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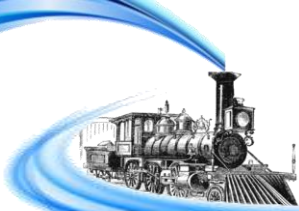
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ADVANCING CRITICAL THINKING SKILLS IN FUTURE ENGINEERS THROUGH THE ANALYSIS OF AI-GENERATED AND AI-VERIFIED ENGLISH-LANGUAGE SOURCES

Abstract. In the context of the Russian war of aggression against Ukraine, the development of critical thinking skills has become a strategic educational priority. This article presents a pedagogical framework for advancing critical thinking through the analysis of AI-generated and AI-verified English-language sources among students of technical specialties. Conducted over a six-month period with 79 second-year students of the Faculty of Power Engineering and Electromechanics in VNTU, the study integrated tasks involving the evaluation of AI-written summaries, machine translations, and argumentative texts into the English language curriculum. Students were guided to assess accuracy, coherence, bias, and logical structure, with a focus on fostering independent judgment and reflective engagement. The results demonstrate a measurable improvement in students' ability to question, compare, and critically evaluate information – skills essential for academic resilience and civic awareness, particularly in wartime. The study highlights that, when used purposefully, AI tools can serve not merely as aids for language production but as catalysts for analytical thinking. Ethical considerations such as data privacy, authorship, and AI transparency



were also addressed throughout the intervention. The article concludes with practical recommendations for educators and outlines directions for future research, including long-term skill retention, cross-disciplinary transfer of critical thinking, and the adaptation of such frameworks for low-connectivity or high-risk learning environments. The proposed model positions English language education as a platform for intellectual empowerment in a time of national adversity.

Keywords: critical thinking, artificial intelligence, English language teaching, AI literacy, wartime education.

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ФОРМУВАННЯ НАВИЧОК КРИТИЧНОГО МИСЛЕННЯ МАЙБУТНІХ ІНЖЕНЕРІВ ЧЕРЕЗ АНАЛІЗ АНГЛОМОВНИХ ДЖЕРЕЛ, ЗГЕНЕРОВАНИХ АБО ВЕРИФІКОВАНИХ ШТУЧНИМ ІНТЕЛЕКТОМ

Анотація. В умовах російської агресії проти України розвиток критичного мислення набуває стратегічного значення в системі освіти. У статті представлено педагогічну модель формування критичного мислення через аналіз англomовних джерел, згенерованих або верифікованих штучним інтелектом, серед студентів технічних спеціальностей. Дослідження тривало шість місяців і охопило 79 студентів другого курсу факультету електроенергетики та електромеханіки ВНТУ. До навчальної програми з англійської мови були інтегровані завдання з оцінювання текстів, створених за допомогою ШІ: резюме, машинні переклади та аргументативні статті. Студенти аналізували точність, зв'язність, упередженість



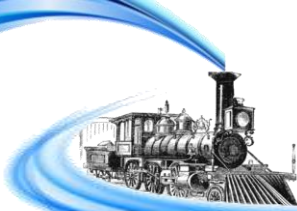
і логічну структуру матеріалів, що сприяло розвитку незалежного мислення та рефлексії. Результати дослідження засвідчили покращення здатності критично оцінювати інформацію, порівнювати джерела та формулювати обґрунтовані висновки – навички, що мають вирішальне значення для академічної стійкості та громадянської свідомості, особливо в умовах війни. Досвід показав, що за цілеспрямованого педагогічного використання інструменти ШІ можуть слугувати не лише допоміжними засобами, а й каталізаторами аналітичного мислення. У процесі роботи також розглядалися етичні питання, зокрема конфіденційність даних, авторство та прозорість функціонування ШІ. У завершенні статті наведено практичні рекомендації для викладачів і окреслено перспективи подальших досліджень – зокрема щодо довготривалого ефекту, міждисциплінарного переносу навичок критичного мислення та адаптації моделі до середовищ із низьким рівнем доступу до цифрових технологій. Запропонована модель позиціонує викладання англійської мови як платформу для інтелектуального розвитку в умовах національних викликів.

Ключові слова: критичне мислення, штучний інтелект, викладання англійської мови, ІТ-грамотність, освіта в умовах воєнного стану.

During times of national emergency, education not only must continue – but modify, resist, and prosper. This Russian invasion in Ukraine has put every institution in our society to the test, but maybe education is an area more severely impacted. Students and teachers have to put up with damaged power lines, air raid siren messages, and mental strain. But with these intrusions come classrooms – physical and virtual – as areas for intellectual resistance, civic education, and individual empowerment. Here, education about critical thinking ceases to be an academic imperative but a strategic imperative. It enables students to discern between information in times of war contexts, recognize propaganda messages, make informed choices, and intellectually remain autonomous in a world of online manipulation.

The historic entwining of artificial intelligence (AI) with world communication and learning once more redefines the way in which critical thinking needs to be learned and applied. AI applications like ChatGPT, Grammarly, and Google Translate now provide not just linguistic support but knowledge gatekeepers and generators. For students in Ukraine – and for students at technical universities – these applications provide a double-edged sword. On the positive side, they provide democratization of English-language resources, allowing students access to real resources irrespective of infrastructure constraints. Conversely, they pose new literacies in which recognizing the source, purpose, and verifiability of knowledge is of equal value to language proficiency per se.

This article explores how the analytical engagement with AI-generated and AI-verified English-language sources can serve as a powerful pedagogical strategy for



advancing critical thinking skills among Ukrainian students. It draws on examples from real classroom practice during wartime, highlighting how AI can be used not as a shortcut, but as a catalyst for inquiry, reflection, and independent thought. In doing so, the study positions language learning not only as a means of international communication, but as a form of intellectual resistance – one that empowers students to question, verify, and construct meaning even under the most adverse conditions.

Problem statement and its scientific and practical relevance

Over the past decade, the rapid integration of artificial intelligence in learning settings has done more than just change the resources available to language students but the nature of knowledge creation, transmission, and validation itself. Although AI-powered platforms have immense potential for English language learning support, they also engender complex intellectual and ethical challenges – at least in extreme contexts such as wartime Ukraine.

A growing body of research has emphasized the need to move beyond surface-level engagement with digital tools and toward their meaningful integration into pedagogical frameworks [1, 2] that prioritize higher-order thinking. However, much of this scholarship remains abstract or confined to stable contexts in developed countries. In contrast, Ukrainian educators and students operate under a dramatically different set of constraints – limited electricity, irregular access to devices and connectivity, and the ever-present psychological pressure of military conflict. In this environment, the need for efficient, adaptive, and cognitively rich teaching strategies is not only academic but existential.

Despite the abundance of AI-generated content in the digital space – from news articles and social media posts to summaries, translations, and even essays – there remains [3] a notable gap in language education: learners are rarely taught how to critically engage with these materials. They often rely on AI outputs as final truths rather than interrogating their origins, accuracy, or potential biases. This uncritical use of AI poses risks, particularly in conflict-affected societies where disinformation, deepfakes, and algorithmic manipulation are not theoretical concerns but tangible threats to civic coherence and national security.

Thus, the problem addressed in this article lies in the insufficient development of critical thinking skills among students using AI-generated or AI-verified English-language sources. The lack of targeted pedagogical strategies for training learners to assess the credibility, structure, and intent of such content diminishes their ability to function as autonomous thinkers and informed communicators. In the Ukrainian context, where resilience must be intellectual as well as physical, this gap carries profound implications for educational policy, curriculum design, and national recovery efforts.

From a scientific perspective, the study contributes to the emerging discourse at the intersection of AI literacy, critical pedagogy, and language education. It seeks to fill a methodological void by offering a structured approach to teaching analytical engagement with AI-mediated content, thereby aligning with global educational



priorities while remaining rooted in the practical realities of a country at war. From a practical standpoint, the research responds to an urgent need for teaching tools that are not only innovative but also feasible, relevant, and empowering in the face of adversity.

Review of recent research and identification of the research gap

The convergence of artificial intelligence, language learning, and critical thinking development has become a focal point in educational research, particularly in the context of digital transformation and global crises. Recent studies have begun to explore how AI tools can influence the cognitive dimensions of learning, but the integration of these tools into pedagogical frameworks for the explicit development of critical thinking remains uneven and under-theorized – especially in fragile or disrupted educational environments.

Guendouz and Benettayeb (2024), in their study published in *Afak for Sciences Journal*, examined [4] the role of AI-generated content in promoting reflective thinking among English as a Foreign Language (EFL) students. They found that when students were prompted to analyse the coherence, tone, and factual accuracy of ChatGPT-generated texts, they exhibited stronger metacognitive engagement and improved argumentation skills. However, the study was conducted in a controlled digital environment with stable infrastructure, and did not address issues of disinformation or socio-political instability.

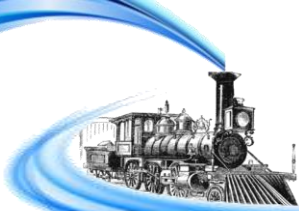
Similarly, in a meta-analysis of AI-supported writing instruction, Yu & Trainin highlighted [5] that tools such as Grammarly and QuillBot can support learners' self-correction practices and lexical precision. Yet the authors noted a tendency among students to accept AI suggestions uncritically, emphasizing the need for instructional mediation to transform these platforms from passive aids into catalysts for analytical learning.

A more socially grounded perspective is presented by Wang & Tian, who explored [6] the ethical implications of relying on AI in academic writing. Their findings stress the importance of equipping students with AI literacy – not only technical skills but also the ability to question algorithmic bias and opacity. However, their study remained largely conceptual, without pedagogical implementation.

Recently Ukrainian scholars have also begun to engage with these themes. Kaminsky, in *E-Learning Innovations Journal*, explored [7] the use of AI tools in blended learning environments during martial law. Their work emphasizes the flexibility of AI-powered platforms in asynchronous instruction, but it stops short of proposing a structured method for developing critical thinking through content analysis.

Collectively, these studies suggest [8] a growing awareness of the cognitive and ethical dimensions of AI-assisted language learning. However, several important areas remain underexplored and are the focus of this article:

- a) the systematic development of critical thinking skills through guided analysis of AI-generated and AI-verified English-language texts;
- b) pedagogical strategies tailored to conflict-affected environments, where cognitive autonomy and media literacy have direct implications for personal safety and national resilience;



- c) the use of real-time, unstable, or algorithmically biased content as a training ground for fostering skepticism, reasoning, and evidence-based judgment in students;
- d) the adaptation of global AI literacy frameworks to the Ukrainian educational context, where infrastructural, psychological, and civic challenges intersect.

By addressing these unsolved aspects, this article contributes to a more comprehensive and context-sensitive understanding of how AI technologies can be repurposed not merely to automate learning processes, but to deepen learners' intellectual agency in times of profound societal disruption.

Purpose of the article

The primary purpose of this article is to develop and justify a pedagogical approach that integrates the analysis of AI-generated and AI-verified English-language sources as a means of cultivating critical thinking skills among university students in Ukraine. In light of the complex challenges [8] posed by the Russian invasion – including widespread disinformation, infrastructural instability, and psychological strain – this study seeks to reframe English language instruction as more than just a communicative practice. It positions the classroom as a site of intellectual resilience, where students learn not only to use language but to interrogate it, question the reliability of information, and form evidence-based judgments.

The article aims to demonstrate how AI tools – often viewed as shortcuts or passive aids – can instead be transformed into catalysts for critical inquiry. By engaging students in the evaluation of text coherence, argumentative logic, source credibility, and potential algorithmic bias, the proposed approach encourages learners to develop higher-order thinking skills essential for academic, professional, and civic life. This is particularly relevant in the Ukrainian context, where the ability to think critically, assess sources independently, and resist manipulation is not only an educational objective but a matter of national significance.

Through a combination of theoretical grounding, analysis of recent research, and practical classroom insights, the article offers a structured, context-sensitive model that educators can adapt to empower students intellectually – even in conditions of extreme adversity as now in Ukraine – in the conditions of severe war of aggression of Russia against my state.

Presentation of the main material

To explore how the analysis of AI-generated and AI-verified English-language sources can support the development of critical thinking skills, a six-month pedagogical intervention was carried out among 79 second-year students of the Faculty of Power Engineering and Electromechanics at Vinnytsia National Technical University in Ukraine. The study took place under wartime conditions, in a blended format that combined offline instruction (when available) and asynchronous digital learning. All participants gave informed consent, and strict confidentiality protocols were observed. No personal data was disclosed or used



beyond the scope of the study, and all results were anonymized in accordance with ethical standards.

The instructional model focused on three core principles: critical engagement with text content, awareness of AI-generated features, and reflection on trustworthiness and bias. Each of the three phases of the intervention included targeted tasks using real AI tools, followed by structured discussions, individual written reflections, and peer evaluations. The following examples illustrate the types of tasks implemented and their observed impact on students' critical thinking.

Example 1. Evaluating AI-generated summaries of news articles.

Students were given original English-language news reports from reliable sources (e.g. *BBC*, *The Guardian*) and corresponding summaries generated by ChatGPT. Their task was to analyse differences in tone, emphasis, and factual completeness. One particular case involved a report on Ukraine's energy infrastructure, where the AI summary omitted key geopolitical context and softened the emotional register. Students flagged this discrepancy, sparking a discussion about algorithmic neutrality and the risks of over-relying on seemingly objective AI-generated content. Post-task reflections showed [9] improved ability to identify bias and assess the credibility of summarized information, as measured by structured rubrics and teacher feedback.

Table 1.

Examples of student tasks, materials, analysis focus, findings, and learning outcomes.

Task	Materials used	Focus of analysis	Key findings	Observed learning outcome
Analysis of AI-generated summaries of news reports	Original English-language news articles from reliable sources (BBC, The Guardian) and summaries generated by ChatGPT	Comparison of tone, emphasis, and factual completeness	In a case on Ukraine's energy infrastructure, the AI summary omitted key geopolitical context and softened the emotional register. Students flagged bias and discussed algorithmic neutrality	Improved ability to identify bias, assess credibility, and understand risks of uncritical reliance on AI content
Comparison of AI and human translations of technical texts	Ukrainian technical manuals translated into English using Google Translate and DeepL, compared with professional human translations	Accuracy of terminology, clarity, and domain-specific consistency	AI mistranslated several industry-specific terms (e.g., 'заземлення' inconsistently as 'grounding' and 'earthing'), which students identified	Increased precision in evaluating translations, better awareness of semantic nuances in technical English



Task	Materials used	Focus of analysis	Key findings	Observed learning outcome
Critical review of AI-generated argumentative essays	Essays produced by ChatGPT on topics like nuclear energy policy in Ukraine	Logical structure, use of evidence, and balance of perspectives	AI text showed coherent structure but lacked depth and counterarguments; students challenged oversimplified reasoning	Enhanced skills in identifying weak arguments, recognizing missing perspectives, and demanding balanced evidence
Fact-checking AI-generated summaries of scientific articles	Original peer-reviewed research papers and AI-generated summaries	Accuracy of scientific claims and interpretation of data	AI summaries occasionally misrepresented statistical results or omitted key limitations of studies	Strengthened skills in cross-referencing claims, verifying accuracy, and detecting omissions in academic contexts

Source: Compiled by the authors.

Example 2. Comparing AI-translated texts with human-verified versions.

In another task, students worked with technical texts translated from Ukrainian into English using Google Translate and DeepL, and compared them with professionally edited human translations. The selected texts included descriptions of electromechanical systems and safety protocols. Students evaluated the clarity, precision, and domain accuracy of the outputs, noting how AI often mishandled industry-specific terms (e.g. "заземлення" translated inconsistently as "grounding" or "earthing"). The group discussions led to deeper understanding of semantic nuance and terminological consistency – critical skills for future engineers working with international documentation. By the end of the module, students were more confident in validating translations and questioning linguistic surface correctness.

Table 2.

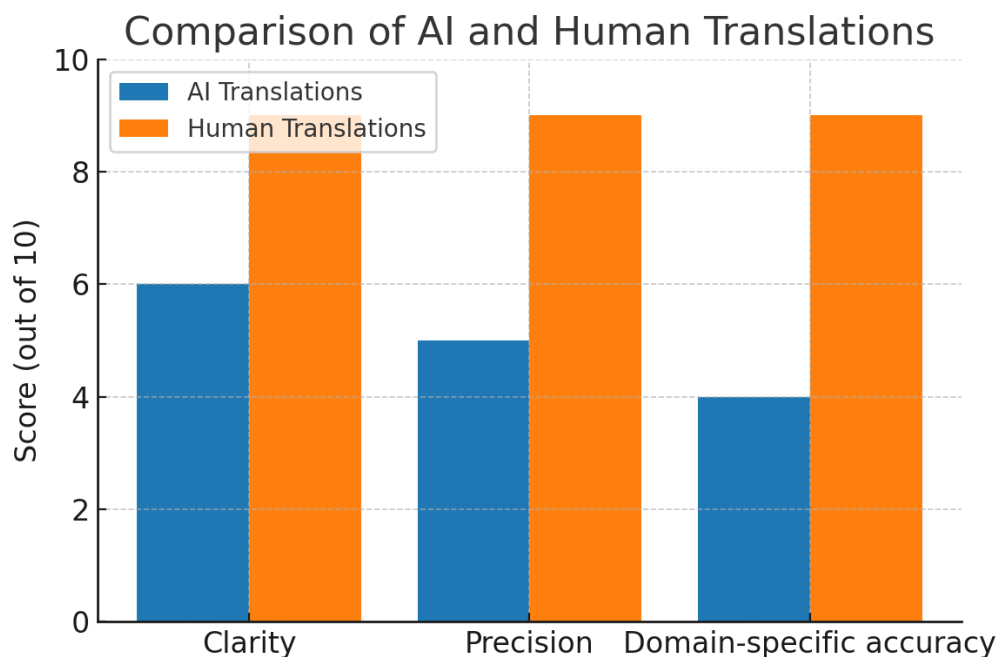
Analysis of AI and human translations across different domains

Task	Materials used	Focus of analysis	Key findings	Observed learning outcome
Comparison of AI and human translations of technical texts	Technical texts (electromechanical systems, safety protocols) translated from Ukrainian to English using Google Translate, DeepL, and professional human translations	Clarity, precision, and domain-specific accuracy	AI often mistranslated industry-specific terms (e.g., 'заземлення' inconsistently as 'grounding' or 'earthing')	Improved ability to validate translations, greater awareness of semantic nuances, and understanding of terminological consistency

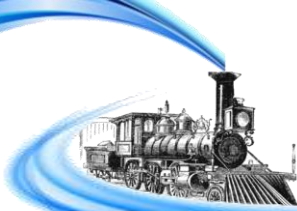


Task	Materials used	Focus of analysis	Key findings	Observed learning outcome
Review of AI translations of legal contracts	Bilingual legal contracts translated using Google Translate, DeepL, and human legal translators	Accuracy of legal terminology and preservation of contractual meaning	AI occasionally misinterpreted legal clauses, altering intended obligations	Enhanced awareness of the risks of AI translation in high-stakes documents; improved legal terminology recognition
Analysis of AI translations of medical documentation	Medical protocols and patient care guidelines translated using AI tools and compared with human medical translators	Correct use of medical terminology and clarity of procedural instructions	AI substituted non-standard terms that could cause misunderstandings in medical practice	Strengthened capacity to verify critical domain terminology; increased caution with medical content translation
Evaluation of AI translations of marketing materials	Advertising texts translated by AI tools and professional marketing translators	Tone, cultural appropriateness, and persuasive language	AI maintained literal meaning but failed to adapt persuasive tone and cultural references	Improved understanding of cultural adaptation in translation; increased ability to detect tone misalignment

Source: Compiled by the authors.



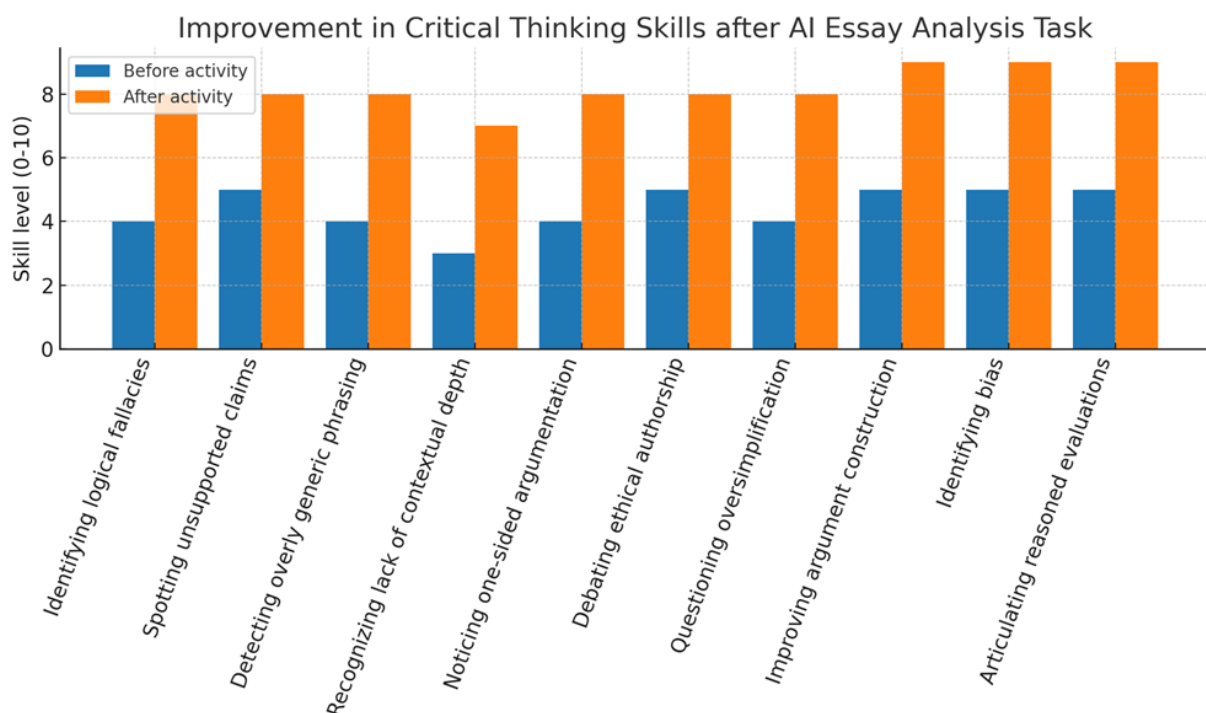
Source: based on authors' research.



Example 3. Debating ethical scenarios involving AI assistance in academic writing.

A third component of the course involved reading and analysing AI-generated argumentative essays on topics such as climate change, energy policy, and academic integrity.

Improvement in critical thinking skills after AI-generated essay analysis task



Source: based on authors' research.

Students were asked to identify logical fallacies, unsupported claims, and overly generic phrasing – common features in unedited AI writing. One group analysed a ChatGPT essay arguing for the use of nuclear energy in Ukraine. While the structure was logically coherent, students criticized the lack of contextual depth and one-sided presentation of benefits. This exercise prompted debates on ethical authorship, the dangers of information oversimplification, and the role of human judgment in academic work.

Across all tasks, students' written reflections and oral contributions showed a measurable shift from passive acceptance of AI outputs to active questioning, source triangulation, and skepticism – core indicators of critical thinking. Final assessment tasks revealed [10] significant improvement in the ability to construct arguments, identify bias, and articulate reasoned evaluations of English-language texts produced or mediated by AI.



The scientific results of the study justify the claim that targeted analysis of AI-generated and AI-verified materials, when embedded in a structured pedagogical framework, can effectively develop critical thinking skills in technical students. This is particularly impactful in the Ukrainian context, where future professionals must be equipped not only with technical knowledge, but also with the cognitive tools to navigate a complex, information-saturated, and politically charged global environment.

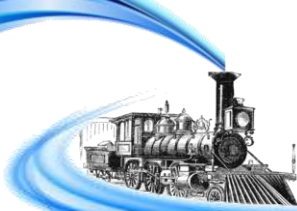
Conclusions and prospects for further research

The results of this study confirm that the thoughtful integration of AI-generated and AI-verified English-language sources into the learning process can [11] meaningfully contribute to the development of critical thinking skills among students of technical specialities. Far from being passive consumers of digital content, students learned to engage actively with information – to question, analyse, compare, and reflect – even when the source appeared linguistically flawless or factually convincing. Through guided tasks and real-life examples, they developed the ability to detect bias, identify logical inconsistencies, and make reasoned judgments, all of which are essential competencies for both academic and professional success.

This is especially relevant in the context of modern Ukraine, where the educational system continues to function [12] under the stress of military aggression, societal disruption, and digital information warfare. In such a setting, language education must extend beyond grammar and vocabulary – it must foster intellectual resilience and prepare students to operate critically within complex information ecosystems. This study illustrates that AI tools, often viewed as shortcuts or potential threats to academic integrity, can in fact become powerful allies when used pedagogically to promote cognitive engagement and analytical thinking.

However, this research also opens the door to further questions. Future studies could investigate how students' critical thinking develops over longer periods and whether these skills transfer to other domains beyond language learning – such as professional communication, civic participation, or technical decision-making. There is also a need to explore differentiated approaches for learners with varying levels of digital literacy, especially in regions with limited access to technology or stable infrastructure. Moreover, the ethical dimensions of AI use in education – particularly regarding authorship, transparency, and reliance – merit deeper and more interdisciplinary investigation.

In conclusion, the findings underscore the potential of AI not as a replacement for human reasoning, but as a stimulus for it. When framed within a thoughtful pedagogical design, AI becomes not the enemy of critical thinking, but its proving ground – especially in a nation where truth, autonomy, and clarity of thought are among the most powerful tools of resistance and reconstruction.



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