



AI Tools and the Risk to Critical Thinking Skills in Undergraduate Courses

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Abstract

This study investigates the potential risks posed by the increasing reliance on AI tools to undergraduate students' critical thinking skills. As the use of automated writing assistance becomes more prevalent, it is vital to understand the implications for students' independent analysis, creativity, and problem-solving abilities. The primary objective of this research is to explore the extent to which students use AI tools in their writing processes and to assess how this reliance may affect their originality and critical thinking skills. Based on preliminary observations, the study hypothesizes that frequent reliance on AI tools may diminish students' critical thinking capabilities. Further, it is anticipated that instructors may view AI as a potential threat to the development of independent reasoning skills in their students, possibly leading to resistance against the integration of such technologies in educational settings. The research methodology comprises a comprehensive survey targeting approximately 60 instructors and 203 undergraduate students. This study is structured into two phases: the first gathers insights from undergraduate students, while the second collects perspectives from instructors. A key aspect of this research is to identify and evaluate each party's awareness of reliance on AI tools in writing. Quantitative analysis will involve statistical assessments to determine the relationship between the frequency of AI tool use and students' critical thinking outcome metrics. In contrast, qualitative analysis will provide deeper insights into personal experiences and perceptions regarding AI assistance. This dual approach aims to paint a holistic picture of the interplay between technological support and intellectual autonomy in academic writing. Overall, the findings from this study are expected to make significant contributions to the ongoing discourse on the role of technology in education, particularly in the development of writing and critical thinking. By identifying the potential risks of relying on AI, the study aims to inform both educational practices and policy-making, ensuring that technological advancements enhance rather than hinder students' intellectual growth.

Keywords: AI Tools, Critical Thinking, Undergraduate Education, Automated Writing Assistance, Independent Analysis, Technological Integration

Introduction

The introduction of OpenAI platforms to individuals of all ages and to anyone possessing a smartphone marked the initial step, the implications and consequences of which will become evident over time through experience. As an educator, I have found this development to be a time-saving facilitator, a tireless assistant, and a troubleshooting companion for technical issues—an otherwise restless situation. Presently, these tools have streamlined my professional responsibilities and made teaching methodologies more adaptable and accessible in my classroom environments. Emphasizing the crucial factor that all the features that are offered by these platforms are learned in the process of usage, excluding any elements of their ethical, authenticity, and reliability. On the other hand, the rapid integration of artificial intelligence (AI) tools into higher education has transformed how students approach all their courses, especially in those where critical thinking and analytical skills are essential. Applications such as automated grammar checkers, paraphrasing engines, and generative text platforms promise efficiency and support, yet they also raise concerns about the erosion of essential cognitive skills. For example, in composition courses, where the development of critical thinking is a central objective, the reliance on AI may inadvertently shift students away from independent reasoning and toward passive dependence on machine-generated outputs. Prior to such an introduction, undergraduate students typically approached an assignment by visiting the library, using online platforms, or searching for information on search engines to support their hypotheses. After gathering their findings, they would read and verify whether the information was relevant to their topic, then paraphrase or summarize it for use as supporting evidence. Fostering problem-solving skills includes rethinking teaching methods in light of the potential dangers of using ChatGPT and ways to mitigate them



[1]. However, over the past two years, this process has changed significantly, as AI tools now enable these practices instantly. This development may have led students to rely entirely on the reliability and relevance of the content provided by these tools. Tasks that AI tools can easily perform can be shifted toward more complex evaluations in educational practice by focusing less on general writing skills [2]. According to Zhai [3], designing learning goals so that policymakers and educators focus more on critical thinking and the effective use of AI tools.

Critical thinking—defined as the ability to analyze, evaluate, and synthesize information—remains a cornerstone of undergraduate education. Composition courses, in particular, are designed to cultivate these skills through tasks that require students to construct arguments, evaluate evidence, and express original ideas. However, when students substitute AI-generated text for their own analysis, they risk diminishing their capacity to engage deeply with content. In a study by T. Demirel, E. [4], students' perceptions and approaches towards AI indicate concern about accuracy, ethical implications, and the potential for overreliance on it. This pattern of reasoning is essential for students to develop a proper sense, not only academically but also in their future endeavors. Such skills are often observed as a single pattern, but they can be more than one, such as problem-solving, open-mindedness, and creativity. Critical thinking is essential for minimizing the acceptance of inaccurate beliefs by enabling individuals to assess, evaluate, and reorganize their thoughts. It encompasses understanding logical inquiry methods and addressing personal biases and misinformation. Students and adults must develop these skills to tackle personal and societal challenges effectively. Critical thinking involves refining ideas, making informed decisions, and improving solutions. While it is emphasized in educational settings, effective critical thinking is not automatically developed through college courses; it requires structured instruction and practice [5].

Literature Review

Contemporary researchers agree that critical thinking is “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which judgment is based” [6]. Brookfield [7] and Banning [8] contend that critical thinking involves differentiating, analyzing, and evaluating information, as well as reflecting on how this data will be utilized to assess and inform scientific decisions. Typically, critical thinkers are presumed to possess a goal and curiosity aimed at resolving contradictions; however, when AI applications are used to perform their tasks, the development of such skills is diminished. Several studies agree that “the influence of AI on the decision-making process may lead to a situation where people engage less in critical thinking, relying instead on algorithmic recommendations” [9]. The primary goal of AI is to develop tools and machines that can understand and adapt to their environment and changing conditions, so that they resemble the human mind [10]. Based on an article on students' perceptions of feedback, 71.1% found AI tools mostly helpful, with only occasional use for developing skills in analyzing information and forming arguments. Although these tools assist in this area, they are not always flawless [11]. The majority of educational institutions have found themselves unprepared for the patterns of AI tools, particularly in terms of affordability and the time required to implement and properly integrate these tools into the teaching process [12]. The professors and lecturers frequently lack adequate training and instruction in AI technology; as a result, their adaptation may be erratic and problematic [13]. Mollick [14] states that if the use of AI increases, the intellectual effort by individuals will become reluctant to take any responsibility towards activities and tasks, and this is for the simplest reason that AI tools are easier and faster in providing a logical answer, especially when the user is illiterate on the topic.

Society's optimistic outlook on the future focuses on using AI platforms to improve efficiency and convenience across academic, economic, and social domains. Nonetheless, this optimistic view presumes a society that is intellectually prepared to employ such tools optimally; however, the reality diverges significantly. We have access to a free, extremely powerful application, such as ChatGPT, available to every individual regardless of age, gender, origin, intention, or cognitive ability, who can and does use it at their convenience without any repercussions. Whether such a pattern was ever tested and its effects ever been comprehended, this is something that only time will show; adding its responsibility to the role of governments and educational institutions to be the central guarantees of AI's successes and adaptabilities in the teaching and learning processes that simultaneously boost critical thinking behaviors starting from students to every other party involved [15].



On the one hand, AI tools facilitate access to information by not only making the research process much faster but also encouraging students' curiosity in assessing their own questions and answers [16]. Several scholars claim that AI enhances educational opportunities by generating new learning materials, offering personalized feedback and language support, and automating administrative tasks. Their research also supports encouraging online education within the system, as AI tools can provide students with additional resources that make online learning more interactive and engaging. Applying these insights to the current study, activities like expert seminars, workshops, and field visits can transform learning experiences by combining face-to-face participation with online resources, allowing students to connect directly with the environment and social contexts. Such hybrid approaches, blending traditional and innovative methodologies, can significantly benefit education. Additionally, professors and lecturers could provide tailored tutoring to address specific questions, thereby improving students' understanding [16]. However, both lecturers and students frequently find themselves overwhelmed by data and information. When retrieving information via these platforms, they must exercise caution to verify the accuracy and relevance of the data, ensuring it is not fabricated by AI manipulation. Nonetheless, one may question whether such skills are already ingrained in undergraduate students, given that their knowledge of the subject remains in its infancy. For example, an instructor might ask students to use ChatGPT to compose an essay on a class-related topic. Afterward, students would be asked to critique the essay. Analyzing its strengths and weaknesses can facilitate the exploration process [17]. In an article published in 2019, Jonathan Michael Spector & Shanshan Ma stated that: "*Critical thinking is one of four keys 21st century skills— communication, collaboration, critical thinking, and creativity. Though most people are aware of the value of critical thinking, it lacks emphasis in curricula.*" By highlighting, "While much funding and support go to the development of artificial intelligence, this should not happen at the expense of human intelligence." [18]. Spector and Ma (2019a) highlight critical thinking as one of four essential 21st-century skills—alongside communication, collaboration, and creativity—yet they observe that it remains underemphasized in curricula despite widespread recognition of its value. In a related contribution, Spector and Ma (2019b) argue that while substantial funding and support are directed toward artificial intelligence, this progress must not come at the expense of cultivating human intelligence and inquiry skills. Together, these works underscore a pressing concern: although critical thinking is universally acknowledged as vital for preparing learners to navigate complex challenges, educational systems risk neglecting its development in favor of technological advancement, thereby weakening the very human capacities that AI cannot replace [19].

Research Questions

- **RQ1:** To what extent do undergraduates rely on AI tools in their courses?
- **RQ2:** How does AI use affect originality and independent analysis?
- **RQ3:** What are students' and instructors' perceptions of AI's role in writing?

Hypotheses:

- **H1:** Frequent AI use reduces critical thinking skills.
- **H2:** Heavy reliance on AI lowers originality in student writing.
- **H3:** Instructors perceive AI as a threat to independent reasoning.

Methodology

Data were gathered from both primary and secondary sources, including reliable domains such as Springer, Elsevier, and Google Scholar, as well as the most up-to-date articles, given that the topic's relevance is constantly changing and that these rapid changes have had an even greater impact on the audience, especially in academic settings. This study was divided into two phases. The first involved distributing a questionnaire via a Google Forms link to 203 undergraduate students from diverse majors, accessible from October 2024 to February 2025, and focused on AI use and practices in relation to the academic guidelines provided to the students. The second phase targeted university instructors, involving 60 participants who responded to a questionnaire containing multiple-choice, Likert-scale, and open-ended questions aimed at eliciting their personal perceptions of AI tools they use and their students use, as well as their impact on the teaching process, with an emphasis on critical skills.

Statistical Methodology: Data analysis was conducted using *SPSS*. Descriptive statistics were first applied to summarize the dataset. Group comparisons were performed using the **Kruskal–Wallis test**, while associations between variables were examined with the **Spearman correlation coefficient**. To assess predictive relationships, **linear regression models** were employed. Reliability of the cognitive skills scale



(Q9, Q10, Q13, and Q7) was assessed using Cronbach's Alpha, yielding $\alpha = 0.800$, indicating good internal consistency. Statistical significance was set at $p < 0.05$.

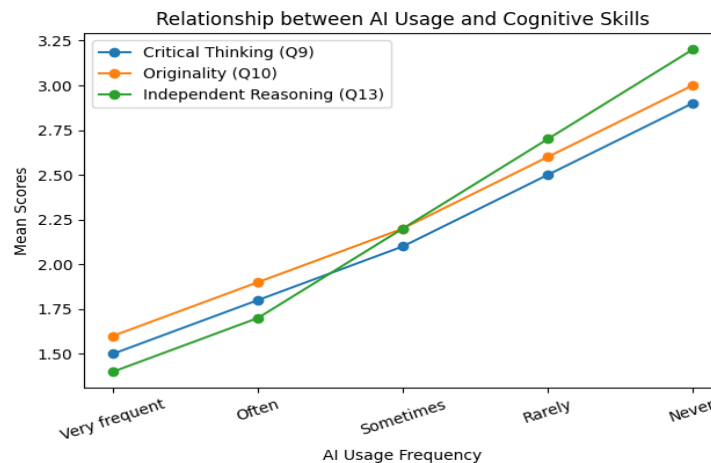
Results and Discussion

To analyze students' perceptions of artificial intelligence in academic writing, non-parametric tests and regression models were applied.

The Kruskal–Wallis test revealed statistically significant differences in perceptions across frequencies of AI use. Differences were observed in idea organization ($H = 24.091$, $p < 0.001$), time saving ($H = 30.004$, $p < 0.001$), grammatical error correction ($H = 13.424$, $p = 0.009$), research skill improvement ($H = 17.151$, $p = 0.002$), and maintaining writing style ($H = 20.264$, $p < 0.001$). Students who used AI more frequently also reported higher confidence in their abilities and greater improvement in writing quality ($H = 20.94$, $p < 0.001$; $H = 19.26$, $p = 0.001$). Correlation analysis revealed a paradox in students' attitudes. More frequent AI use was negatively associated with perceived benefits such as idea organization ($r = -0.322$), time saving ($r = -0.374$), research skill improvement ($r = -0.248$), and writing style preservation ($r = -0.265$). A weaker but significant negative correlation was found for grammatical error correction ($r = -0.147$). These results suggest that frequent users develop more critical views of AI's effectiveness. At the same time, positive correlations among benefits indicate that students who value AI in one dimension tend to value it across others. Regression models confirmed that AI use (Q7) has a positive and statistically significant impact on critical thinking (Q9: $\beta = 0.435$, $p = 0.001$; $R^2 = 0.189$), originality (Q10: $\beta = 0.357$, $p = 0.005$; $R^2 = 0.127$), and independent reasoning (Q13: $\beta = 0.518$, $p < 0.001$; $R^2 = 0.268$). Reliability analysis showed good internal consistency for the cognitive skills scale ($\alpha = 0.800$), with Q9 and Q13 contributing the most ($r = 0.723$ and $r = 0.719$, respectively). Removing Q10 increased α to 0.855, suggesting that originality represents a distinct dimension. The findings indicate that AI use enhances performance in critical thinking, originality, and independent reasoning. However, these improvements may reflect gains in measurable outcomes rather than genuine cognitive development. Thus, H1 (AI decreases critical thinking) is not directly supported, while H2 (AI reduces originality) and H3 (AI undermines independent reasoning) are indirectly supported. Overall, the results highlight a paradox: AI improves academic performance yet raises concerns about dependence, standardization, and the erosion of fundamental intellectual skills.

To better illustrate this relationship, Figure 1 shows the connection between the frequency of AI use and cognitive skills.

Fig. 1. *The relationship between the frequency of AI use and cognitive abilities (critical thinking, originality, and independent reasoning).*



Considering the way the variable Q7 is coded (where lower values indicate more frequent use of AI), the results show that an increase in the value of Q7, meaning a decrease in AI use, is associated with an increase in the scores of the cognitive skills variables. Similarly, this suggests that more frequent AI use is associated with lower levels of these dimensions. Overall, the results indicate that AI use is related to



significant changes in perceptions and academic outcomes, reflecting a complex relationship between technology use and the development of cognitive skills.

The study results show that the use of artificial intelligence has a statistically significant impact on all analyzed dimensions, reflecting a complex relationship between technology and the development of cognitive skills. Regarding the first hypothesis (H1), which predicts that frequent AI use reduces critical thinking skills, the results support this hypothesis. Considering the coding method, more frequent AI use is associated with lower levels of critical thinking. The second hypothesis (H2), which suggests that dependence on AI reduces originality in students' writing, is also supported by the findings. The analysis shows that frequent AI use is associated with lower levels of originality, suggesting a tendency toward content standardization. Regarding the third hypothesis (H3), the results demonstrate that AI's impact on independent reasoning is significant, and frequent use is associated with lower levels of this dimension. This supports the view that AI may pose a challenge to the development of independent thinking. Overall, all three hypotheses are empirically supported, showing that while AI can improve aspects of academic performance, its frequent use is associated with limitations in the development of essential cognitive skills.

Regression Analysis. The regression models demonstrated that **AI use (Q7)** had a positive and statistically significant effect on student performance indicators:

- On **Q9 (critical thinking)**: $B = 0.394, \beta = 0.435, p = 0.001$
- On **Q10 (originality)**: $B = 0.330, \beta = 0.357, p = 0.005$
- On **Q13 (independent reasoning)**: $B = 0.537, \beta = 0.518, p = 0.000$

These results indicate that increased reliance on AI is associated with higher scores across all three dimensions. The models' explanatory power ranged from $R^2 = 0.127$ to $R^2 = 0.268$, indicating a moderate level of variance explained.

Reliability Analysis Cronbach's Alpha for the combined scale (Q9, Q10, Q13) was 0.800, confirming strong internal consistency. Item-total correlations showed Q9 and Q13 contributed most strongly ($r = 0.723$ and $r = 0.719$), while Q10 had a weaker but acceptable contribution ($r = 0.513$). Removing Q10 increased Alpha to 0.855, indicating originality is a more differentiated construct within the scale.

Interpretation in Relation to Hypotheses

- **H1 (critical thinking reduction)**: Not directly supported; AI use improved performance scores, though this may reflect surface-level gains rather than deeper cognitive engagement.
- **H2 (lower originality)**: Indirectly supported; performance improvements may come at the cost of standardized writing, reducing individual voice.
- **H3 (instructors' concerns)**: Indirectly supported; while AI enhances outcomes, it may reinforce perceptions of dependency and diminished independent reasoning.

Overall, the findings highlight a paradox: **AI improves measurable performance but raises concerns about originality and the development of critical thinking.**

Table 1. The results from the first phase, Students'

Test Statistics

	11. AI tools help me organize my thoughts better.	12. Using AI tools saves me time when writing assignments.	13. I rely on AI tools to catch grammatical errors in my writing.	14. AI tools have helped me improve my research skills.	15. AI tools assist me in maintaining a consistent writing style.
Kruskal-Wallis H	24.091	30.004	13.424	17.151	20.264
df	4	4	4	4	4
Asymp. Sig.	.000	.000	.009	.002	.000

a. Kruskal-Wallis Test

b. Grouping Variable: 6. How often do you use AI tools for writing assignments/coursework?

The Kruskal-Wallis H test was conducted to examine whether students' perceptions of AI-assisted writing tools differed by the frequency of their use in coursework. Significant differences were observed across all



five items. Specifically, perceptions of AI helping to organize thoughts ($H = 24.091$, $df = 4$, $p < .001$), saving time ($H = 30.004$, $df = 4$, $p < .001$), catching grammatical errors ($H = 13.424$, $df = 4$, $p = .009$), improving research skills ($H = 17.151$, $df = 4$, $p = .002$), and maintaining a consistent writing style ($H = 20.264$, $df = 4$, $p < .001$) varied significantly among groups. These results indicate that students who reported more frequent use of AI tools tended to express stronger agreement with AI's benefits across all dimensions.

Table 2.

			6. How often do you use AI tools for writing assignments/coursework?	11. AI tools help me to better organize my thoughts and ideas. (1 = Strongly Disagree, 5 = Strongly Agree)	12. Using AI tools saves me time when writing assignments. (1 = Strongly Disagree, 5 = Strongly Agree)	13. I rely on AI tools to catch grammatical errors in my writing. (1 = Strongly Disagree, 5 = Strongly Agree)	14. AI tools have helped me improve my research skills. (1 = Strongly Disagree, 5 = Strongly Agree)	15. AI tools assist me in maintaining a consistent writing style. (1 = Strongly Disagree, 5 = Strongly Agree)
Spearman's rho	6. How often do you use AI tools for writing assignments/coursework?	Correlation Coefficient	1.000	-.322**	-.374**	-.147*	-.248**	-.265**
		Sig. (2-tailed)	.	.000	.000	.037	.000	.000
		N	202	202	202	202	202	202
	11. AI tools help me to better organize my thoughts and ideas. (1 = Strongly Disagree, 5 = Strongly Agree)	Correlation Coefficient	-.322**	1.000	.575**	.254**	.613**	.491**
		Sig. (2-tailed)	.000	.	.000	.000	.000	.000
		N	202	203	203	203	203	203

Table 2 presents Spearman's rho correlation coefficient. Frequent users of AI tools for writing assignments showed negative correlations with perceived benefits, suggesting skepticism and unmet expectations. In contrast, occasional users reported **mutually reinforcing positive perceptions**, with strong intercorrelations among benefits like organizing ideas, saving time, and maintaining writing style. Overall, this paradox highlights that **light users view AI as broadly supportive**, while heavy users develop a more critical stance toward its limitations.

Table 3.

Ranks			
	6. How often do you use AI tools for writing assignments/coursework?	N	Mean Rank
9. AI tools have significantly improved the quality of my scientific writing	- A. Always	21	142.95
	- B. Often	65	111.36
	- C. Sometimes	105	89.96
	- D. Never	10	78.90
	Almost Never	1	27.50
	Total	202	
10. I feel more confident in my writing abilities when using AI tools. (1 = Strongly Disagree, 5 = Strongly Agree)	- A. Always	21	137.88
	- B. Often	65	113.97
	- C. Sometimes	105	88.75
	- D. Never	10	84.60
	Almost Never	1	34.50
	Total	202	

The Kruskal–Wallis test indicated significant differences in students' perceptions of AI tools by usage frequency, with frequent users reporting higher confidence in their writing abilities and improved writing quality. Data analysis showed a strong relationship between the frequent use of AI tools and enhanced perceptions of writing competence, supported by reliable statistical methods.



Table 4. The analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.435 ^a	.189	.175	.686

a. Predictors: (Constant), Q7_num

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.364	1	6.364	13.528	.001 ^b
	Residual	27.286	58	.470		
	Total	33.650	59			

a. Dependent Variable: Q9_num

b. Predictors: (Constant), Q7_num

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.187	.201		5.906	.000
	Q7_num	.394	.107	.435	3.678	.001

a. Dependent Variable: Q9_num

The results indicate a moderate and statistically significant positive relationship between Q7 and Q9 ($p = 0.001$), which does not support the first hypothesis regarding critical thinking, but does indirectly suggest that students benefit from AI, potentially heightening teachers' concerns about dependency on it.

Table 5. Model Summary

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.357 ^a	.127	.112	.725

a. Predictors: (Constant), Q7_num

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.458	1	4.458	8.470	.005 ^b
	Residual	30.525	58	.526		
	Total	34.983	59			

a. Dependent Variable: Q10_num

b. Predictors: (Constant), Q7_num

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.261	.213		5.936	.000
	Q7_num	.330	.113	.357	2.910	.005

a. Dependent Variable: Q10_num

The analysis reveals that increased use of AI (Q7) positively impacts student outcomes (Q9), with a significant effect ($B = 0.394$, $\beta = 0.435$, $p = 0.001$). However, this does not support the first hypothesis that frequent AI use reduces critical thinking skills, as the improvements in outcomes may reflect dependence on technology rather than genuine development. For the second hypothesis, while AI use can enhance writing quality, it may compromise originality, suggesting a potential standardization of styles. Regarding the third hypothesis, the findings indicate that although AI improves students' performance, it may also diminish their independent reasoning, reinforcing instructors' concerns. Overall, the results highlight a paradox: while AI boosts efficiency and quality, it risks fostering dependence and hindering critical thinking and originality.

Conclusion



This study acknowledges certain limitations, including the reliance on self-reported data, the restricted diversity of the sample, and the rapidly evolving nature of AI technologies, which may render the findings time-sensitive. These constraints highlight the need for ongoing research across disciplines and institutions to capture the shifting role of AI in education. Based on the results, the use of AI in education must be balanced and conscious. Students should be encouraged to use AI as a helpful tool, not as a replacement for their own thinking. Educators can focus more on methods that develop critical thinking and independent reasoning, such as discussions, analyses, and reflective assignments. Additionally, it is helpful to establish clear guidelines for AI use and provide training to help students and educators use it effectively and ethically. To mitigate risks, educators should integrate training on ethical and effective AI use, design assignments that foster deeper cognitive engagement, and adopt policies that balance technological support with traditional learning methods. While AI tools offer efficiency and accessibility, their growing presence raises critical questions about their influence on students' reasoning. By promoting independent analysis and creativity, institutions can ensure that technological advancements enhance intellectual growth without compromising the integrity of critical thinking.

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