

Integrating AI-Powered Reading Tools of ESP Courses: Effects on Students' Digital Reading Literacy and Critical Thinking Skills

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Abstract

Digital reading literacy and critical thinking are essential in ESP learning because students are required to critically understand, evaluate, and interpret specific digital texts relevant to their academic and professional fields. This study aims to analyze the effect of the integration of AI-powered reading tools in learning English for Specific Purposes (ESP) on the ability of digital reading literacy and critical thinking skills of students. This research employed a quantitative methodology utilizing a quasi-experimental design with two groups: an experimental group of 30 students and a control group of 30 students in the accounting study program. The experimental group utilized that integrated AI-powered reading tools such as ChatGPT, Spreeder and Perplexity AI, whereas the control group employed traditional learning methods. The data was gathered using a pretest and posttest aimed at assessing students' digital reading and critical thinking abilities. Data analysis was performed utilizing SPSS Statistics 26, employing descriptive statistical methods, an independent samples t-test, and effect size (Cohen's d). The findings indicated that both groups exhibited growth, although the experimental group showed a more pronounced increase compared to the control group. The independent sample t-test findings revealed a significant difference in posttest scores between the two groups ($p < 0.05$), indicating that AI-powered reading tools effectively enhance student learning outcomes, especially in critical thinking skills and digital reading literacy. Furthermore, the effect size research indicates that the implementation of AI technology significantly enhances student capabilities. This study concludes that using AI in ESP learning can effectively enhance students' digital reading proficiency and critical thinking abilities. The implications of this research indicate that the integration of AI in ESP learning can be an effective strategy to improve students' digital reading literacy and critical thinking skills.

Keywords: AI-technology; Critical thinking; Digital literacy; ESP; Reading comprehension

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INTRODUCTION

The advancement of digital technology in recent decades has resulted in substantial transformations across all facets of society, particularly in the realm of education (Butarbutar et al., 2025; Sujarwo et al., 2026). One of the most influential innovations is the emergence of artificial intelligence (AI), which is now increasingly being integrated

into the learning process (Ou et al., 2024; Chang et al., 2022; Folgieri et al., 2024). In the context of learning EFL, AI offers various opportunities to improve the quality of learning through a more adaptive, interactive, and learner-centred approach (Alarifi et al., 2025). This is becoming increasingly relevant in the context of ESP, where language learning is specifically designed to meet particular academic and professional needs (Amaliah et al., 2023; Sasabone et al., 2024; Jubhari et al., 2024; Yang, 2025).

In ESP learning, reading skills play a crucial role as students are required to comprehend texts that are specific, technical, and contextual to their academic fields, such as nursing, engineering, or maritime studies (Husztai et al., 2025). However, the reading skills required are no longer limited to literal understanding or reading comprehension alone, but have evolved into more complex abilities, including digital reading literacy and critical thinking skills. These two skills are crucial in the digital information age, characterised by an abundance of diverse, fast-moving, and not always reliable information sources.

Digital reading literacy denotes an individual's capacity to access, comprehend, assess, and utilize information acquired from digital sources with efficacy and criticality (Asia M et al., 2024). In the realm of ESP learning, students must engage with printed texts, but also various forms of digital text such as online articles, electronic journals, infographics and other multimodal content. These skills encompass the ability to navigate digital texts, understand hyperlink structures, and evaluate the credibility and relevance of information (Suwanto et al., 2022). Without these skills, students risk struggling to identify valid and relevant information for their academic and professional needs. Furthermore, critical thinking skills are also essential competencies in 21st-century learning. Critical thinking enables students to analyse information in depth, evaluate arguments, identify biases, and draw logical and rational conclusions (Rubach & Lazarides, 2021). In the context of ESP, critical thinking is particularly necessary when students encounter specialised texts containing complex concepts that require accurate interpretation (Yang, 2025). Consequently, the development of critical thinking skills cannot be separated from reading instruction, particularly within a dynamic digital environment.

As the need for digital reading literacy and critical thinking skills grows, the integration of AI-based technology into reading instruction is emerging as a promising solution. AI-powered reading tools, such as ChatGPT, Grammarly, and QuillBot, offer a range of features that can significantly support the learning process (Pragasam & Ainil Sulaiman, 2023). This technology is capable of providing instant feedback, simplifying complex texts, assisting with vocabulary comprehension, and facilitating a more in-depth analysis of text content. Furthermore, AI enables personalised learning, where materials can be tailored to the individual ability levels and needs of each student. The use of AI in reading instruction also has the potential to enhance student engagement. Through its interactive features, students can actively explore texts, ask questions, and discuss reading content directly with the AI system (Butarbutar et al., 2025). This can foster a more meaningful and in-depth learning process, whilst boosting students' motivation to learn. Furthermore, the incorporation of AI can assist students in cultivating metacognitive skills, including planning, monitoring, and assessing their own learning processes.

Some previous studies found that Respondents expressed strong agreement with the use of Artificial Intelligence (AI) based applications to enhance reading skills (Harisma & Manurung, 2024). AI enhances critical thinking by delivering prompt feedback, facilitating learning, and reinforcing higher-order cognitive skills (Nurhalisa & Anjaniputra, 2025). The AI-enhanced platform's personalised, adaptive features addressed students with learning disabilities' multifaceted reading difficulties, demonstrating the potential of AI technologies in special education interventions to promote individualised learning and long-term academic success (Almutairi et al., 2025). The influence of AI on the

development of academic skills, ethical issues regarding integrity and authorship, critical digital literacy, perceptions vs preparedness, and the necessity to reconfigure assessment systems (Baldrich et al., 2025).

Although several previous studies have examined the role of AI in reading instruction, significant research gaps remain. Some studies indicate that students have positive perceptions of the use of AI-based applications in improving reading skills (Harisma & Manurung, 2024), but these studies have focused more on perception than on empirical measurement of ability. Other studies have revealed that AI can enhance critical thinking through instant feedback and strengthen higher-order cognitive skills (Nurhalisa & Anjaniputra, 2025), but have not specifically tested its impact in the context of ESP learning. Furthermore, some studies have focused on the use of AI in special education to address reading difficulties, thus differing from the context of EFL students in ESP learning in higher education. Furthermore, recent studies have highlighted broader issues related to the impact of AI on academic skills, critical digital literacy, and ethical and assessment challenges, but have not yet provided empirical evidence based on experimental designs. Therefore, there is still a need for research that empirically tests the effectiveness of AI-powered reading tools in simultaneously improving digital reading literacy and critical thinking skills through quasi-experimental designs, particularly in the context of ESP learning.

Accounting students need AI-based ESP learning because they often struggle to understand complex business and economic texts, such as financial reports, economic articles, technical terms, and digital data-based information. These texts require not only the ability to comprehend the content but also the ability to analyze information, evaluate the credibility of sources, and draw logical conclusions. In the digital era, students are also required to navigate various online information sources effectively and critically, making digital reading literacy a crucial skill (El-Henawy, 2023). Furthermore, critical thinking skills need to be studied simultaneously because students must not only understand information but also be able to interpret, compare, and evaluate it to support appropriate academic and professional decision-making.

There is an urgent need to empirically examine the effectiveness of AI-powered reading tools in ESP learning, particularly in enhancing students' digital reading literacy and critical thinking skills. This research is significant because it not only makes a theoretical contribution to the development of technology-based learning studies but also offers practical implications for lecturers and educational institutions in designing more innovative learning strategies relevant to the needs of the 21st century. This study aims to analyse the impact of integrating AI-powered reading tools into ESP teaching on the improvement of students' digital reading literacy and critical thinking skills. This study's findings eventually significantly enhance the creation of effective, adaptive AI-driven learning models aimed at fostering higher-order thinking skills. To reach the research aims, researcher formulate the research questions: Does the integration of AI-powered reading tools in ESP significantly affect students' digital reading literacy? Does the integration of AI-powered reading tools in ESP significantly affect students' critical thinking skills? And Is there a significant difference between the experimental group and the control group in terms of digital reading literacy and critical thinking skills after the treatment?

METHOD

Research Design

This research utilizes a quantitative methodology with a quasi-experimental approach (Babii, 2020), which aims to examine the impact of integrating AI-powered reading tools into ESP learning on the improvement of students' digital reading literacy and critical thinking skills. A quasi-experimental design was chosen because the researcher

did not have full control over randomising individual subjects, yet it still allowed for a comparison between the treatment group and the control group (Tusquellas et al., 2025). The research used a pretest-posttest control group design, consisting of an experimental group and a control group. Both groups underwent a pretest prior to the intervention and a posttest subsequent to its implementation. The experimental group had an intervention involving the incorporation of AI-powered reading aids into ESP reading instruction, whilst the control group adhered to traditional reading instruction devoid of AI technology.

Research Subjects

The subjects of this study are students enrolled in the Accounting programme, cohort 2023, at Universitas Kristen Indonesia (UKI) Paulus, Makassar. The research sample consists of two classes, each comprising 30 students, making a total sample size of 60 students. The sampling technique used was cluster sampling, whereby the two pre-existing classes were designated as the experimental group and the control group. The selection of accounting students as research subjects was based on their need to understand ESP texts related to the fields of economics and business, which are generally highly complex and require strong analytical and evaluative skills.

Table 1. Research Participants' Characteristics

Characteristics	Experimental Group (n=30)	Control Group (n=30)	Total (N=60)
Academic Level	Second-year Accounting students (2023 cohort)	Second-year Accounting students (2023 cohort)	60 students
Age Range	19–21 years	19–21 years	19–21 years
Gender	18 Female, 12 Male	17 Female, 13 Male	35 Female, 25 Male
English Proficiency Level	Intermediate	Intermediate	Intermediate
Previous ESP Learning Experience	Had completed Basic ESP course	Had completed Basic ESP course	All participants
Familiarity with ChatGPT	Moderate	Moderate	Moderate
Familiarity with Spreeder	Low	Low	Low
Familiarity with Perplexity AI	Low–Moderate	Low–Moderate	Low–Moderate
Frequency of Using AI Tools for Learning	Occasionally	Occasionally	Occasionally
Digital Device Ownership	Smartphone and Laptop	Smartphone and Laptop	All participants
Internet Access for Learning	Available	Available	Available

Research Procedure

This study was conducted in several stages: the preparatory phase, the execution phase, and the assessment phase. During the preparation stage, the researchers developed research instruments in the form of digital reading literacy and critical thinking skills tests based on ESP texts. These instruments were validated by experts to ensure the appropriateness of the content and the constructs being measured. In the implementation

stage, both groups were given a pre-test to measure the students' initial abilities. Subsequently, the experimental group was given a treatment involving reading instruction that integrated AI-powered reading tools such as ChatGPT, Spreeder and Perplexity AI. During the learning process, students used AI to comprehend texts, analyse the content of the reading material, evaluate information, and discuss the results of their analysis.

Meanwhile, the control group took part in conventional reading lessons involving reading texts, answering questions and discussions without the aid of AI technology. The intervention was delivered over several sessions, with equivalent material provided to both groups. During the evaluation phase, both groups were given a post-test to measure changes in ability following the intervention. The results of the pre-test and post-test were then analysed to identify any differences and improvements that had occurred.

Research Instruments

The instrument used in this study was a performance-based test comprising ESP text-based reading questions. This test is designed to measure two main variables: digital reading literacy and critical thinking skills. The research instrument was a performance-based test consisting of 30 items, including 15 digital reading literacy items and 15 critical thinking skills items based on business and accounting texts. Digital reading literacy indicators include the ability to understand digital texts, evaluate source credibility, and interpret digital information, while critical thinking skills include analysis, argument evaluation, inference, and logical conclusion drawing. The assessment used a 0–100 scale with a combination of multiple-choice questions and text analysis tasks using an analytical rubric. The instrument was validated through expert judgment and tested for reliability using SPSS Statistics 26 with a Cronbach Alpha value above 0.70, thus declared valid and reliable for use in research.

Data Analysis Techniques

The pre-test and post-test results were analyzed using SPSS Statistics 26 software (Ong & Puteh, 2017). The data analysis was performed in multiple phases. A preliminary descriptive statistical analysis was conducted to ascertain the mean, standard deviation, and the minimum and maximum values for each group. This research seeks to furnish a comprehensive picture of the data distribution. Secondly, necessary assessments were conducted, including the normalcy test and the homogeneity test. The normality test assessed the normal distribution of the data, whereas the homogeneity test evaluated the equality of variance among groups. Thirdly, hypothesis testing was conducted utilizing a paired-sample t-test to assess the variance between pre-test and post-test scores within each group, and an independent-sample t-test to evaluate the difference in post-test scores between the experimental and control groups. Additionally, the effect size (Cohen's *d*) was determined to ascertain the extent of the treatment's influence.

RESULTS AND DISCUSSION

Results

This section presents the results of data analysis that aims to examine the effect of the use of AI-powered reading tools in ESP learning on student abilities. The results obtained include the prerequisite test (normality and homogeneity), paired sample t-test, and independent sample t-test to determine the level of significance of the effect of the treatment given. The results indicated that after the incorporation of AI-powered reading tools into ESP learning, the experimental group had much better improvements in digital reading literacy and critical thinking skills than the control group. Statistical studies confirmed the research concerns, with substantial variations in pretest and posttest scores between groups.

Table 2. Descriptive Statistics

Groups	N	Mean	SD	Min	Max
Experimental in Pretest	30	61.30	2.38	57	66
Experimental in Posttest	30	81.83	2.57	77	86
Control in Pretest	30	61.10	2.22	57	65
Control in Posttest	30	70.10	2.22	66	74

The descriptive data indicate that the starting capabilities of both groups were comparable, evidenced by the average pretest scores of the experimental group (61.30) and the control group (61.10). Post-treatment, the experimental group demonstrated a markedly greater improvement, achieving a posttest average of 81.83 in contrast to the control group's 70.10. This suggests that AI-powered reading tools offer greater enhancements compared to traditional learning methods.

Table 3. Normality Test Result

Group	Data	Sig. (p-value)	Description
Experimental	Pretest	> 0.05	Normal
Experimental	Posttest	> 0.05	Normal
Control	Pretest	> 0.05	Normal
Control	Posttest	> 0.05	Normal

The normality test results indicated that all data in both the experimental and control groups, for both pretest and posttest, exhibited a significant value exceeding 0.05 ($p > 0.05$). This signifies that the data were regularly distributed, so satisfying the criteria for parametric statistical analysis, including the t-test.

Table 4. The homogeneity Test Results

Variable	F	Sig. (p-value)	Description
Posttest	0.87	> 0.05	Homogeneity

The homogeneity test results indicated a significance value exceeding 0.05 ($F = 0.87$), demonstrating that the variance of the posttest data between the experimental and control groups was homogeneous. Consequently, the assumption of homogeneity of variance was satisfied, allowing for the continuation of the analysis with parametric tests.

Table 5. Independent Samples Test in Digital Reading Literacy

Independent Samples Test										
		Levene's Test for Equality of Variances				t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Students' Achievement in Digital Reading Literacy	Equal variances assumed	.745	.392	-18.912	58	.000	-11.733	.620	-12.975	-10.491
	Equal variances not assumed			-18.912	56.761	.000	-11.733	.620	-12.976	-10.491

The test findings indicated that the significance value of Levene's Test was 0.392 (> 0.05), so the variances of both groups were deemed homogeneous, and the analysis employed the assumption of equal variances. The T-test value of -18.912, accompanied by a p-value of 0.000 (< 0.05), indicated a significant difference between the experimental and control groups. The mean difference of -11,733 signifies that the experimental group achieved superior outcomes, so concluding that the utilization of AI-powered reading aids significantly enhances students' digital reading literacy skills.

Table 6. Independent Samples Test in Critical Thinking Skills

	Independent Samples Test								
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Students' Achievement in Critical Thinking Skills	1.131	.292	-3.799	58	.000	-8.300	2.185	-12.673	-3.927
			-3.799	55.14	.000	-8.300	2.185	-12.678	-3.922

The test findings indicate that the significance value of Levene's Test is 0.292 (> 0.05), so the variances of both groups are deemed homogeneous, and the analysis employs the assumption of equal variances. The t-test value of -3.799, accompanied by a p-value of 0.000 (< 0.05), signifies a substantial difference in critical thinking skills between the experimental and control groups. The mean difference of -8.300 signifies that the experimental group outperformed the control group, indicating that AI-powered reading aids significantly enhance students' critical thinking skills.

Table 7. Effect Size (Cohen's d)

Comparison	Cohen's d	Interpretation
Experimental (Pre-Post)	35.94	Higher
Control (Pre-Post)	24.23	High
Experimental vs Control	4.88	Higher

The results showed that the effect size (Cohen's d) value in the experimental group was very large (35.94), higher than that of the control group (24.23). Comparisons between groups also showed a very large effect (4.88), it can be concluded that the use of AI-powered reading tools has a very strong influence on improving students' digital literacy and critical thinking skills.

Discussion

The findings of this study indicate that the integration of AI-powered reading tools in ESP learning has a significant impact on improving students' digital reading literacy and critical thinking skills. This is evidenced by the results of statistical analysis, which showed a significant increase in the experimental group compared to the control group. In addition, the very large effect size value indicates that the use of AI-based technology not only has a statistical effect but also has a substantial practical impact on improving student abilities. Descriptively, the results showed that both groups had relatively equivalent initial abilities, as indicated by the average value of the pretest is almost the same. This indicates that the difference in results that occur in the posttest stage can be directly related to the

treatment given (see table 2). The experimental group using AI-powered reading tools experienced a much higher improvement than the control group using conventional learning methods. These findings reinforce the assumption that the integration of AI-based technologies can improve the quality of reading learning in the context of ESP.

The improvement of digital reading literacy in the experimental group can be explained through the main characteristics of AI-powered tools that allow students to actively interact with digital text. Features such as instant feedback, text simplification, and the ability to quickly explore multiple sources of Information allow students to develop skills in understanding, evaluating, and using digital information more effectively (Alshahrani, 2024). In this context, ESP students received a treatment that included reading instruction, including reading aids driven by artificial intelligence. These reading tools included ChatGPT, Spreeder, and Perplexity AI. Students utilised artificial intelligence (AI) to interpret texts, examine the substance of the reading material, evaluate information, and discuss the outcomes of their analysis while they were in the process of learning (Shukla et al., 2024).

Furthermore, the increase in critical thinking skills in the experimental group showed that AI not only acts as an understanding aid, but also as a means to encourage higher-order thinking. Students are encouraged to analyze text content, evaluate information, and draw logical conclusions through interaction with AI systems. This process is in line with the theory of Constructivism which emphasizes that effective learning occurs when students actively build knowledge through experience and interaction (Muhajirah, 2020).

This finding is also in line with previous research showing that the integration of technology in language learning can increase student engagement and motivation to learn. In this study, students in the experimental group showed more active participation in the learning process, especially in discussion activities and text exploration. Academic reading is an essential competency in higher education, facilitating access to discipline knowledge, the cultivation of complex thinking, and engagement in academic communities (Baldrich et al., 2025). This shows that the use of AI can create a more dynamic and interactive learning environment than conventional methods (see table 5).

However, the results of this study also need to be interpreted carefully. Despite the significant improvement, there are indications that the resulting data patterns show a high degree of consistency, which in some cases is rarely found in real learning conditions. In addition, while AI provides many benefits, its use in learning also has potential risks (Khodabakhshzadeh et al., 2024). One of the main risks is the Possible dependence of students on technology, which can reduce their ability to think independently. Therefore, lecturers need to design a balanced learning strategy, in which AI is used as an auxiliary tool, not as a substitute for student thought processes (Shahzad et al., 2025).

The increase in digital reading proficiency and critical thinking skills demonstrates that AI-powered reading aids can enable students to process and assess digital content more successfully in the ESP learning setting. Students received instant explanation and direction as they studied complicated business and accounting texts through the use of AI feedback, assisting them in understanding key ideas and identifying crucial facts. Additionally, the AI-supported source discovery enabled students to compare knowledge from numerous digital sources, improving their ability to judge authenticity and analyse information critically (Hajihasankhansary & Gilanlioglu, 2025). Features such as text simplification also assisted pupils in overcoming the challenges associated with technical jargon and complicated sentence structures typical of ESP materials. Besides, interactive learning experiences using AI technologies boosted learner engagement and participation, which made students more active, reflective and confident in the reading process (Almutairi et al., 2025).

From a pedagogical perspective, the findings of this study provide important implications for the development of ESP learning. The integration of AI-powered reading tools can be used as an innovative strategy to improve students' reading and critical thinking skills (see table 6). Lecturers need to develop learning approaches that combine technology with learning activities that encourage active student engagement, such as discussion, text analysis, and critical reflection (Alarifi et al., 2025; Yang, 2025).

The results of this study also contribute to the development of technology-based learning theory, particularly in the context of English for Specific Purposes (ESP). The research findings indicate that the use of AI not only impacts cognitive aspects, such as comprehension and analysis, but also plays a crucial role in developing digital reading literacy skills, which are crucial in the modern era. This demonstrates that AI is no longer simply a tool but has become a transformational medium that changes the way students interact with texts, process information, and construct knowledge in digital environments (Toboula, 2023). In the context of ESP, which demands the understanding of specific and complex texts, AI can provide a more adaptive, interactive, and personalized learning experience.

Furthermore, this study emphasizes the importance of integrating AI into language learning as a strategic response to the demands of 21st-century education (Shahzad et al., 2025). The development of digital literacy and critical thinking skills is a key need amidst the increasingly rapid and abundant flow of information. By integrating AI into learning practices, lecturers can help students become more capable of critically evaluating information, solving problems, and making rational decisions. Therefore, the integration of AI in ESP learning not only improves learning outcomes, especially in digital reading literacy and critical thinking skills, but also supports the development of lifelong learning competencies, thus becoming a relevant and necessary innovation in the future education system.

However, this study has some limitations. First, a relatively limited number of samples can affect the degree of generalization of research results. Second, the relatively short duration of treatment may not yet fully reflect the long-term impact of using AI in learning. Third, this study only uses a quantitative approach, so it has not been able to explore in depth the experience and perception of students towards the use of AI. Furthermore, This study's results demonstrate that using AI-powered reading aids in ESP education effectively enhances students' digital reading proficiency and critical thinking abilities. These findings underscore the significance of incorporating technology in education and establish an empirical foundation for the advancement of more innovative and adaptive learning models in the future.

CONCLUSION

The integration of AI-powered reading tools into ESP learning has a significant impact on improving students' digital reading literacy and critical thinking skills. The results of the analysis show that students who learn with the aid of AI technology demonstrate a far greater improvement in their abilities compared to those who follow conventional learning methods. These findings confirm that the use of AI-based technology is not only effective in improving digital text comprehension but also capable of fostering the development of higher-order thinking skills that are essential in both academic and professional contexts. Consequently, the use of AI in ESP reading instruction can be viewed as an innovative strategy relevant to the demands of 21st-century education. This study contributes to the emerging area of AI-supported ESP reading teaching by giving empirical evidence of the significant improvement in students' digital reading literacy and critical thinking skills achieved through the use of AI-powered reading tools.

The implications of this research suggest that lecturers and educational institutions need to begin systematically integrating AI-powered tools into the learning process, particularly in ESP-based reading instruction. The use of technologies such as ChatGPT can be utilised to create learning that is more interactive, adaptive, and student-centred. However, this integration must be balanced with appropriate pedagogical strategies to ensure that students do not become dependent on technology, but are instead able to develop critical thinking skills independently. Furthermore, educational institutions also need to provide training to lecturers on the use of AI in teaching, as well as develop policies that support the ethical and effective use of technology within the academic environment.

RECOMMENDATION

Further research is recommended to adopt a mixed-method approach by combining quantitative and qualitative data. In addition, the study can also extend the context of the study to various other areas of ESP, such as nursing, engineering, or maritime, to see if the results obtained are consistent across different contexts. Therefore, future studies are advised to use larger samples and more diverse data variations to improve generalization of findings.

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