THE PARADOX OF ARTIFICIAL INTELLIGENCE USAGE IN HIGHER EDUCATION: BETWEEN ENHANCING LEARNING EFFECTIVENESS AND THE DECLINE OF STUDENTS CRITICAL THINKING SKILLS

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ABSTRAK

Perkembangan *Artificial Intelligence* (AI) membawa perubahan besar dalam pendidikan tinggi, terutama dalam meningkatkan efektivitas pembelajaran dan memberikan personalisasi yang adaptif. Penelitian ini mengkaji paradoks penggunaan AI yang sekaligus meningkatkan efektivitas pembelajaran namun berpotensi menurunkan kemampuan berpikir kritis mahasiswa. Metode deskriptif kuantitatif digunakan dengan pengumpulan data melalui kuesioner skala Likert 4 poin kepada 70 mahasiswa dari berbagai negara (Indonesia, China, Malaysia, dan Tunisia) serta wawancara dengan dosen yang menyampaikan data nilai akademik mahasiswa terkait tingkat penggunaan AI dalam menyelesaikan tugas. Hasil kuesioner menunjukkan skor rata-rata efektivitas pembelajaran berbasis AI pada kategori tinggi di semua negara (3,01–3,16), sementara skor kemunduran kemampuan berpikir kritis berada pada kategori sedang (2,3–2,68), mengindikasikan adanya penurunan kemampuan analitis seiring intensitas penggunaan AI. Data nilai mahasiswa dari wawancara tersebut mendukung temuan bahwa penggunaan AI yang berlebihan berpotensi menyebabkan *cognitive offloading* yang dapat mengurangi kemandirian berpikir mahasiswa. Kesimpulannya, AI efektif meningkatkan proses pembelajaran namun diperlukan strategi seimbang agar mahasiswa tetap aktif dan mandiri secara intelektual di era digital

Kata Kunci : Kecerdasan buatan, efektivitas pembelajaran, berpikir kritis, pengalihan kognitif, pendidikan tinggi.

ABSTRACT

The development of Artificial Intelligence (AI) has significantly transformed higher education by enhancing learning effectiveness and providing adaptive personalization. This research explores the paradox of AI usage, which improves learning outcomes but may diminish students' critical thinking skills. A quantitative descriptive method was used, collecting data through a 4-point Likert scale questionnaire from 70 students across Indonesia, China, Malaysia, and Tunisia, along with interviews with lecturers regarding students' academic performance related to AI usage in assignments. The questionnaire results show that the average score for AI-based learning effectiveness is high across all countries (3.01–3.16), while the decline in critical thinking skills is moderate (2.3–2.68), indicating a decrease in analytical abilities with increased AI usage. Interview data further support the finding that excessive AI use can lead to cognitive offloading, reducing students' independence in thinking. In conclusion, while AI effectively enhances the learning process, it is crucial to implement balanced strategies to ensure that students remain active and intellectually independent in the digital era.
Keywords: Artificial Intelligence, learning effectiveness, critical thinking, cognitive offloading, higher education.

INTRODUCTION

The rapid development of Artificial Intelligence (AI) technology has driven significant transformation in higher education. AI enables adaptive personalized learning, automated assessment, and more efficient access to materials, thereby enhancing the quality of the teaching and learning process[1]. demonstrates that the utilization of AI-based chatbots and interactive platforms has been proven to enrich students' learning experiences and reduce lecturers' administrative burdens.[2] Furthermore emphasizes that the integration of AI in project-based learning effectively fosters the development of critical and creative thinking skills[3]. Various tools such as Grammarly, ChatGPT, QuillBot, Mendeley, and Turnitin are widely

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used by students to improve academic effectiveness and productivity[4],[5] The capability of AI models to generate human-like text and complete complex tasks has also been discussed by[6].

Numerous studies in the past decade indicate that the adoption of AI in higher education significantly affects the quality of learning and students' cognitive development. Sugiarto et al. (2024)[1] highlight AI's role in learning personalization and increased accessibility to digital materials, while Rifky (2024)[2] and Adnin (2024)[3] report that using AI-supported chatbots, interactive platforms, and project-based learning boosts student motivation, engagement, and creativity. Rabbianty et al. (2023)[4] dan Wulandari et al. (2024)[5] document the use of AI tools like Grammarly, ChatGPT, and QuillBot to support more effective and efficient academic task completion. However, research by Nasution et al (2025)[7], Parveen & Kumar, (2024)[8], and Wirawan et al. (2024)[9] underline the negative potential of cognitive offloading—students' dependence on AI which may ultimately reduce the intensity of critical thinking and deep reasoning during learning. These studies form the understanding that although AI offers significant benefits to higher education, caution is needed to ensure its use continues to promote the development of students' critical thinking skills rather than hindering their intellectual independence.

Despite the various benefits, a new paradox emerges that deserves attention. Nasution et al. (2025)[7] found that excessive dependence on AI can diminish students' cognitive abilities, especially critical thinking. Parveen & Kumar (2024)[8] describe cognitive offloading as students' tendency to transfer cognitive load to technology, which can weaken thinking autonomy. Wirawan et al. (2024)[9]

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specifically note a potential decline in reasoning and decision-making skills due to AI dominance in the learning process. Similar concerns are raised by Erduran & Levrini, (2024)[10] and Jelahut et al. (2021)[11], who highlight the risk of students accepting AI recommendations without critical evaluation. Besides diminished analytical skills, AI usage may also increase plagiarism risks, raise data privacy issues, and widen digital divides[9].

Unlike many prior studies focusing on AI's role in innovation and learning efficiency, few have specifically examined the mechanisms and factors mediating the decline in critical thinking skills in Indonesian higher education contexts. This study aims to investigate the paradox of AI use in higher education—how this technology can simultaneously enhance learning effectiveness while potentially reducing students' critical thinking abilities. By measuring the extent of AI's influence on these two aspects, this research is expected to contribute scientific understanding.

RESEARCH METHOD

This study employs a quantitative descriptive approach aimed at systematically and accurately depicting the phenomenon of Artificial Intelligence (AI) use in higher education, particularly concerning the paradox between increased learning effectiveness and the decline in students' critical thinking skills based on measurable data[12]. Data collection was conducted using two primary instruments: interviews with lecturers and a questionnaire distributed via the Google Forms platform, chosen for its user-friendly interface and integrated analytical features that facilitate efficient data management and interpretation. The questionnaire comprised 20 closed-ended items with a 4-point Likert scale, divided into two categories: 10 items measuring the effectiveness of AI-based learning and 10 items assessing perceptions of the decline in critical thinking skills due to AI use, including a mix of positively and negatively worded items to reduce response

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bias[13]. The study subjects consisted of two groups: 15 students who completed assignments with AI assistance and 70 students from various universities, disciplines, and countries (China, Malaysia, Tunisia, and Indonesia) actively using AI in their learning processes. The diversity of respondents aimed to enrich the dataset and broaden the scope of findings through the variation in student perceptions and experiences. The collected questionnaire data were analyzed using descriptive statistics to identify patterns and trends, while interview data were processed thematically to deepen understanding of the paradoxical impact of AI in the learning context, resulting in a holistic mapping of both the benefits and risks of AI use in higher education.

RESULTS AND DISSCUSSION

1. RESULTS

a. Interview

The first set of data in this study was collected through interviews with lecturers. The percentage of AI usage in assignments was calculated using an AI checker application, while students' grades were determined based on several components: comprehension of the assignment (60%), participation in the learning process (20%), and the quality of the submitted work (20%), totaling 100%. Below are the final assignment grades obtained from the students:

Subject	AI (%)	Mark	Grade
1	88%	85	A
2	42%	85	A
3	65%	84	A-
4	51%	90	A
5	57%	90	A
6	48%	85	A
7	35%	90	A
8	66%	90	A
9	43%	88	A
10	67%	83	A-
11	55%	85	A

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12	68%	90	A
13	29%	90	A
14	33%	85	A
15	59%	85	A

The data indicate that the use of artificial intelligence (AI) by students during the completion of assignments contributes significantly to their learning outcomes. This is reflected in the academic achievements of all students, which demonstrate positive impacts from the integration of AI in technology-based learning activities within the academic environment.

b. Quissioner

The data obtained from the questionnaire use a Likert scale from 1 to 4, where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. Before analysis, the questionnaire data were processed; since some statements were negative, reverse scoring was applied. Below are the results of the questionnaire data after grouping should be concise, factual, and state briefly the purpose of the research, the principal results and major conclusions.

1) Indonesia

Subject	Variable	Average
49 Student	v1	3,03
	v2	2,47

2) China

Subject	Variable	Average
15 Student	V1	3,05
	V2	2,65

3) Malaysia

Subject	Variable	Average
5 Student	V1	3,16
	V2	2,68

4) Tunisia

Subject	Variable	Average
1 Student	V1	3,01
	V2	2,3

After the data were analyzed and the average for each category was obtained, the data were then classified according to the predetermined categories. The results showed that every student believes AI makes learning easier for them. However, students also recognize that AI has a negative impact on their critical thinking abilities.

DISSCUSSION

The development of artificial intelligence (AI) in higher education has had a dual impact, on one hand enhancing learning effectiveness, while on the other hand raising concerns about students' critical thinking abilities. Several studies indicate that the use of AI can improve learning outcomes through personalization and rapid feedback[14]. This study explores both aspects through two groups of subjects: 15 Indonesian students to analyze the influence of AI usage in the learning process, and 70 students from diverse backgrounds (Indonesia, China, Malaysia, and Tunisia) to understand their perceptions of this technology.

The selection of diverse respondents allows for a comprehensive analysis of how AI is adopted in various educational cultural contexts. Initial findings suggest that while AI significantly contributes to academic achievement, there is also a noticeable trend of declining critical thinking skills that warrants serious attention. Previous research indicates that excessive reliance on technology can reduce students' metacognitive engagement[15]. The combination of task analysis and questionnaire methods in this study offers a comprehensive view of AI's impact in higher education, capturing both measurable learning outcomes and student perceptions. While task analysis reveals how AI affects academic performance, the questionnaire highlights students' attitudes and experiences. This dual approach enriches the findings, emphasizing that AI influences not only what students achieve, but also how they engage with and perceive the learning process.

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a. Interview

The researcher collected assignments from 15 students who served as the subjects of this study. Each assignment was analyzed using an AI detection tool (AI checker) to measure the extent to which artificial intelligence contributed to its completion. This process aimed to objectively quantify AI involvement by generating a percentage score that reflects AI-generated content within each submission. Based on the results, the data were categorized into two groups: high AI use (greater than 60%) and low AI use (less than 60%), following the classification method used by[16].

After categorizing the assignments, the researcher proceeded to document and analyze the corresponding grades awarded to each student. These grades were based on standard academic assessment criteria, including content accuracy, coherence, originality, and structure. The categorization allows for a comparative overview between the level of AI reliance and the quality of student output, as reflected in their academic performance. The following are the students' assignment grades, presented according to their respective AI usage groupings.

The following are the students' assignment grades, already categorized accordingly:

Table 1. Student Assignment Score

Category	Average (%)	Grade
High use Ai	86,4%	A
Low use Ai	87,3%	A

The table above shows that students with varying levels of AI utilization—whether >60% or <60%—consistently achieved high academic grades in the A and A- range. These final grades were not solely based on assignment outcomes, but also took into account student participation, comprehension of the material, and the quality of submitted work. These findings confirm that proportional use of AI can support academic achievement without compromising the quality of understanding or student engagement in the learning process. The success of students in achieving high grades through the diverse utilization of AI demonstrates that the use of this technology can complement the learning process holistically. AI is not merely a tool to assist in task completion but also serves as an educational resource that encourages students to be more active in understanding the material.

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With the presence of AI, students can quickly access a variety of references and sources of information, thereby enriching their knowledge and deepening their understanding of the concepts being studied. This is important because quality academics are not only determined by the final results of assignments but are also supported by an active and in-depth learning process.Other research confirms that AI use can increase the effectiveness of the learning process, speed up access to information, and help students structure and personalize their assignments[17].

More broadly, AI is recognized as playing a significant role in motivating and fostering student independence. AI provides real-time feedback and personalized learning, which enhances motivation and improves academic outcomes. Recent research also indicates that 90% of students feel more motivated to learn with AI assistance, and that AI is instrumental in delivering innovative, interactive, and adaptive learning experiences[18]. However, alongside the various benefits offered, the implementation of AI in education must remain under strict supervision to prevent excessive dependence that could diminish students' critical thinking and independence.

The use of AI needs to be accompanied by policies that regulate the boundaries and ethics of utilizing this technology, as well as integration that aligns with humanistic and interactive teaching methods. With proper management, AI has great potential to continue supporting the enhancement of academic achievement and the quality of learning, especially in facing the challenges of an increasingly dynamic and rapidly evolving digital era. This strategic policy is essential to ensure that AI remains a supportive tool that strengthens, rather than replaces, the roles of educators and students in the educational process.

b. Quissioner

The second research subject group consists of 70 students from diverse cultural backgrounds and different educational systems, including students from various countries. Data collection was conducted using a carefully designed questionnaire aimed at evaluating students' perceptions of the impact of artificial intelligence (AI) implementation on their learning experiences. The questionnaire focused on assessing students' awareness of the benefits and influences of AI in the

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learning process, including aspects such as learning effectiveness, motivation, and ease of access to information.

After the questionnaire was distributed and collected, the data from student responses were classified based on the respondents' countries of origin. The next stage of data processing involved calculating the average scores for each country group, which were then categorized into predetermined classifications. This categorization approach aims to systematically identify and compare the differences in perceptions among students from various cultural and geographical backgrounds. By establishing comprehensive analysis criteria, this research seeks to explore how cultural factors and educational contexts influence students' attitudes and views toward the integration of AI technology in learning, thereby providing a deeper and nuanced understanding of the dynamics of AI adoption in various higher education environments.

Table 2. Average Categories[19]

Average (%)	Category
3-4	High
2-2,9	Medium
1-1,9	Low

After completing data collection, the data were then analysed using the following formula:

$$Rata - rata(mean) = \frac{\sum X}{N} \text{ [20]}$$

$\sum X$ = the total sum of all questionnaire scores/responses from all respondents

N = the number of respondents/total data

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Table 3. Average Questionnaire Score

Countries	Learning Effectiveness	Category	Decline in critical thinking	Category
Indonesia	3,03	**High**	2,47	**Medium**
China	3,05	**High**	2,65	**Medium**
Malaysia	3,16	**High**	2,68	**Medium**
Tunisia	3,01	**High**	2,3	**Medium**

The results of the questionnaire analysis involving 70 students from four different countries and universities indicate that the integration of artificial intelligence (AI) in the learning process has a positive impact on learning effectiveness. The average scores for the learning effectiveness indicators obtained from each country—Indonesia (3.03), China (3.05), Malaysia (3.16), and Tunisia (3.01)—all fall within the "high" category, indicating that the majority of students from these countries perceive AI-based learning as an effective method. Factors such as ease of access to information, real-time feedback, and AI's ability to assist in rapid problem-solving are significant aspects that enhance students' understanding of the material and significantly boost their learning productivity. These findings are consistent with contemporary learning theories that emphasize the role of adaptive technology in improving interaction and the quality of the teaching-learning process.

Furthermore, the personalized learning experiences provided by AI technology allow students to tailor their learning experiences according to their individual needs and learning styles. This adaptation creates a more flexible and responsive learning environment that accommodates the diverse characteristics of learners, thereby optimizing the internalization of educational material. With interactive, easily accessible learning resources that can be accessed at any time, AI is capable of addressing various learning challenges in the digital era, including limitations of time and space. Therefore, the integration of AI not only strengthens the effectiveness of learning but also supports the sustainability of inclusive education that is oriented towards self-directed learning on a global scale.

These findings are in line with the results of Wang et al (2024)[21]in their study titled "Artificial intelligence in education: A systematic literature review," which found that adaptive learning made possible by AI in education (AIED) can improve student test scores by up to 62%. Moreover, the general use of AI has been shown to increase student performance by 30% and reduce anxiety by 20%. These findings confirm that AI serves as a catalyst for educational transformation that is effective, adaptive, and relevant to the needs of modern times. The role of AI in enhancing learning effectiveness is not limited to the use of advanced technology, but also includes a significant improvement in the quality of the learning experience and student outcomes.

In examining the variable of declining critical thinking skills associated with the use of artificial intelligence (AI), the research findings reveal average scores of 2.47 for Indonesia, 2.65 for China, 2.68 for Malaysia, and 2.3 for Tunisia. All these scores fall within the "moderate" category, with Indonesia, China, and Malaysia approaching the upper limit of this classification. These results suggest a notable trend among students in these three countries, indicating that as their engagement with AI in learning intensifies, they may exhibit symptoms of diminishing critical thinking skills. Conversely, Tunisia's score of 2.3 also reflects a similar trend, albeit with a slightly lesser impact compared to the other nations.

The implications of these findings are significant, as they suggest that the convenience and efficiency afforded by AI may inadvertently lead some students to become less proactive in exercising their analytical and evaluative skills independently. This phenomenon raises concerns about the potential shift in students' roles from active participants in the learning process to passive consumers who exhibit a high degree of dependency on technology. If this trend persists without deliberate efforts to enhance critical thinking literacy within educational frameworks, there is a tangible risk that students may increasingly rely on AI for cognitive tasks, thereby undermining their ability to engage in independent thought and analysis [7].

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Supporting this perspective, the research conducted by Favero et al (2025)[22] corroborates the notion that increased frequency of AI usage correlates positively with cognitive offloading ($r = +0.72$). This indicates that students are more likely to offload cognitive tasks onto AI systems as their reliance on these technologies grows. Furthermore, a significant negative correlation is observed between the intensity of AI use and critical thinking scores ($r = –0.68$), suggesting that heightened dependence on AI is associated with diminished critical thinking capabilities. Additionally, a robust negative correlation exists between the level of cognitive offloading and critical thinking ability ($r = –0.75$), reinforcing the idea that as students delegate cognitive responsibilities to AI, their critical thinking skills may deteriorate.

Further regression analysis reveals a total negative effect of AI use on critical thinking ability quantified at $–0.42$ ($SE = 0.08$; $p < 0.001$), underscoring the statistical significance of this relationship. These findings highlight the urgent need for educational strategies that not only promote the effective utilization of AI but also prioritize the cultivation of critical thinking skills among students. In light of these insights, it is imperative for educators and policymakers to develop instructional approaches that strike a balance between leveraging AI technologies and fostering an environment conducive to critical thinking development. This may involve integrating AI tools in a manner that encourages active engagement, critical inquiry, and reflective practices, ensuring that students remain active participants in their learning journeys.

By doing so, educational institutions can mitigate the risks associated with cognitive offloading and dependency on technology, ultimately enhancing the overall quality of education in the digital age. This can be achieved by integrating balanced pedagogical approaches that combine traditional learning methods with digital tools, ensuring that students not only have access to information but also develop critical thinking, problem-solving, and memory retention skills. Furthermore, institutions should promote digital literacy programs that teach students how to use technology responsibly and reflectively, rather than relying on it as a crutch. Teachers can also play a vital role by designing learning activities that require active engagement, collaboration, and independent reasoning, rather than passive consumption of information. Through such strategies, schools and universities can foster a more resilient, adaptable, and intellectually capable

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generation that can thrive amidst rapid technological advancement without becoming overly reliant on it.
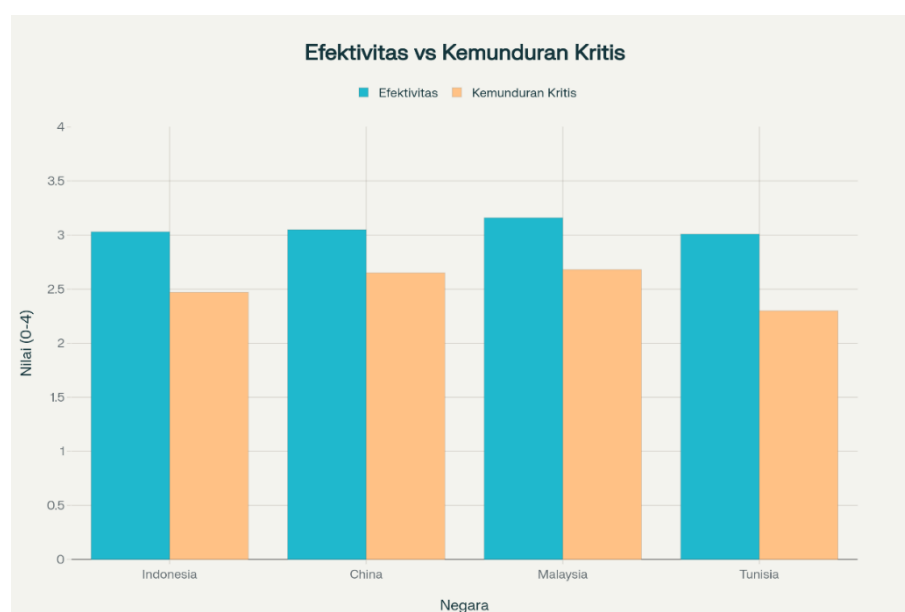

Figure 1. Diagram of Learning Effectiveness vs Decline in Critical Thinking

Diagram Explanation:

The average scores for **learning effectiveness**, which fall within the high category across all countries, indicate that students have a positive perception of the use of artificial intelligence (AI) as a tool capable of enhancing the quality of the learning process. This perception reflects a belief that AI can support various aspects of learning, such as accelerating access to information, providing real-time feedback, and offering more interactive and personalized learning resources tailored to individual needs. Consequently, the integration of AI in education is viewed as an effective technological innovation that strengthens material comprehension and enhances students' academic productivity across diverse cultural contexts and educational systems.

On the other hand, the evaluation results concerning the variable of **declining critical** thinking **skills** reveal scores in the moderate category for all four countries, with the highest score in Malaysia (2.68) and the lowest in Tunisia (2.3). This indicates a concern among students that intensive use of AI may potentially diminish their critical thinking abilities. This concern is crucial to address in the development of educational policies and the implementation of AI technology,

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ensuring that the use of AI does not replace the analytical and reflective activities that are central to critical thinking. Therefore, learning strategies that integrate AI need to be carefully designed to continue promoting the development of critical thinking skills while maximizing the benefits of technology in supporting effective and meaningful learning processes.

CONCLUSION

This research demonstrates that the integration of artificial intelligence (AI) in higher education across Indonesia, China, Malaysia, and Tunisia significantly contributes to enhancing learning effectiveness, as evidenced by students' positive perceptions of AI use in the learning process. The advantages of AI, such as ease of access to information, real-time feedback, and personalized learning experiences, are perceived as effective tools for accelerating the understanding of learning materials and boosting students' motivation. These findings align with the study by Wang et al. (2024), which indicates that adaptive learning systems powered by AI can lead to improved academic performance and reduced student anxiety. The ability of AI to tailor educational experiences to individual needs not only fosters a more engaging learning environment but also empowers students to take ownership of their educational journeys.

However, this study also uncovers a critical phenomenon—the potential decline in critical thinking skills as the use of AI becomes more pervasive. The average critical thinking decline scores across all participating countries fall within the moderate category, with Indonesia, China, and Malaysia nearing the upper limit of this classification. This trend suggests a rising risk of cognitive offloading, where students may rely excessively on AI tools for information and problem-solving, thereby diminishing their active cognitive engagement. Such findings raise important questions about the long-term implications of AI integration in education, particularly regarding the development of essential cognitive skills that are vital for academic and professional success.

This result is further supported by Favero et al. (2025), who report a strong negative correlation between AI use, cognitive offloading, and critical thinking ability. This correlation emphasizes the need for vigilance regarding the unintended consequences of technology in educational settings. In response to these challenges, it is imperative for academics and education policymakers to prioritize balanced strategies that harness AI innovations to enrich the learning experience while simultaneously reinforcing students' critical literacy and analytical skills. Educational curricula should be designed to ensure that students continue to actively engage in reflective thinking, problem-solving, and independent decision-

making. By doing so, we can ensure that technological advancements do not come at the expense of developing competencies that are central to 21st-century skills. Overall, this study underscores the necessity of a holistic approach that integrates the strengths of AI technology with the cultivation of a critical thinking culture, thereby creating an adaptive, effective, and sustainable learning ecosystem in the era of the digital revolution.

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