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Integrating Digital Tools in Project-Based Learning to Enhance Nursing Students' Critical Thinking Skills

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Abstract. Critical thinking is essential for nursing students to ensure evidence-based decision-making and safe clinical practice. However, many students struggle with English academic reading, which limits their ability to develop these skills. This mixed-methods study explored nursing students' perceptions of technology-assisted Project-Based Learning (PjBL) in enhancing critical thinking and collaboration. Thirty-five final-year nursing students engaged in group-based critical reading tasks using digital tools such as Google Translate and ChatGPT. Quantitative results showed significant improvement in critical thinking scores, rising from low (10) to medium-high levels (18–24), though progress was inconsistent. Qualitative findings revealed challenges related to limited vocabulary, grammar, and confidence, alongside benefits of collaborative learning and digital support. These findings align with Paul and Elder's intellectual standards and the community of inquiry framework, emphasizing the need for structured strategies that integrate technology, academic literacy, and affective support. Practical implications include incorporating guided critical reading, digital literacy training, and differentiated scaffolding into nursing curricula to prepare students for global healthcare contexts.

Keywords: *Academic Reading, Critical Thinking, Digital Tools, Nursing Education, Project-Based Learning*

INTRODUCTION

Critical thinking is increasingly recognized as an essential skill for nursing students and professionals, with a growing body of research emphasizing its importance in nursing education and clinical practice(Falcó-Pegueroles et al., 2021). Over the last five years, critical thinking and its disposition have been incorporated as a core element of nursing curricula to enhance decision-making and patient care(İlaslan et al., 2023). The National League for Nursing (NLN) and the American Association of Colleges of Nursing (AACN) mandate that critical thinking should be assessed as a key indicator of

the quality of nursing education programs (Malone et al., 2024). As a result, many previous studies have proposed various strategies to promote critical thinking in nursing education, including questioning, reflective writing, case-based interventions, and other innovative teaching methods (Li et al., 2019). These approaches aim to foster critical thinking skills, which are fundamental for effective decision-making and providing high-quality care in nursing practice. The advancement of digital technology has significantly reshaped the landscape of education, including nursing education(Dicheva et al., 2023).

Project-Based Learning (PjBL), supported by digital technologies, is increasingly being utilized to enhance critical thinking and collaborative skills among nursing students (Lee et al., 2024). These skills are crucial in contemporary nursing practice, where analytical abilities, evidence-based decision-making, and teamwork are required to address complex clinical scenarios(Xie et al., 2025). However, despite the growing adoption of digital technology in PjBL, challenges remain regarding its integration, particularly in fostering an optimal learning experience that promotes the development of students' critical thinking and collaboration skills (Eswaran, 2024). While many studies have explored the benefits of digital technology and PjBL in nursing education (Meum et al., 2021) there is still a gap in understanding how these technologies specifically influence nursing students' perceptions of their learning experiences in terms of critical thinking and collaboration.

Furthermore, proficiency in English is becoming increasingly important for nursing students, as it enhances both academic performance and communication in diverse healthcare settings (Alqahtani, 2022). English for Specific Purposes (ESP), particularly tailored to nursing contexts, has been shown to improve students' ability to understand medical texts, write case reports, and engage in professional discussions (Lu, 2018). However, many nursing students face challenges in mastering English due to limited exposure and practice opportunities throughout their studies. To address this, it has been recommended that nursing curricula incorporate targeted English language training alongside core competencies such as critical thinking (Barton et al., 2018). This integrated approach would better prepare students for the globalized healthcare environments in which English proficiency is often indispensable. Despite the advances in and the integration of digital technology, there remains a significant research gap in examining nursing students' perceptions of these experiences, particularly in how technology-assisted PjBL influences the development of critical thinking and collaboration skills (D. Zhang & Hwang, 2023). This study seeks to fill this gap by exploring nursing students' perceptions of their experiences with digital technology-assisted PjBL, focusing on its impact on their critical thinking and collaborative learning abilities. Thus this study addresses the following research questions:

1) How do nursing students perceive their experiences with digital technology-assisted PjBL in terms of developing critical thinking skills?

2) What are the perceived benefits and challenges of collaborative learning in a digital technology-assisted PjBL environment?

The research exploring nursing students' perceptions of their experiences with digital

technology-assisted Project-Based Learning (PjBL) in terms of developing critical thinking skills offers several significant contributions and novelties to the field of nursing education. First, it provides valuable insights into the students' subjective experiences with the integration of digital tools in their learning process, specifically in relation to enhancing critical thinking abilities. By focusing on students' perceptions, this study fills a gap in the literature that often prioritizes academic outcomes over individual learner experiences. It offers a deeper understanding of how digital technology-supported PjBL environments can foster critical thinking skills, which are essential for decision-making and patient care in nursing practice. Furthermore, this study contributes to the growing body of research on how digital tools can be effectively used to enhance nursing education by bridging the gap between theoretical knowledge and clinical practice, ensuring students are better prepared for real-world challenges. In addition to investigating critical thinking development, the second research question on the perceived benefits and challenges of collaborative learning in a digital technology-assisted PjBL environment brings novelty by examining the dynamic interaction between technology and collaborative learning in nursing education.

This research explores the multifaceted role of collaboration in PjBL, shedding light on how digital technology can facilitate teamwork, communication, and problem-solving among nursing students. The novelty of this research lies in its focus on the perceived advantages and drawbacks of digital collaboration in a nursing context, an area that has not been comprehensively addressed in prior studies. By examining the nuances of collaborative learning through digital platforms, this study uncovers not only the positive outcomes such as enhanced teamwork and peer support but also the potential challenges, such as technological limitations and interpersonal conflicts. These findings are crucial for informing the design and implementation of future PjBL initiatives in nursing programs, ensuring that digital tools are used to create effective and engaging collaborative learning experiences. Thus, this research contributes to the ongoing conversation about the integration of digital technology in nursing education by exploring how it impacts both critical thinking and collaborative learning. It provides practical implications for educators and curriculum developers by highlighting the benefits and challenges of technology-assisted PjBL. Additionally, the study offers recommendations for refining PjBL strategies and digital tools to better support nursing students in developing essential skills required for effective nursing practice in the modern, technology-driven healthcare environment.

Collaborative critical thinking (CCT) skills are increasingly recognized as a fundamental component of nursing education, as they align with the profession's requirement for swift, accurate decision-making within a collaborative clinical context (Eskiyurt & Özkan, 2024). Nursing practice demands that professionals not only possess strong individual clinical knowledge but also engage in effective teamwork, making CCT an essential competency (Barton et al., 2018).The ability to work collectively in decision-making, especially in high-pressure environments, is crucial in ensuring patient safety and optimizing care outcomes (Sung & Hsu, 2025). By incorporating collaborative

critical thinking into nursing curricula, educational programs can better prepare students for the real-world demands Xie et al., (2025) they will face in clinical settings, where interdisciplinary collaboration and rapid problem-solving are the norms (Boon et al., 2019). Drawing on the Community of Inquiry framework established by Q. Zhang et al., (2025) CCT is conceptualized as a reflective and rational cognitive process that emerges from social interactions in a collaborative learning environment. This model highlights the synergistic relationship between three critical elements: cognitive presence, social presence, and teaching presence (Parrish et al., 2021). Cognitive presence refers to the extent to which learners are able to construct meaning and engage in deep thinking during the learning process(Al Mamun & Lawrie, 2024). Social presence encompasses the ability of participants to express themselves and establish relationships within the group, fostering a sense of community and trus (Kreijns et al., 2022). Teaching presence involves the facilitation and guidance provided by educators to ensure that the learning process remains focused and effective (Rapanta et al., 2020).Together, these dimensions contribute to the overall effectiveness of collaborative learning, enabling students to engage in critical dialogue, challenge assumptions, and refine their thinking through peer interactions and instructor guidance(Gillies, 2019).In nursing education, this framework is especially pertinent, as students are not only required to understand nursing theory but also to apply that knowledge in real-world clinical settings, often under pressure and in collaboration with a team of professionals(Hashemiparast et al., 2019).

Critical thinking in nursing encompasses various skills, including analysis, inference, evaluation, and explanation (Cui et al., 2018). The collaborative application of these skills in a group setting fosters a dialogic process that enhances the quality of decision-making (Qudrat-Ullah, 2025). This is particularly important in nursing, where decisions must be made quickly and are often complex, involving multiple perspectives. Technology-enhanced learning environments offer unique opportunities for students to engage in collaborative critical thinking (Su & Zou, 2022). Online platforms facilitate discussions where students can critically evaluate peer arguments, share diverse perspectives, and revise their views based on feedback (Oh et al., 2018). This dynamic allows students to refine their problem-solving strategies through the exchange of ideas, fostering a deeper understanding of nursing concepts and their practical applications (Al-Omari et al., 2024).Feedback mechanisms within these platforms also play a critical role in supporting the development of reflective thinking, allowing students to reconsider their assumptions and approach problems from new angles (Montebello et al., 2018). The ability to measure CCT within digital learning environments is essential for evaluating the success of technology-based pedagogical approaches (Tang, 2025). Parameters that can be used to assess CCT include the quality of collaborative interactions, the meaningfulness of discussions, the ability to engage in reflective thinking, and the sense of ownership over collective decisions (Borge et al., 2018).These indicators help educators understand the effectiveness of technology-assisted collaborative learning in fostering critical thinking skills among nursing students (Su & Zou, 2022). In nursing education, CCT not only serves as a tool for academic learning

but also as a vital skill for solving clinical problems in teams(Yeung et al., 2023). By developing these skills, nursing students are better prepared to contribute to decision-making processes in real-world clinical scenarios, where collaboration is key to ensuring optimal patient outcomes(Vázquez-Calatayud et al., 2024). Therefore, measuring and enhancing CCT through digital technology and project-based learning approaches offers significant potential to improve nursing education and practice.

Project-Based Learning (PjBL) has emerged as a highly effective pedagogical strategy for fostering key competencies essential for the 21st century, including communication,collaboration, and problem-solving skills(AlAli, 2024). Characterized by its learner-centered and project-oriented approach, PjBL unfolds over an extended period and culminates in the creation of a meaningful end product(Peeters et al., 2025). In nursing education, this approach holds particular significance, as it seamlessly integrates theoretical knowledge with clinical practice and interpersonal skills, preparing students for the complex, interdisciplinary demands of healthcare(Berndtsson et al., 2020). Through PjBL, nursing students are provided with opportunities to engage in real-world tasks such as designing evidence-based interventions, developing nursing care scenarios, and organizing public health education campaigns(Xie et al., 2025). These assignments enable students to apply their knowledge in practical, hands-on contexts, reinforcing the link between classroom learning and professional practice (Spaan et al., 2024).

The core dimensions of Project-Based Learning (PjBL) include the formulation of a driving question or authentic problem (Miller & Krajcik, 2019), active inquiry through investigation (Wale & Bishaw, 2020), collaboration among students (Gratton, 2019), the creation of tangible products [(Schönsleben, 2019), and reflection and revision (McGahan, 2018). Each of these elements plays a critical role in ensuring that PjBL fosters meaningful learning (Basri et al., 2024). For instance, the driving question prompts students to engage deeply with the material, while the investigative nature of the approach encourages them to explore solutions creatively (Sasson Lazovsky et al., 2025). Collaborative work within teams further strengthens students' ability to communicate and share ideas, which is vital in the healthcare setting where teamwork is essential (Fox et al., 2018). Additionally, the creation of tangible products not only ensures that students apply their learning in a practical context but also provides them with concrete outcomes that they can present and reflect upon (Molderez & Fonseca, 2018). Reflection and revision, which are integral to the PjBL process, allow students to refine their ideas and approaches, fostering continuous improvement(Eswaran, 2024). Importantly, PjBL supports the early development of professional identity, helping students see themselves as active participants in the healthcare field(Tsybulsky & Muchnik-Rozanov, 2019),while simultaneously promoting self-regulated learning, where students take responsibility for the progression of their project (Wu, 2024). The emphasis on collaboration and constructive feedback is essential in shaping students' professional skills and preparing them for the challenges they will encounter in clinical practice (Kourgiantakis et al., 2019).

Student perceptions of Project-Based Learning (PjBL) can be assessed through emotional and cognitive engagement (Schaddelee & McConnell, 2018), the perceived relevance of the project to real-world applications, and their perceptions of how PjBL enhances critical thinking skills (Song et al., 2025). Understanding these perceptions is critical to evaluating the effectiveness of PjBL in nursing education. Studies consistently indicate that when PjBL is implemented, students exhibit increased knowledge retention, higher levels of learning satisfaction, and improved problem-solving abilities(L. Zhang & Ma, 2023). These findings highlight the significance of PjBL as an effective pedagogical approach in nursing education, particularly in terms of its impact on students' critical thinking and practical problem-solving skills (Yeung et al., 2023). As such, understanding student perceptions of PjBL provides valuable insights into how well this approach supports the learning outcomes that nursing programs strive to achieve (Schaddelee & McConnell, 2018). By gathering and analyzing these perceptions, educational institutions can better refine and adapt their teaching strategies to ensure that PjBL continues to meet the evolving needs of nursing students and the healthcare profession at large(Lee et al., 2024).

Advancements in digital technology have profoundly transformed educational practices, particularly in the implementation of Project-Based Learning (PjBL)(Atanasova & Minkova, 2023). In this context, digital technology functions not merely as a technical tool but also as a mechanism for cultivating a more expansive and flexible collaborative learning environment (Fischer et al., 2020). Technologies such as Learning Management Systems (LMS), collaborative applications like Google Docs, Trello, Miro, and online discussion platforms like Zoom and Microsoft Teams facilitate student interactions across both temporal and spatial boundaries (Yadav & Bondre, 2025). These tools allow students to collaborate more efficiently, access materials remotely, and communicate seamlessly, thus enriching the overall learning experience. According to Wang incorporating visual, verbal, and interactive elements into learning is linked to enhanced conceptual understanding and increased cognitive engagement, which are essential for fostering deep learning (Wang et al., 2018). This capability is especially beneficial in PjBL, where the collaborative nature of learning and real-world problem-solving are key components.

In nursing education, the integration of digital technology extends beyond traditional classroom settings to simulate clinical cases, document care processes, and facilitate interdisciplinary project management (da Silva Tiago & Mitchell, 2024). The effective use of digital technology in this context supports various dimensions, including accessibility, usability, engagement, and collaboration enhancement(Meesad & Mingkhwan, 2024). For example, simulation tools can replicate complex clinical scenarios, allowing nursing students to practice decision-making and problem-solving skills in a controlled virtual environment (Jans et al., 2023). Additionally, collaborative platforms provide a space for students to work together on projects, exchange ideas, and offer constructive feedback, regardless of their physical location (Al-Samarraie & Saeed, 2018). Research by Kuru suggests that students generally hold positive perceptions of

technology integration in their learning experiences, especially when the systems in place promote active participation, open communication, and access to comprehensive learning resources (Kuru Gönen, 2019). This aligns with the broader shift toward digital tools in education, which have been shown to enhance engagement and support flexible learning approaches, making them highly relevant in the context of nursing education. Students' perceptions of the utilization of digital technology can be assessed through several parameters, including beliefs about the effectiveness of communication, ease of coordination, availability of feedback, and the extent to which technology enhances learning outcomes (Panigrahi et al., 2018). These perceptions are critical in evaluating the success of digital tools in PjBL and are particularly relevant in the post-pandemic educational landscape, where hybrid and flexible learning modalities have become essential(Tyagi et al., 2023). For nursing students, these perceptions are crucial because they influence how effectively digital tools can facilitate collaboration and critical thinking in project-based learning environments. Understanding these perceptions is key to developing effective and sustainable educational strategies that not only integrate digital technology but also foster critical thinking, collaborative skills, and engagement. As nursing education continues to evolve, comprehending how students interact with and benefit from digital technology will guide the development of future teaching methods and ensure that nursing curricula meet the needs of both students and the healthcare industry (Suryani et al., 2024).

METHOD

This study employed a mixed-methods design, integrating both quantitative and qualitative approaches to achieve a comprehensive understanding of nursing students' experiences with digital-technology-assisted Project-Based Learning (PjBL). A total of 35 final-year nursing students from an Indonesian health sciences institute participated through convenience sampling, organized into six groups of five to six members. From May to June 2025, students engaged in a series of structured critical-reading tasks involving international journal articles. Digital tools, including Google Translate, ChatGPT, Auris, and Speed Audio, were utilized to support reading comprehension and vocabulary development. Quantitative data were collected using a rubric adapted from Paul and Elder's (2007) intellectual standards, which assessed accuracy, clarity, precision, depth, relevance, and logic. This rubric enabled researchers to track changes in students' critical-thinking performance across various reading tasks. Qualitative data were obtained through semi-structured interviews conducted in Indonesian to mitigate linguistic barriers and facilitate open reflection. These interviews provided deeper insights into the challenges and perceptions of students while engaging with English academic texts and digital tools. All data were systematically analyzed, with numeric scores employed to observe developmental patterns in critical thinking, while thematic analysis of interview transcripts facilitated the identification of recurring issues such as limited vocabulary, grammatical difficulties, lack of confidence, and reliance on

translation tools. Collectively, these methodologies offered a rich description of how technology-enhanced PjBL influenced students' learning, see Table 1.

Table 1. *level of critical thinking*

Standards & Elements	1	2	3	4
Accuracy (Ac) : Understanding the main objectives	Significantly imprecise, characterized by erroneous or ambiguous objectives.	The low accuracy of the stated objectives is a misrepresentation.	Some accuracy in purpose, but with subtle inaccuracies.	Total accuracy and explicit intent
Clarity (Cl) : Comprehending factual information, data, or evidence-based examples.	Without the inclusion of empirical data, factual evidence, or comprehensible specifics.	Inadequate or insufficient utilization of evidence, data, or illustrative examples derived from the reading material.	Minimal use of facts, information, or reading examples	Frequently use facts, data, or examples from the reading correctly.
Precision (Pre): Categorization and utilization of reading materials and specialized vocabulary	Refrain from employing specialized terminology in the reading material.	The accuracy is low, although there is an attempt to employ specialized vocabulary, it is used incorrectly or with minimal effectiveness	Some degree of accuracy, utilizing precise terminology relevant to the subject matter, may facilitate accurate paraphrasing.	Demonstrate a high level of precision through the consistent application of discipline-specific terminology, frequently employing accurate paraphrasing techniques
Depth (Dp): Demonstrating the complexity of comprehension	Lack of comprehension regarding the interrelationship	Limited comprehension or engagement with	Particularly, it is essential to comprehend the interrelationship	A nuanced comprehension of intent, conceptual

	among purpose, concept, and support in the context of reading.	the objectives of reading, as defined.	between objectives, concepts, and the provision of assistance in reading.	frameworks, and the facilitation of text preparation.
Relevance (Re): Identify and draw conclusions while incorporating personal reflections informed by the content of the reading.	Lack of relevance or conclusion articulated.	Limited relevance, with fundamental conclusions articulated.	here is some relevance to the fundamental conclusions; however, there is a lack of personal engagement with the concepts.	Total relevance, which encompasses several underlying assumptions, may necessitate the incorporation of personal perspectives on subjects derived from the content.
Logic (Lo) : Implementing Theoretical Concepts and Content	Failing to apply the concept	Inadequate execution of concepts or erroneous application of concepts	Numerous applications of the concept, employing overarching principles.	Application of the overarching concept across various contexts, illustrated through specific examples and empirical data.

RESULT AND DISCUSSION

A. Initial Assessment of Critical Thinking

The six standards of critical thinking skills were evaluated by researchers serving as English lecturers. According to the assessment rubric, the scores presented in Chart 1 indicate that students' critical thinking skills were initially assessed at a low level, with a score of 10 corresponding to level 2 across all indicators. However, a notable enhancement was observed in the third article, wherein the majority of groups attained a score of 18 (level 3), and some groups even reached a score of 24 (level 4). This

progression signifies a comprehensive mastery of the criteria, including accuracy, clarity, precision, depth, relevance, and logic. These findings suggest that engaging in repeated critical reading exercises can enhance the quality of critical thinking; however, it is important to note that the trajectory of improvement is not uniformly consistent across all groups.

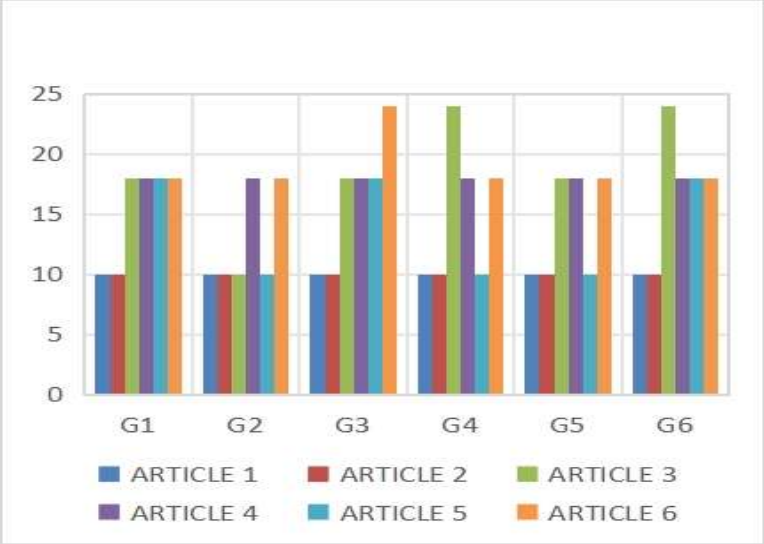

Chart 1. Students' Critical Thinking Score

Fluctuations in scores observed in the subsequent article, particularly within groups G4 and G6 both of which attained a peak score of 24 before subsequently declining to 18 suggest that critical thinking skills remain inadequately stabilized. Potential contributing factors may encompass text complexity, learner motivation, and the employed learning strategies. This observed pattern aligns with prior research findings , which assert that the advancement of critical thinking necessitates ongoing practice and instructional support (Lorencová et al., 2019). Nonetheless, the notable variability in scores underscores the necessity for supplementary interventions, such as reflective discussions and structured feedback, to facilitate more consistent improvement(Harris et al., 2023).

The results of the analysis indicate that students' critical thinking skills demonstrated improvement following several critical reading exercises. However, this enhancement was not consistently observed. This trend aligns with the findings of Song, who assert that critical thinking evolves through a systematic process of repetition and the application of intellectual standards, including accuracy, clarity, and logical coherence. Research grounded in the Paul-Elder framework further illustrates that structured interventions, such as peer feedback and collaborative discussion, can significantly enhance students' critical thinking capabilities (Rajaram, 2021). Nonetheless, in contrast to the aforementioned study, which reported more stable improvements, the data presented in Table 2 reveals fluctuations in scores, suggesting that mastery of critical thinking skills remains unstable and is potentially influenced by variables such as student

motivation and the complexity of the texts encountered.

Furthermore, these findings align with Hyytinen theoretical framework, which conceptualizes critical thinking as a multifaceted skill encompassing interpretation, analysis, evaluation, inference, explanation, and self-regulation(Hyytinen et al., 2021).Empirical studies utilizing Facione's indicators indicate that the equitable development of this skill is challenging without the implementation of consistent learning strategies and sufficient instructional support. Additional research on the application of critical reading methodologies, such as SQ3R, further corroborates the assertion that critical reading exercises can enhance students' critical thinking abilities. However, the efficacy of these exercises is significantly contingent upon their intensity and the active engagement of students in the learning process. Consequently, the results of this analysis substantiate the existing literature, emphasizing that the cultivation of critical thinking necessitates a systematic and sustained approach, rather than mere exposure to textual materials.

Table 2. a*pplications utilized by students for reading international articles*

Group	Translation Application	Reading Analysis Aplication	Recording Application	Article Search Database	Tittle of Article/ Topic
Group 1	Google translate	ChatGPT	Auris	Google scholar	The Effect of Brisk Walking on Blood Pressure in Hypertension Patients: A Literature Review Author: I Kade Wijaya
Group 2	Google translate	ChatGPT	Speed Audio	Pubmed	Stunting in Childhood: An Overview of Global Burden, Trends, Determinants, and Drivers of Decline Author: Tyler Vaivada et.al
Group 3	Google translate	ChatGPT	Auris	Google scholar	The Effect of Choking Management Education for Toddlers Aged 1-5 Years on Parents Knowledge Author: Rafidaini Sazarni Ratiyun et.al

Group	Translation Application	Reading Analysis Aplication	Recording Application	Article Search Database	Tittle of Article/ Topic
Group 4	Google translate	ChatGPT	Auris	Google scholar	Effect of Progressive Muscle Relaxation (PMR) on Blood Pressure among Patients with Hypertension Author: Ida Rosdiana, Yanti Cahyati
Group 5	Google translate	ChatGPT	Manual	Google scholar	The Effect of Combined Foot Massage and Nature Music on the Sleep Quality of Critically Ill Patients Author : Nunung Nurhayati et.al
Group 6	Google translate	ChatGPT	Manual	Google scholar	Differences in Student Readiness using Animated Videos about First Aid About Burns Author : Usnawiyah, Rida Darotin

The analysis of Table 2 reveals that all groups employed Google Translate for the translation of international articles, demonstrating a significant reliance on automated translation tools. For reading comprehension, all groups utilized ChatGPT, highlighting the role of artificial intelligence in facilitating the understanding of article content and potentially offering summaries or interpretations. Variability was observed in the recording methods. Groups 1, 3, and 4 employed Auris, Group 2 utilized Speed Audio, while Groups 5 and 6 opted for manual recording. This variation suggests differing preferences for technological support in enhancing listening and note-taking skills. The majority of groups (1, 3, 4, 5, and 6) utilized Google Scholar as a resource for article searches, whereas Group 2 utilized PubMed, which is more specialized for the health domain. The topics of the selected articles were uniformly related to health, encompassing issues such as hypertension, stunting, choking management, muscle relaxation, sleep quality, and student preparedness in first aid. This alignment indicates a research focus on public health concerns and clinical interventions. Overall, these findings suggest that students are leveraging AI-based technologies (such as ChatGPT) and translation tools to address language barriers and facilitate text analysis. However, the differences in the use of recording applications and databases indicate distinct

learning strategies among the groups. This pattern aligns with prior research emphasizing the significance of technology integration in literature-based learning, particularly in enhancing access to and comprehension of scientific sources.

During the subsequent meeting, the researcher examined the challenges encountered by students while engaging in discussions on the various topics presented in the article. In each reading session, students provided critiques of the topics during group discussions. During the dialogue in Group 1, several students expressed that they found it challenging to employ critical thinking skills in their analysis of the text. This difficulty arose for several reasons: firstly, the text was in English, which posed comprehension difficulties; secondly, the students had no prior experience reading journal articles in English; and thirdly, challenges in group discussions included issues related to the pronunciation of vocabulary and numerical expressions, exemplified by words such as "advancement," "combines," and "ill." The following outlines the reasons articulated by each group that may have contributed to students' difficulties in reading English texts and articles, accompanied by excerpts from interviews conducted in Indonesian:

B. Nursing Students' Perceptions of Their Experiences with Digital Technology-Assisted Project-Based Learning (PjBL)

The challenges associated with the analysis of English texts are primarily attributable to several interconnected factors, including limited vocabulary and the presence of technical terminology. Students frequently encounter difficulties due to their insufficient familiarity with a range of words and academic terms, necessitating frequent interruptions to consult definitions, which impedes reading fluency and results in fragmented comprehension. Additionally, technical terms, particularly those pertaining to specialized fields such as medicine or science, further complicate the reading process, as they necessitate a level of expertise that may not be possessed by all learners."*Due to language barriers, it was difficult for us to understand the article's content, as the word choice was not straightforward. The frequent repetitions of words further complicated our comprehension*." (G2).The preceding statement illustrates that the primary challenge encountered by students is language. Difficulties in comprehending the content of articles are attributed to the employment of complex and excessively sophisticated vocabulary, which obstructs the understanding of key concepts. Furthermore, the redundancy of words within the text contributes to a convoluted sentence structure, potentially diminishing the clarity and accuracy of the conveyed information. This suggests a necessity for students to receive support in the form of critical reading strategies, including paraphrasing techniques, the identification of main ideas, and the utilization of contextual translation tools. More broadly, these findings reflect prevalent challenges in engaging with international literature, particularly for learners who do not utilize the source language as their primary means of communication. Such difficulties can adversely affect critical thinking indicators such as clarity (Cl) and precision (Pre), as students often concentrate on word-for-word translation rather than grasping the overarching meaning. Consequently, pedagogical interventions, such as training in academic reading strategies and the incorporation of

AI-based technology for text analysis, may facilitate the surmounting of these obstacles.

Student from G5 stated that *"Limited vocabulary and understanding of grammar, such as passive conditional sentences or mixed tenses, as well as difficult or technical topics, require a better grasp of both language and content*" (G5). The aforementioned statement delineates the limitations of vocabulary and grammatical comprehension as primary barriers to understanding international articles. These challenges encompass intricate sentence structures, including passive constructions, conditional clauses, and mixed tenses, which necessitate a profound grasp of grammatical rules. Furthermore, the complexity of technical topics exacerbates these difficulties, as students must not only comprehend the language but also the underlying concepts presented in the articles. This illustrates that the obstacles encountered are twofold: linguistic and conceptual. From an academic perspective, this issue significantly impacts critical thinking indicators such as precision and depth, as linguistic limitations impede the ability to categorize information and establish connections among concepts comprehensively. These findings underscore the necessity for learning strategies that incorporate the enhancement of academic vocabulary, exercises focused on complex sentence structures, and contextual approaches to the comprehension of technical terminology. Additionally, technological supports, such as AI-based reading analysis applications and adaptive grammar exercises, may serve as viable solutions to mitigate these challenges.

The statement from G6 indicates that a primary obstacle for students is their insufficient habituation to reading lengthy texts in English. "*We rarely read long texts in English, and there are many unfamiliar words*"(G6). A lack of exposure to English academic literature results in a restricted vocabulary, which hinders students' ability to thoroughly comprehend the content of scholarly articles. This challenge is fundamental, as it not only impacts word-by-word comprehension but also diminishes the capacity to grasp the central ideas and argumentative structures within the text. From an academic perspective, this issue adversely affects critical thinking indicators such as clarity and depth, as students often become mired in the process of decoding individual words rather than engaging in comprehensive analysis. These findings underscore the necessity for pedagogical strategies that promote the gradual engagement with extended texts, the enhancement of academic vocabulary, and the integration of technological resources such as contextual translation applications and AI-based reading analysis tools. Such an approach may facilitate improvements in critical reading skills and diminish reliance on literal translations.

The statement from G4 identifies two primary obstacles to student reading comprehension: limited vocabulary and a lack of habituation to reading extensive texts in English "*Limited vocabulary, such as not knowing many words in the text and frequently stopping to look up their meanings, as well as a lack of habit in reading English texts, has resulted in not being accustomed to reading in English"*(G4). Students frequently interrupt their reading to look up the meanings of words, which suggests that their comprehension process is constrained to the lexical level, rather than

encompassing the overall meaning of the text. This absence of a reading habit in English signifies a low exposure to academic sentence structures and technical terminology, resulting in a lack of familiarity with complex linguistic patterns. From an academic perspective, this challenge adversely affects critical thinking indicators, such as clarity and depth, as students struggle to identify main ideas and connect concepts at a deeper level. These findings underscore the necessity for instructional strategies that prioritize the enrichment of academic vocabulary, the gradual practice of reading lengthy texts, and the integration of technology, such as contextual translation applications and AI-based reading analysis tools. Such an approach can enhance students' reading fluency and diminish their reliance on searching for individual words.

Students often lack the experience or habit of engaging with English-language academic literature, thereby encountering significant challenges in comprehending scientific texts. Their limited exposure to academic language results in unfamiliarity with technical vocabulary, complex sentence structures, and writing styles inherent to scholarly discourse, which differ markedly from those found in popular texts. Consequently, the analytical process becomes arduous, as students are required to acclimate to both a foreign language and an academic format simultaneously. *"Not accustomed to reading English journals, so I don't know what it means."* (G3). This observation indicates that students are not familiar with reading English-language journals, which hinders their comprehension of vocabulary and the overall content of the texts. This challenge is significant, as their limited exposure to academic language renders them unacquainted with specialized terminology and intricate sentence structures. Consequently, the reading process is obstructed, and a thorough understanding of fundamental concepts is not attained. From an academic perspective, this barrier affects critical thinking indicators such as clarity and relevance, as students encounter difficulties in identifying main ideas and relating information to pertinent contexts. These findings underscore the necessity for pedagogical strategies that progressively enhance the engagement with English-language journals, augment academic vocabulary, and incorporate supportive technologies, such as contextual translation applications and AI-driven reading analysis tools. By implementing this approach, students can cultivate reading habits and improve their comprehension of textual content more effectively.

This statement illustrates that "*Not accustomed to reading journals in English, I often struggle to understand medical terms and their meanings in Indonesian*." (G1). Students encounter challenges in comprehending articles due to a lack of familiarity with reading English-language journals. This impediment is further intensified by their inability to recognize medical terminology and translate it into Indonesian, thereby constraining their overall understanding of the text. The issue is both linguistic and terminological, as students grapple with not only general vocabulary deficits but also specialized terms that necessitate advanced knowledge. From an academic perspective, this barrier adversely affects critical thinking indicators such as accuracy and precision, as students struggle to discern the meanings of terms and apply them appropriately in their analyses. These

findings underscore the necessity for educational strategies that incorporate the enrichment of technical vocabulary (specifically medical terminology), incremental journal reading practice, and the integration of technology, including contextual translation applications and AI-based analytical tools. This multifaceted approach has the potential to enhance students' comprehension of terminology and mitigate language barriers in engaging with international literature.

The primary obstacles encountered by students in reading English texts are linguistic and phonological in nature. Insufficient comprehension of language structure and vocabulary impedes the reading process, while discrepancies between spelling and pronunciation further exacerbate the challenges faced. Students lacking familiarity with the pronunciation of English words often struggle to connect the written form with its corresponding meaning, resulting in a superficial understanding of the text. This barrier adversely affects critical thinking indicators such as clarity and precision, as students find it difficult to identify main ideas or utilize terminology accurately. These findings underscore the necessity for learning strategies that incorporate simultaneous reading and listening exercises, reinforcement of academic vocabulary, and the utilization of technology, including text-to-speech and AI-based reading analysis applications. Such an approach has the potential to enhance students' language comprehension and phonetic skills, thereby rendering the reading process more effective. Accordingly, G1, G3, G4, G5, and G6 indicate that "*When reading, we lack focus and concentration, making it easy to get distracted, especially when the text is long and tedious* (G4). *Difficulty pronouncing English words that are rarely heard*" (G3). "*Pronunciation differs from spelling, making it difficult to spell the words*" (G6). "*Limited reading ability*" (G1). "*The spelling and pronunciation are different*" (G5).

The G4 statement indicates that a primary obstacle to comprehension is a lack of concentration when engaging with lengthy texts, particularly those perceived as tedious. This distraction adversely affects the ability to grasp main ideas and synthesize information, thereby impeding the attainment of critical thinking indicators such as depth and logical reasoning. This challenge underscores the necessity for the implementation of learning strategies that incorporate active reading techniques, such as note-taking and highlighting significant concepts, as well as effective time management to sustain focus. Additionally, the G3 statement suggests that this difficulty is not confined to reading alone, but is also associated with phonological processing and listening skills. Students often struggle with the pronunciation of English words, which impedes their understanding of relevant terminology. The repercussions of this issue are evident in indicators of clarity and accuracy, as students are unable to connect the written words with their correct phonetic representations. Proposed solutions include the incorporation of listening practice and the utilization of audio applications to enhance phonetic proficiency.

G6 highlighted the distinction between spelling and pronunciation in English, which often confuses students. This challenge can hinder comprehension of vocabulary and sentence structure, subsequently impacting accuracy. A recommended strategy is the

implementation of technology-based phonetic practice, such as text-to-speech applications, alongside vocabulary enhancement through visual-audio methods. In contrast, G1 identifies limitations in reading abilities, encompassing fundamental aspects such as speed, fluency, and reading comprehension. These limitations have a pervasive effect on all critical thinking indicators, particularly regarding clarity and depth. The proposed solution involves intensive reading practice with progressively challenging texts, as well as the utilization of technological tools, such as reading analysis applications, to facilitate an understanding of text structure. Lastly, G5 points out a disparity between writing and pronunciation, specifically the divergence between the written form and the phonetic representation of words. This obstacle suggests an inadequacy in phonetic skills and vocabulary comprehension, adversely affecting accuracy and precision. Recommended interventions include audio-based pronunciation exercises and the integration of phonetic learning into critical reading practices.

This statement underscores a significant affective barrier, specifically the students' lack of confidence in their English language proficiency. This condition engenders hesitance toward engaging in reading or analyzing texts, primarily due to apprehensions regarding the potential for errors or difficulties in comprehending the material. The ramifications of this phenomenon extend beyond mere motivation; they also impede the development of critical thinking skills, as students often shy away from thorough analysis and are reluctant to engage with complex ideas. Academically, this issue adversely influences all indicators of critical thinking, particularly in terms of logical reasoning and depth of understanding, stemming from insufficient efforts to connect concepts and evaluate arguments effectively. To address this challenge, it is imperative to implement strategies that enhance self-efficacy, such as collaborative learning, constructive feedback, gradual exposure to less complex texts, and the integration of supportive technology (e.g., AI applications that offer interactive assistance). Such an approach can facilitate the enhancement of students' confidence and mitigate their fear of making mistakes.

The group from G5 and G6 stated that "*Lack of confidence and giving up easily can make individuals feel afraid of making mistakes or feeling inferior before we even attempt to understand the text*" (G5). "*Lack of confidence"* (G6). A lack of confidence, coupled with a tendency to give up easily, results in an aversion to making mistakes or feelings of inferiority prior to engaging with the text. This observation suggests that the primary obstacle to comprehension is not solely linguistic, but also psychological; specifically, it reflects a deficit in self-confidence regarding reading English texts. Students often evade challenges due to their fear of error, causing the learning process to stagnate before they attempt to comprehend the content. The repercussions of this phenomenon are manifested in critical thinking indicators, such as logical reasoning and depth of analysis, which are hindered by insufficient effort to analyze and integrate concepts. This situation underscores the necessity for an approach that enhances self-efficacy, such as through collaborative learning, constructive feedback, and incremental practice designed to bolster confidence.

Participant G6 articulated a lack of confidence, thereby reinforcing the assertion that affective factors significantly influence difficulties in critical reading. Insufficient self-assurance discourages students from employing comprehension strategies, thereby stifling the advancement of their reading skills. The resultant impact is a constraint on various critical thinking indicators, particularly accuracy and relevance, as students refrain from exploring the meaning of the text. Appropriate interventions may include motivational strategies such as mentoring, group discussions, and the integration of interactive technology (e.g., user-friendly AI applications) to mitigate the fear of making mistakes.

The findings of this study indicate that nursing students' critical thinking skills improved after several critical reading exercises integrated into technology-assisted Project-Based Learning (PjBL). Initial scores were consistently low (10 points, corresponding to level 2), but subsequent sessions demonstrated significant progress, with scores reaching 18–24 points (levels 3–4). This improvement, although not uniform across all groups, reflects the potential of PjBL combined with digital tools to foster critical thinking in nursing education.

These results align with Elder & Paul, (2007) which emphasizes six intellectual standards—accuracy, clarity, precision, depth, relevance, and logic—as essential for developing critical thinking. The rubric applied in this study was based on these standards, and the observed score progression suggests that repeated exposure to structured critical reading tasks supports the gradual mastery of these elements. However, the fluctuations in scores across groups indicate that critical thinking development is not instantaneous but requires sustained practice and instructional support, consistent with Paul and Elder's assertion that critical thinking evolves through systematic engagement.

Furthermore, the integration of digital tools within PjBL resonates with the Community of Inquiry (CoI) framework Mielikäinen & Viippola, (2023), which posits that meaningful learning emerges from the interplay of cognitive presence, social presence, and teaching presence. In this study, cognitive presence was facilitated through the use of AI-based applications (e.g., ChatGPT) and translation tools (Google Translate), enabling students to comprehend complex texts. Social presence was evident in collaborative group discussions, which encouraged peer interaction and shared problem-solving. However, challenges such as limited vocabulary and low self-confidence highlight the need to strengthen teaching presence through targeted scaffolding and feedback to ensure that students remain engaged and supported throughout the learning process.

The findings also reflect principles of Constructivist Learning Theory, which advocates for active, collaborative learning experiences that allow students to construct knowledge through authentic tasks. By engaging students in reading and analyzing international journal articles, PjBL provided a contextually rich environment that bridged theoretical knowledge and practical application. Nevertheless, variations in performance among groups suggest that individual differences in engagement and prior language

proficiency significantly influence outcomes, underscoring the importance of differentiated instructional strategies.

Finally, the reliance on digital tools such as Google Translate and ChatGPT underscores the role of Digital Literacy in contemporary education. While these tools mitigated language barriers and facilitated comprehension, excessive dependence on automated translation and AI-generated summaries may hinder the development of independent academic reading skills. This finding aligns with previous research emphasizing that technology should serve as a scaffold rather than a substitute for cognitive effort (Tang, 2025). Therefore, future interventions should incorporate strategies that promote gradual autonomy in academic reading, such as guided paraphrasing exercises and vocabulary-building activities, alongside the use of supportive technologies.

In summary, the integration of technology-assisted PjBL demonstrates promise in enhancing critical thinking and collaborative skills among nursing students. However, the observed inconsistencies and reliance on digital tools highlight the need for a balanced approach that combines technological support with pedagogical strategies aimed at fostering academic literacy and learner confidence. These insights contribute to the refinement of nursing curricula by advocating for systematic incorporation of digital tools, structured critical reading practices, and affective support mechanisms to prepare students for the demands of globalized healthcare environments.

CONCLUSION

This study demonstrates that the integration of technology-based Project-Based Learning (PjBL) can enhance the critical thinking skills of nursing students, although the improvement observed is not uniformly consistent. Quantitative data indicate that initial critical thinking scores were low. However, these scores increased following several critical reading exercises, particularly from the third article onward. These findings align with existing literature, which emphasizes that the development of critical thinking necessitates continuous practice and instructional support. Furthermore, interview results identified the primary obstacles faced by students, including limited vocabulary, inadequate understanding of grammar, a lack of habituation to reading lengthy English texts, and diminished self-confidence. The utilization of technology, such as Google Translate and ChatGPT, mitigated some of these challenges; however, the reliance on these tools underscores the necessity for more comprehensive learning strategies aimed at fostering critical reading independence. In summary, this study significantly contributes to the understanding of students' perceptions of technology-based PjBL and the challenges they encounter. The results affirm that the advancement of critical thinking and collaboration skills necessitates a systematic approach that integrates academic reading practice, vocabulary enhancement, and appropriate technological support. Additionally, this study has practical implications for the development of nursing curricula that are more attuned to students' needs in engaging with international literature. Future research should encompass a larger and more diverse cohort of nursing students from various institutions. This approach will enhance the generalizability of the findings and facilitate the assessment of whether analogous patterns of critical-thinking development arise across different educational, cultural, or linguistic contexts.

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