of 21.05 with a median of 21, a score range of 16–25, and a standard deviation of 2.16. The equality of mean and median reinforced that the distribution was fairly balanced, though slightly skewed toward higher scores (negative skewness). With a relatively narrow range of values (16–25), most lecturers expressed similar assessments, indicating broad agreement that AI integration is necessary in the development of ESP instruction for healthcare education.

This is consistent with Hapsari and Wu (2022) studies that AI chatbots alleviate speaking fear and increase interaction. Furthermore, the expressed willingness to embrace AI-based interactive e-books affirms Chang et al (2023) findings on educators' adoption of AI tools when exposed to adequate training.

Overall, the needs analysis supports the project's emphasis on creating an AI-compatible interactive e-book for ESP in health science, specifically on learning medical terms, adaptive learning, and practicing speaking in real time—concerns highlighted as high priority by all of the stakeholder groups and backed up in earlier studies (Haryani, 2025; Šokčević, 2024; Gutiérrez, 2023).

2) Design and Development Output

The AI-enhanced interactive e-book English for Healthcare Professionals was designed via the needs analysis and iteratively prototyped. Figures 1, 2, and 3 depict the most important interface and integration features.

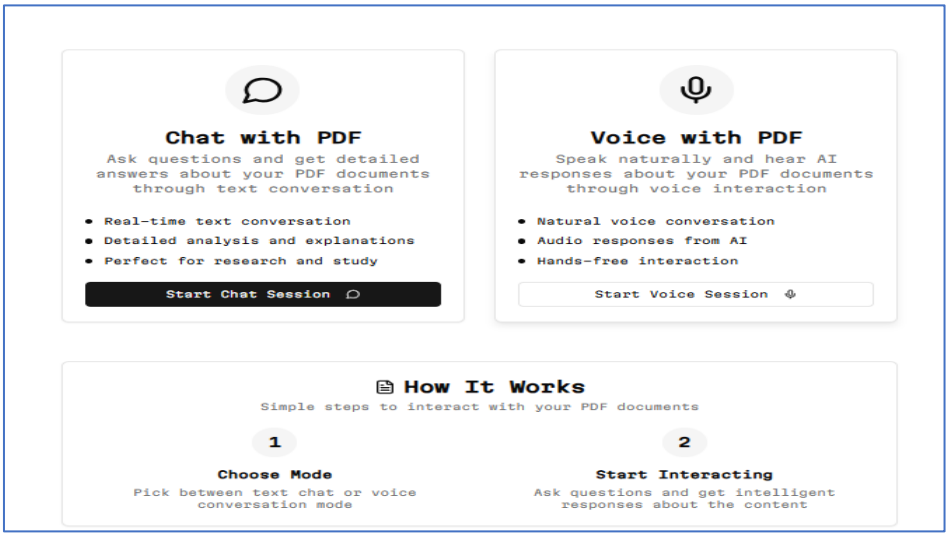

Fig. 1. Home Feature Interactive menu showing, *Chat with PDF* and *Voice with PDF* modes, allowing text-based and voice-based interaction with the book content.

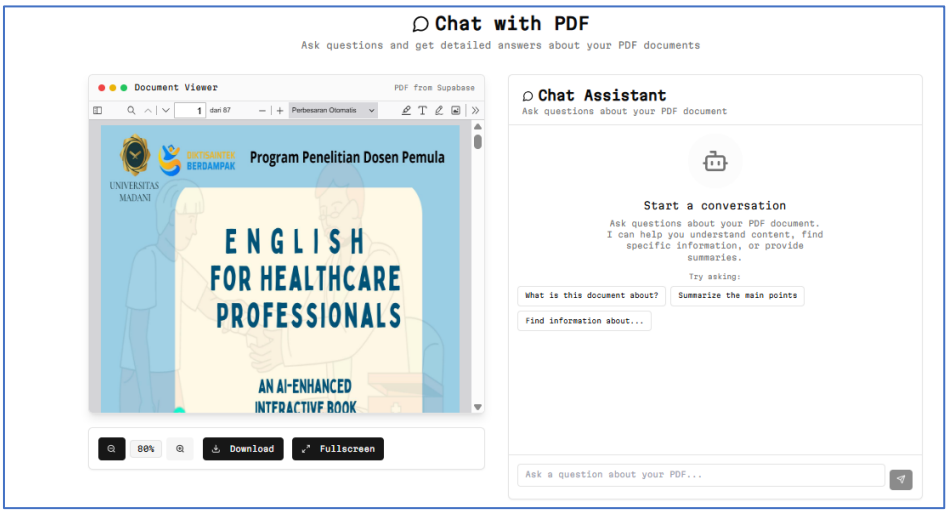

Fig. 2. *Chat with PDF* Feature of AI Integrated E-book

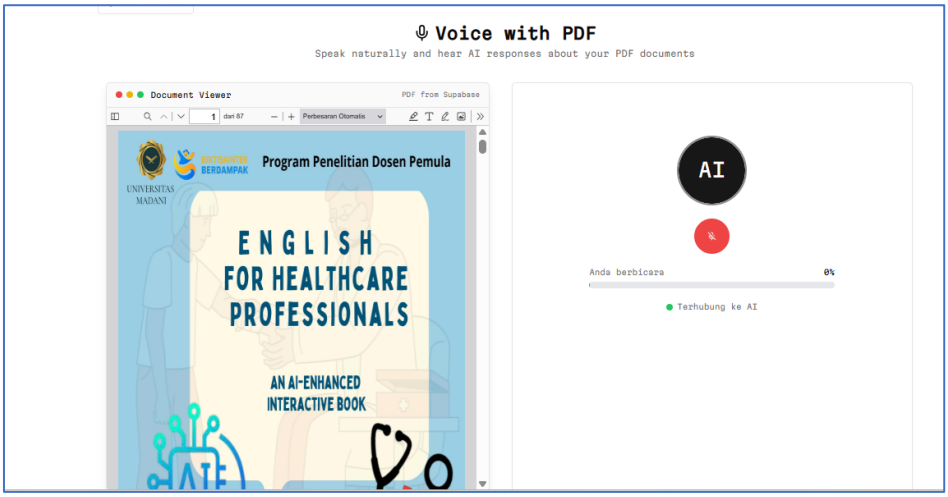

Fig. 3. *Voice with PDF* Feature of AI Integrated E-book

This integration combines adaptive learning, NLP chatbot for medical conversation imitation, and speech recognition for pronunciation suggestions, as recommended by Tapalova and Zhiyenbayeva (2022) and Hapsari and Wu (2022)

According to the needs analysis results, the AI-driven interactive e-book English for Healthcare Professionals was created and utilized to highlight required learning needs in medical English competency. The material was categorized into thematic units (i.e., Patient Interview, Medical Vocabulary, Clinical Case Discussion), and each unit included concise learning objectives, interactive exercises, multimedia materials, and AI-driven feedback features.

There are three major AI-enabled capabilities of the e-book:

1) Adaptive Learning – Dynamically adjusting task difficulty based on learners' performance and progress.
2) NLP Chatbot – Simulating real-life medical conversation for practice in listening and speaking with immediate feedback.
3) Speech Recognition – Live pronunciation assessment and correction.

This model aligns with earlier suggestions for technology-assisted and personalized ESP learning (Tapalova & Zhiyenbayeva, 2022; Chang et al., 2023) and is in line with the promotion of medical communication competence by Hapsari and Wu (2022). Through its inclusion of adaptive learning pathways and multimodal interaction, the e-book addresses the dual demands identified in the needs analysis of contextual use and engagement of learners.

3) Implementation & Testing

The implementation stage was where interactive AI-powered e-book was incorporated into ESP courses of health science students for a specific period of teaching. Pre-test was administered to the participants to measure their speaking ability under five categories—fluency, pronunciation, vocabulary, grammar, and content & coherence.

According to the descriptive analysis, the median speaking score for students prior to the intervention (pre-test) was 11, with a lowest score of 5 and a highest score of 15. Following the intervention, the median score on the post-test rose to 19.5, with a lowest score of 11 and a highest score of 23. The interquartile range (IQR) for the pre-test was 2, whereas for the post-test it rose to 3, reflecting a difference in the level of progress among students.

The Wilcoxon Signed-Rank Test produced a significance value (Sig. 2-tailed) of 0.000 ($p < 0.05$), demonstrating a statistically significant difference between the scores of the pre-test and post-test. Consequently, the intervention demonstrated efficacy in enhancing the speaking skills of the students.

Table 2. Descriptive Analysis of Pre-test and Post-test Speaking Scores

	N	Median	Minimum	Maksimum	IQR	Sig (2-tailed)
Pre-test Score	58	11	5	15	2	0.000
Post-test Score	58	19.5	11	23	3	

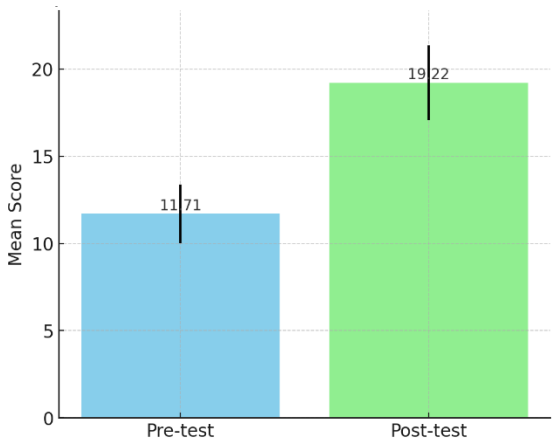

Fig. 4. Comparison Pre-test and Post-test Scores

This level of improvement is significantly greater relative to earlier studies on these AI-powered platforms (Gutiérrez, 2023), and this suggests that adaptive learning, NLP chatbot, and real-time speech recognition feedback might have significantly influenced students' speaking skills. These results are supplemented by previous assertions that AI can be applied for personalized and interactive ESP learning improvement (Tapalova & Zhiyenbayeva, 2022; Hapsari & Wu, 2022), especially if developed based on learners' requirements and professional backgrounds.

4) Evaluation & Refinement

At the end of the implementation period, the students were required to fill a reflection questionnaire in order to assess their learning experience with the AI-boosted interactive e-book. The data of reflection were descriptively analyzed in 23 version of SPSS, and the outcomes are shown in Table 3.

Table 3. Descriptive Statistics – Student Reflection of AI-integrated e-book

	N	Mean	Median	Minimum	Maksimum	SD	IQR
Analysis of Students's reflection on AI integrated e-book	58	76.2	79.5	39	90	13.7	19

The data indicate that student feedback had a mean score of 76.22 and a median of 79.50, with a relatively wide distribution (SD = 13.71; range = 51). Overall, most students provided positive feedback on the AI-integrated e-book program for English for Specific Purposes (ESP) in healthcare, although there was considerable variation across individual responses.

Qualitative comments on open-ended questions also provided richness to the assessment:

1) 1Preferred features: access flexibility, sensitivity of AI chatbot, provision of interactive pronunciation and grammar check, and contextualization of medical English words.
2) Problems mentioned: fluctuating internet connection for impacting audio-based AI capabilities, question constraint on chatbot option, and need for more heterogeneous multimedia (video/audio).
3) Suggestions for improvement: adding the voice interaction of the AI to finish Indonesian–English functionality, adding more comprehensive multimedia assets, and adding more varied case scenarios.

They are in line with previous studies on the motivational and pedagogical advantages of AI-assisted learning tools (Hapsari & Wu, 2022; Tapalova & Zhiyenbayeva, 2022). The technical problems that have been noted will inform development improvement for the second cycle of development, such as feature stability improvement, improvement of AI functionality, and diversity of interactive content.

Fig. 5. Average Score of Students' Reflection

3.2. Discussion

The current results align with previous studies on learning innovations involving e-books and AI. The incorporation of interactive digital books with tasks that require higher-order thinking skills, as shown by Sianturi et al (2021), highlights the ability to enhance cognitive involvement in ESP settings. Likewise, AI-powered customized and adaptive learning frameworks noted by Sajja et al (2023), and Goel (2020) correspond with the adaptive pathways utilized in the present AI-augmented e-book. In the design of ESP curricula, the bilingual and collaborative learning methods outlined by Asrifan et al (2025) provide additional backing for incorporating AI to

promote language proficiency and collaboration. Furthermore, the generative AI model for intelligent tutoring described by Maity and Deroy (2024) alongside the AI in Education 5.0 framework proposed by Ari Irvan et al (2024) offer conceptual support for enhancing the system's future functionalities. Zawacki-Richter et al (2019), Fontaine et al (2019), and Komolafe et al (2025) underline the effectiveness of adaptive e-learning in training healthcare professionals, whereas advances in virtual patient simulation (Shaw et al., 2025) and (Nofal et al., 2025) showcase wider application opportunities. Ultimately, the incorporation of smart interactive multimedia in e-healthcare (Tyagi et al., 2021) strengthens the significance of multimodal resources, a concept already integrated into the e-book's existing design.

The findings from the needs analysis indicated a robust and uniform interest in AI-assisted instructional tools among students, curriculum stakeholders, and ESP instructors. This agreement aligns with earlier findings that technology-enhanced learning settings are both sought after and progressively anticipated in higher education (Haryani, 2025; Šokčević, 2024). This research builds on previous findings by incorporating viewpoints from various stakeholders, thus reinforcing the case for adoption at the curriculum level.

The development and design stage produced an interactive e-book enhanced by AI, featuring adaptive learning, a chatbot based on NLP, and capabilities for speech recognition. This integration surpasses previous studies that typically focused on an individual AI tool (such as chatbots or adaptive platforms alone) by merging various AI capabilities into a single platform (Tapalova & Zhiyenbayeva, 2022; Chang et al., 2023). This design corresponds with ongoing demands for multimodal and tailored learning routes (Hapsari & Wu, 2022) and shows that R&D-driven instructional design can convert theoretical models into practical, user-focused solutions for ESP.

The execution and evaluation phase yielded compelling proof of enhancement: the median speaking scores of students rose from 11 in the pre-test to 19.5 in the post-test, with the Wilcoxon Signed-Rank Test validating statistical significance ($p < 0.05$). This increase is significantly greater than in certain earlier research on AI-driven platforms (Gutiérrez, 2023). The finding indicates that combining adaptive learning, chatbots, and speech recognition could have complementary impacts on the speaking advancement of learners. Still, the differences noted in learning gains—where some students exhibit minimal or even adverse progress—underscore the necessity for customized assistance and deeper exploration of engagement trends among learners.

The refinement and evaluation process also showed that learners preferred the e-book since it was available, pertinent, and autonomous-enabling in nature, as indicated by high general scores for reflection ($M = 76.22$). However, open-ended remarks exposed continued problems in the form of unstable internet access, chatbot limitation, and a greater need for multimedia input. These are in agreement with earlier work on infrastructural and technical challenges in implementing AI (Du & Gao, 2022) and emphasize that the quality of AI-supported learning is contextual factors outside of content design that mediate.

Pedagogically, the implication of the findings has a two-fold impact. First, ESP teachers can deploy AI-capable e-books as additional learning materials to respond to the ongoing problem of learning medical terminology and real-life speaking practice. Second, curriculum planners can see the integration of such AI-capable learning materials as part of organizational efforts to improve ESP instruction in health-related areas. Notably, scalability and sustainability require ongoing improvement, technical assistance, and teacher capacity development, in harmony with organizational preparedness in AI implementation (Amiri et al., 2024).

Finally, this study is not without limitations. The sample was restricted to one institution and a relatively small cohort of health science students, limiting generalizability. The reliance on self-reported reflections also introduces potential response bias. Future studies could expand to multi-institutional settings, include longitudinal tracking, and employ mixed measures of engagement and performance. Furthermore, ethical considerations regarding data privacy and responsible AI use should be more explicitly addressed in subsequent research.

Overall, this study contributes by demonstrating that an AI-enhanced interactive e-book can serve as a feasible and effective medium for ESP learning in healthcare, while also exposing practical and pedagogical challenges that need to be addressed to ensure broader adoption.

4. Conclusion

This research aimed to create, execute, and assess an AI-powered interactive e-book for English for Specific Purposes (ESP) within the health sciences, catering to the requirements highlighted in the preliminary analysis and the goals specified in the intro. The findings showed notable enhancements in students' speaking skills, favorable user approval, and a strong alignment between the developed resources and learners identified needs, validating the anticipated advantages mentioned initially. At the same time, the study revealed variability in individual performance and technical constraints, such as internet stability and chatbot limitations, which should be considered in future iterations. Beyond confirming the effectiveness of the intervention, the results highlight practical implications for ESP instructors and curriculum designers, while also pointing to the potential of scaling this model across other ESP domains and health-related programs. Future advancements should concentrate on improving feature consistency, broadening multimedia and language capabilities, and implementing this model in wider educational settings to boost accessibility and increase learner involvement.

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Declarations

Author contribution	:	Surip Haryani was responsible for the entire research project. He also led the writing of the manuscript and the collaboration with the second author. Maulida Rahmawati Emha participated in the data collection, transcription and analysis. She also revised the manuscript. Both authors approved the final manuscript.
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