International Journal of Risk and Contingency Management
Volume 12 • Issue 1 • January-December 2024

Risks of AI-Assisted Learning on Student Critical Thinking:
A Case Study of Albania

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ABSTRACT

Artificial Intelligence (AI) has increasingly become a transformative force in the education sector, offering unprecedented opportunities to enhance learning experiences and outcomes. This study examines the potential adverse effects of AI-assisted learning on critical cognitive skills, particularly critical thinking and problem-solving, within the context of Albania's educational landscape. Employing a quantitative methodology, a survey of 53 students was conducted across a private educational institution in Albania to gather data on their experiences and perceptions regarding AI-assisted learning. The findings indicate no significant difference in critical thinking skills between students with prior exposure to AI tools and those without. However, there is a statistically significant negative correlation between reliance on AI tools for assignments and students' problem-solving skills, suggesting that excessive dependence on AI can hinder the development of independent problem-solving abilities. Conversely, a strong positive correlation was found between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency, highlighting the potential benefits of AI in enhancing these aspects of the educational experience. These results emphasize the need for a balanced integration of AI tools in education to ensure they complement rather than replace traditional learning methods. The study's findings have significant implications for educators and policymakers, suggesting that while AI can enhance certain educational outcomes, it is essential to address its potential risks to promote the development of essential cognitive skills. Future research should focus on larger, more diverse samples, incorporate objective measures of cognitive skills, and explore the long-term impacts of AI-assisted learning.

KEYWORDS

Technology Risk, Ethics, Cognitive Development, Pedagogical Implications, Educational Technology, Cognitive Load, Decision-making, Learning Outcomes, Ethical Considerations

DOI: 10.4018/IJRCM.350185

INTRODUCTION

Artificial Intelligence (AI) has increasingly become a transformative force in the education sector, offering unprecedented opportunities to enhance learning experiences and outcomes (Bates et al., 2020; Çela et al., 2024). AI-assisted learning systems promise to revolutionize traditional educational paradigms including offering personalized learning pathways and real-time feedback mechanisms (Bates et al., 2020). However, alongside these advancements, there are growing concerns about the potential adverse effects of AI on critical cognitive skills, particularly critical thinking (Essel et al., 2024; Iqbal & Iqbal, 2024; Parsakia, 2023). This study examines these concerns through a focused examination of AI-assisted learning's impact on student critical thinking within the context of Albania's educational landscape. Critical thinking is a fundamental skill, essential for problem-solving, decision-making, and the ability to analyze and synthesize information effectively (Dwyer et al., 2014). Critical thinking is vital for students to develop these skills to navigate an increasingly complex and information-rich world (Kitsantas et al., 2019). However, there is a growing body of literature suggesting that AI-assisted learning, while beneficial in many aspects, may inadvertently undermine the development of critical thinking skills. This issue arises from the tendency of AI systems to provide readily available solutions and information, potentially discouraging students from engaging deeply with the learning material and developing their analytical abilities.

Education is a fundamental pillar of society, shaping the actions of new generations and preparing them to confront future challenges. An educated populace facilitates national development and accelerates improvements across various sectors. In a dynamic society, the acquisition of new knowledge and tools is essential, particularly in the field of education. The integration of AI within the educational system has revolutionized numerous aspects of teaching and learning. AI has introduced novel methods for enhancing personalized learning, improving assessments, and reducing administrative burdens for educators (Ayala-Pazmiño, 2023). The adoption of AI tools in both pre-university and university education is inevitable, as they provide efficient means for students to meet assignment deadlines and enable professors to generate tailored tasks that address specific student needs. Ayala-Pazmiño (2023) highlights the efficacy of AI in analyzing student data, thereby enabling the customization of learning experiences to individual requirements. The implementation of AI in education promises a more personalized and responsive approach to teaching, ultimately benefiting the educational process.

Despite the numerous benefits associated with AI in education, many educators recognize the potential risks related to data privacy and security. While students may not be fully aware of these risks, educators can discern the potential dangers associated with AI, particularly concerning the automated generation of outputs that may lack appropriate context or accuracy (Cardona, Rodríguez, & Ishmael, 2023). Consequently, AI tools are seen as critical instruments for redefining classroom dynamics and enhancing student engagement in the teaching-learning process (Pavlenko & Syzenko, 2024). However, the extent to which AI tools represent an advantage or a drawback for educational systems remains unclear. Instructors and administrators grapple with determining whether the use of AI tools by students in their assignments might undermine their problem-solving skills and reduce their capacity to independently address complex issues. Conversely, students, who are the primary users of these tools, often perceive AI as significantly aiding their comprehension of complex concepts, irrespective of their field of study. This study aims to investigate the impact of AI tools on students' problem-solving skills and to assess the extent to which these tools assist students in understanding and completing assignments. Through this study, a comprehensive analysis of the benefits and drawbacks of AI usage in education, with a focus on its implications for student learning outcomes and problem-solving abilities.

This study employs a quantitative methodology to explore the risks associated with AI-assisted learning on critical thinking. A survey of 53 students was conducted in an educational institution in Albania to gather data on their experiences and perceptions regarding AI-assisted learning and

its impact on their critical thinking skills. This approach allowed us to systematically measure and analyze the influence of AI tools on the cognitive development of students. The Albanian educational system presents a unique context for this investigation. As a country in the midst of educational reforms (Çela, 2022; Fetahu & Cela, 2022) and technological integration, Albania offers a valuable case study to examine the broader implications of AI in education. This research seeks to identify specific challenges and opportunities within this context, contributing to an understanding of AI's role in shaping critical thinking skills. Through this study, the complex relationship between AI-assisted learning and student critical thinking was examined, providing insights that can inform educators, policymakers, and technology developers. Ultimately, the goal is to ensure that the integration of AI in education enhances rather than hinders the development of essential cognitive skills, promoting a generation of learners who are both technologically adept and critically proficient.

BACKGROUND

In recent years, society has encountered significant challenges in adapting to continuous technological advancements, largely due to the absence of comprehensive guidelines for their implementation. The educational sector, inherently linked to the development of future generations, is profoundly affected by these changes. In Albania, legislative efforts have aimed to address these challenges (Fetahu & Cela, 2022). In 2012, Albania introduced a new law on the pre-university education system, designed to enhance the teaching-learning process by aligning it with the needs of students and the broader society (Fetahu & Cela, 2022). This was followed by a 2015 law on higher education, which intended to improve students' professional and soft skills (Çela, 2022). Since the enactment of these laws, numerous bylaws have been implemented annually to facilitate their application. Notably, the pre-university education law emphasizes the integration of technological tools into curricula from an early age. While this aims to familiarize students with technology, there is a growing concern that the misuse of these tools for tasks, assignments, or projects may erode students' critical thinking skills. Critical thinking is essential in higher education, where students must integrate theoretical and practical knowledge to succeed in their careers. Therefore, interventions are necessary to ensure students use technological tools appropriately without compromising their foundational knowledge and critical thinking development.

In response to these concerns, Albania has initiated various programs to enhance technological skills in pre-university education. The “21st Century Schools” program, a partnership between the UK government and Albanian educational institutions, aims to boost the critical thinking and problem-solving skills of students aged 10-15 through programming (Çela et al., 2024). This program provides schools with micro-bit devices, which are small, programmable computers that enable students to solve problems innovatively and engagingly. Similarly, the Albanian-American Development Foundation (AADF) has funded programs to enhance students' programming and technology skills (Fetahu & Cela, 2022). The vision of the Ministry of Education and educational institutions emphasizes that learning to code in pre-university education prepares students for a rapidly evolving technological world (Fetahu & Cela, 2022). While programming skills are directly applicable in many professions and advantageous in numerous others, an exclusive focus on programming can limit students' career paths, directing them towards specific skill sets. This is evident in the increasing number of students opting to study computer science or software engineering in university, driven by their early exposure to these fields.

Despite the benefits of technological tools in education, their improper use can lead to a decline in critical thinking skills in other areas. The rapid introduction of new technological tools often lacks accompanying guidelines, as seen with the implementation of AI. Though AI has the potential to offer significant educational benefits, its misuse can adversely affect the development of critical thinking skills. This study aims to explore the impact of AI tools on students' problem-solving abilities and assess their effectiveness in helping students understand and complete assignments. By providing

a comprehensive analysis of the advantages and drawbacks of AI in education, this research seeks to inform strategies for integrating technology into the educational system without undermining essential cognitive skills.

REVIEW OF LITERATURE

AI, a subset of computer science, focuses on understanding the nature of intelligence and creating intelligent machines that simulate, extend, and enhance human capabilities (Huang & Qiao, 2024; Saheed et al., 2021). The benefits of technology are undeniable however, its extensive and unguided use has introduced significant challenges in the teaching and learning process, particularly in non-technical study programs. Additionally, the pervasive use of AI tools has been linked to the erosion of students' soft skills, including critical thinking. One of the most prominent AI tools used by students is ChatGPT. Given the educational system's experiences with technological tools, it is acknowledged that these tools have facilitated learning processes and aligned closely with student and societal needs. However, their impact on critical thinking skills has been problematic, often resulting in student complacency and reduced motivation to engage deeply with assignments.

Machine learning systems, such as ChatGPT, can be particularly effective for problems where the rules for generating outcomes are unknown and must be inferred from data. Conversely, rule-based AI approaches manipulate data based on predefined logical propositions, which can be advantageous for problems where the rules are known but their application is cumbersome (Gillani et al., 2023). ChatGPT allows students to pose questions and receive text-based answers, simulating human-like participation in discussions and task completion. The model's reliability stems from its training to recognize patterns and relationships in data without explicit human guidance. However, reliance on AI-generated content can lead to superficial learning, where students memorize information for graduation rather than understanding it for future application. Moreover, ChatGPT's capacity to present preexisting biases or forms of discrimination can discourage students from developing their own judgments or statements, leading to biased learning experiences. Well-explained AI responses may appear more credible to students, causing them to neglect their ideas, resulting in reduced critical thinking and increased laziness.

Pickell and Doak (2023) argue that rather than banning AI tools like ChatGPT, educators should guide students in using them beneficially. This involves leveraging AI to enhance critical thinking by analyzing real-life implications, ethical usage (Huang & Qiao, 2024), and improving assignments without taking AI-generated information at face value. Educators must provide well-structured guidelines to help students achieve educational goals through AI use. AI education aims to develop learners' mindsets and skills concerning AI, facilitating its understanding and application (Huang & Qiao, 2024). Practical training and manuals from technology experts are essential to prevent the decline of critical thinking skills among students. Such guidelines will help students grasp AI principles, experience AI's achievements, and implement AI applications effectively (Xiaodong & Chengche, 2022). By understanding AI's influence, educators can adapt their curricula and teaching methods to remain relevant in an AI-driven future (Vashista et al., 2023). Properly informed students and instructors can use ChatGPT to select appropriate information, adapt it to given instructions, provide reasonable arguments, and define limitations, thus enhancing critical thinking rather than diminishing it. Pusey-Reid and Ciesielski (2024) emphasize that AI usage in education enables the creation of complex and engaging simulations, providing students with immersive and interactive learning experiences. Interactive activities, such as writing responses to case scenarios and critically evaluating AI-generated outputs, promote critical thinking and enhance engagement and communication skills.

Another significant advantage of AI is its ability to aid in comprehending complex concepts (Vajjhala et al., 2021). When students use AI tools to explore study content and answer high-level cognitive questions, they provide rationales for their responses, deepening their understanding. It is crucial to teach students that AI is a tool to supplement, not replace, the in-depth study required for

mastering essential concepts. Faculty members can also use AI to summarize class content and create accessible materials, promoting equitable access to education. Pavlenko and Syzenko (2024) note that the frequency of ChatGPT usage varies across disciplines, with higher usage among Information Technology (IT), Business, and Engineering students. These students rely on ChatGPT for information retrieval, brainstorming ideas, and improving grammar and punctuation. Ramirez and Esparrell (2024) highlight that AI tools can personalize learning by identifying student needs and tracking their progress, thereby developing problem-solving skills rather than merely generating information. Holmes and Tuomi (2022) believe that AI tools, combined with other technologies, can help create adaptive learning experiences tailored to individual student needs. This interaction enables students to identify and select appropriate information, thereby enhancing their learning experience. The impact of AI on education is significant and will continue to grow (Alshahrani et al., 2024). Clear objectives and specific usage guidelines are essential to ensure that AI facilitates the development of problem-solving skills and critical thinking in students.

AI has become an integral part of modern education, influencing teaching methodologies and learning outcomes. AI tools, such as intelligent tutoring systems, adaptive learning platforms, and automated feedback systems, have been credited with enhancing personalized learning experiences and improving academic performance. Studies have demonstrated that AI can provide customized instruction tailored to individual learning needs, allowing students to progress at their own pace and receive immediate feedback on their performance (Holmes et al., 2019). The development of critical thinking skills is crucial for students to navigate the complexities of the modern world. Several researchers have explored the relationship between AI-assisted learning and critical thinking development. AI-supported learning environments could promote critical thinking by engaging students in problem-solving activities and providing them with opportunities to reflect on their learning processes (Cope et al., 2021). However, there are concerns that AI tools might inadvertently hinder the development of critical thinking. Selwyn (2019) argues that the convenience and efficiency of AI systems might lead to passive learning, where students rely heavily on AI for solutions rather than actively engaging in critical analysis. This perspective is supported by empirical studies, such as that of Ouyang et al. (2022), which suggest that while AI tools can enhance learning efficiency, they may also reduce opportunities for deep cognitive engagement.

The extent to which students benefit from AI-assisted learning may depend on their prior exposure to AI tools (Miller, 2023). Prior exposure can familiarize students with the functionalities and potentials of AI, enabling them to use these tools more effectively in their learning processes. Students with prior experience using AI tools are more adept at integrating these technologies into their learning strategies, resulting in better academic performance and skill development (Darvishi et al., 2024). Furthermore, prior exposure to AI can build a foundational understanding of how AI operates, encouraging students to engage more critically with AI-generated content. Students who had previous experience with AI tools demonstrated higher levels of critical thinking and problem-solving skills in AI-supported learning environments compared to those without such experience (Allen and Jevons, 2023; Che, Strang, & Vajjhala, 2021). Educational background plays a significant role in shaping students' readiness to utilize AI tools effectively (Ma & Lei, 2024). Students who are introduced to AI concepts and tools before entering university are likely to develop a more profound understanding of AI's capabilities and limitations (Borger et al., 2023). This early exposure can equip them with the skills needed to critically evaluate AI-generated information and apply it meaningfully in their academic pursuits. Drawing from the existing literature, it is evident that prior exposure to AI tools can influence the development of critical thinking skills. Students who are familiar with AI technologies before entering university are better positioned to leverage these tools for cognitive development. This leads to the formulation of the following hypothesis:

Hypothesis One: Students with prior exposure to AI tools (through school courses, online courses, or self-learning) before university show a more significant improvement in critical thinking skills than those without prior exposure.

The frequency of AI tool usage varies among students, ranging from daily interactions to occasional use (Almaiah et al., 2022). This frequency can impact the effectiveness and perceived benefits of these tools. Research indicates that regular interaction with AI tools can lead to better academic outcomes by continuously reinforcing learning and adapting to students' evolving needs (Srinivasa et al., 2022). Conversely, sporadic use may limit the potential benefits that AI tools offer, as students may not fully leverage the adaptive and personalized features of these technologies. Academic performance is a critical measure of the effectiveness of educational interventions, including AI tools (Owan et al., 2023). Studies have shown that consistent use of AI tools can lead to significant improvements in academic performance. The adaptability of AI tools ensures that students receive targeted instruction that addresses their individual learning gaps. AI-powered platforms could dynamically adjust the difficulty of tasks based on students' performance, thereby promoting a more effective learning environment (Holmes et al., 2019). This adaptability is particularly beneficial for students who engage with these tools regularly, as it ensures that their learning experiences are always aligned with their current proficiency levels.

Assignment efficiency refers to the ability of students to complete their assignments accurately and within a reasonable timeframe. The use of AI tools has been linked to enhanced assignment efficiency due to features such as automated feedback, time management aids, and resource recommendations (Selwyn, 2019). Regular use of these tools allows students to streamline their workflow, reduce the time spent on repetitive tasks, and focus more on critical thinking and problem-solving activities. This immediate feedback loop not only enhances learning but also improves the efficiency with which students complete their assignments. Students' perceptions of the effectiveness of AI tools are crucial in determining their willingness to use these technologies consistently (Albayati, 2024; Bernabei et al., 2023). Positive perceptions are often linked to the perceived improvements in academic performance and assignment efficiency. The existing literature suggests a strong relationship between the frequency of AI tool usage and various educational outcomes, including academic performance and assignment efficiency. Students who engage with AI tools regularly tend to perform better academically and complete assignments more efficiently (Chen et al., 2023). This leads to the formulation of the following hypothesis:

Hypothesis Two: There is a positive correlation between the frequency of AI tool usage (daily, weekly, monthly) and students' perceptions of academic performance and assignment efficiency.

Some researchers argue that AI tools can enhance problem-solving skills by providing students with challenging tasks and immediate feedback (Parsakia, 2023; Winkler et al., 2021). However, others caution that excessive reliance on AI for assignments may undermine the development of these skills (Al-Zahrani, 2024; Vajjhala & Strang, 2017). This concern is based on the observation that AI tools often provide readily available solutions, which can lead students to depend on these tools rather than engage in the critical thinking necessary to solve complex problems independently (Selwyn, 2019). The dependency on AI tools for completing assignments can have significant implications for students' cognitive development. While AI tools can increase efficiency and accuracy in completing tasks, they may also reduce the cognitive effort required from students (Almaiah et al., 2022). This reduction in cognitive engagement can result in a superficial understanding of the material and hinder the development of deeper problem-solving skills. Furthermore, students who rely heavily on AI tools may become passive learners, as they may not actively seek out solutions or develop the perseverance needed to tackle challenging problems (Bhise et al., 2022). This passive learning behavior can be detrimental in the long term, as it may impair students' ability to approach new and complex problems

without the aid of AI. Drawing from the existing literature, it is evident that the relationship between AI tool usage and problem-solving skills is complex. While AI tools offer significant benefits, excessive reliance on them for assignments may negatively impact students' ability to solve complex problems independently. This leads to the formulation of the following hypothesis:

Hypothesis Three: Reliance on AI tools for assignments negatively impacts students' problem-solving skills, reducing their ability to solve complex problems independently.

METHODOLOGY

This study employed a quantitative research design to investigate the influence of AI tools on students' critical thinking skills, academic performance, and problem-solving abilities at a selected non-public university in Albania. The research framework utilized a survey-based approach, gathering data from university students to assess their perceptions and experiences with AI-assisted learning. The study aimed to test three specific hypotheses through statistical analysis of survey responses. The target population comprised university students in Albania, encompassing various disciplines and academic levels, including both undergraduate and graduate programs. The sample was designed to ensure diversity by including students with varying degrees of exposure to AI tools. A sample size of 53 students was selected to balance feasibility and statistical power, enabling rigorous analysis of inter-variable relationships. The study employed a stratified random sampling technique, stratifying the population based on major/field of study, academic year, and prior exposure to AI tools. Random sampling within each stratum ensured a representative sample, facilitating robust comparisons across different student groups.

Data was collected via a structured questionnaire distributed through Google Forms. The survey comprised three sections, demographic information, previous exposure to AI tools, and AI tools usage and impact. Demographic data included the data on age group, major/field of study, and year of study. The questions on previous exposure to AI tools included gathered information on prior exposure to AI tools before university and the frequency of AI tool usage for academic purposes. The questions on AI Tools Usage and Impact addressed the purposes of AI tool usage, its impact on academic performance, critical thinking skills, problem-solving abilities, and overall perceptions of AI tools in education. The independent variables in this study were the prior exposure to AI tools (binary: yes/no) and frequency of AI tool usage (daily, weekly, monthly). The dependent variables included the improvement in critical thinking skills, perception of academic performance and assignment efficiency, reduction in problem-solving skills, and belief in AI tools aiding understanding of complex concepts.

The study complied to ethical standards for research involving human subjects and informed consent was obtained from all participants, ensuring confidentiality and anonymity. Participants were informed about the purpose of the study, the voluntary nature of participation, and the measures taken to protect their data. The study acknowledges potential limitations, including the sample size, self-reported nature of the survey data, and the specific context of university students in Albania, which may affect the generalizability of the findings as data was collected from one single non-public university in Albania.

RESULTS AND DISCUSSION

The study surveyed a diverse group of students from various educational backgrounds to understand their experiences and perceptions of AI-assisted learning. The demographic data collected provides valuable insights into the respondents' profiles, which is crucial for contextualizing the findings. As shown in Table 1, most respondents fall within the 18-22 age group, accounting for 49

Table 1. Age group statistics

Age Group	Count
18-22	49
23-27	2
33 and above	1
28-32	1

Table 2. Major/field of study statistics

Major/Field of Study	Count
Software Engineering	20
Computer Science	14
Business	7
Architecture	3
Business Informatics	2
Architecture	2
Business informatic	1
Interior design	1
Interior design	1
Graphic design	1
Social Sciences	1

of the 53 participants. This predominance is expected given that the survey targeted were university students. Smaller numbers were observed in the 23-27 age group (2 respondents) and 28-32 age group (1 respondent), with one respondent in the 33 and above category. This age distribution highlights that the insights primarily reflect the experiences of younger students who are more likely to be engaged with current educational technologies.

As shown in Table 2, the respondents' fields of study varied, with Software Engineering being the most common major, represented by 20 students. Computer Science followed with 14 students, and Business was the third most common with 7 students. Other fields such as Architecture, Business Informatics, Interior Design, Graphic Design, and Social Sciences were less represented. This distribution indicates a significant interest in technical and business-related fields among the respondents, which may influence their familiarity and comfort with AI tools. Most participants were first-year students, comprising 40 out of the 53 respondents. This is significant as first-year students might be experiencing AI tools in an academic setting for the first time. The remaining students were in their second year (5 students), third year (7 students), or were graduate students (1 student). This year-of-study distribution suggests that most insights come from students who are relatively new to university-level education and its associated technological tools.

When asked about their previous exposure to AI tools before university, responses varied. As shown in Table 3, a significant number of students (25) had explored AI through personal interest and self-learning. Sixteen students reported no prior exposure to AI tools, while nine students had used AI tools through school courses and three through online courses. This variation in prior exposure is essential as it can affect how students perceive and utilize AI tools in their current academic activities.

These demographic insights provide a foundation for understanding the context in which students interact with AI tools. The predominance of younger, first-year students from technical and business fields suggests a high level of adaptability and potential enthusiasm for integrating AI into their

Table 3. AI exposure statistics

AI Exposure	Count
Yes, through personal interest and self-learning	25
No, I had no previous exposure	16
Yes, through school courses	9
Yes, through online courses	3

Table 4. Two-sample t-test results

Group	Mean Problem-Solving Skills
No Prior Exposure to AI Tools	2.688
Prior Exposure to AI Tools	3.216

Table 5. Mann-Whitney U test

Statistic	Value
U-statistic	228.0
p-value	0.172

learning processes. However, the varying levels of previous exposure to AI indicate that while some students may be adept at leveraging these tools, others may need additional support and training to use them effectively. This background sets the stage for analyzing the impact of AI-assisted learning on critical thinking and problem-solving skills among university students.

The interpretation as shown in Table 4 shows that students with prior exposure to AI tools have higher mean problem-solving skills score 3.216 compared to those with no prior exposure 2.688. The t-statistic for this comparison is -1.277, and the p-value is 0.208, which is greater than the 0.05 significance level. The p-value of 0.208 indicates that the difference in problem-solving skills between the two groups is not statistically significant. Mann-Whitney U test and Cohen's d were also calculated.

Mann-Whitney U test is suitable for the comparison of differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed (Kishore & Jaswal, 2022). Cohen's d is a measure of effect size that can be used to indicate the standardized difference between two means helping to understand the magnitude of the difference, even if the p-value is not significant (Ivarsson et al., 2013).

The p-value of 0.172 is greater than 0.05, indicating that there is no statistically significant difference in problem-solving skills between students with and without prior exposure to AI tools. The effect size is 0.390, which indicates a small to medium effect size. The negative value suggests that students with no prior exposure to AI tools have slightly lower problem-solving skills compared to those with prior exposure, although this difference is not statistically significant. The results of the Mann-Whitney U test as shown in Table-5 support the findings from the two-sample t-test, indicating that there is no significant difference in problem-solving skills between students with and without prior exposure to AI tools. Cohen's d provides a measure of the effect size, suggesting that the difference, while small to medium in magnitude, is not statistically significant (Ivarsson et al., 2013). Hence, the failure to reject the null hypothesis and conclusion that there is no significant evidence to suggest that students with prior exposure to AI tools show a more significant improvement in critical thinking skills compared to those without prior exposure.

Based on the analysis of the provided data, we aimed to test the hypothesis that there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2). We began by preparing the data and mapping the frequency of AI

Table 6. Pearson's correlation coefficients between AI tool usage frequency and academic performance indicators

Variable Pair	Pearson's Correlation Coefficient
AI Tool Usage Frequency vs. Perceptions of Academic Performance	0.741
AI Tool Usage Frequency vs. Assignment Efficiency	0.720

Table 7. P-values for correlation between AI tool usage frequency and academic performance indicators

Variable Pair	p-value
AI Tool Usage Frequency vs. Perceptions of Academic Performance	0.000000000517
AI Tool Usage Frequency vs. Assignment Efficiency	0.00000000261

tool usage to numeric values: daily (3), weekly (2), and monthly (1). The relevant columns were extracted, and rows with missing values were dropped to ensure the accuracy of the analysis. The correlation analysis was performed, and the results are summarized in Table 6. The correlation matrix indicated a strong positive relationship between AI tool usage frequency and students' perceptions of academic performance (correlation coefficient = 0.741), as well as assignment efficiency (correlation coefficient = 0.720).

The hypothesis testing results are presented in Table 7.

The p-values for both correlations were extremely low (much less than 0.05), indicating that the correlations are statistically significant. Given the positive Pearson's correlation coefficients (0.741 and 0.720) and the very low p-values, we reject the null hypothesis. This confirms that there is significant evidence to support the alternative hypothesis: there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2).

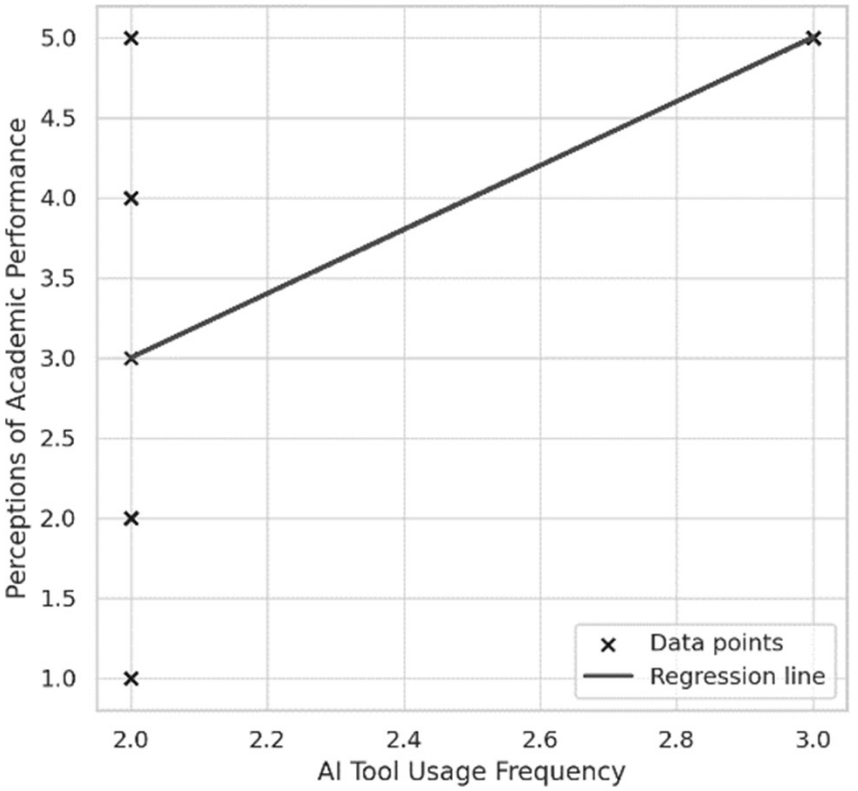
The linear regression plots illustrate the relationships between AI tool usage frequency and two variables: perceptions of academic performance and assignment efficiency. Figure 1 shows the regression line that fits the data points, indicating a positive linear relationship. The black line represents the predicted values based on the linear regression model, and it aligns well with the data points, suggesting that as the frequency of AI tool usage increases, students' perceptions of academic performance also tend to improve.

Figure 2 also demonstrates a similar positive linear relationship. The regression line shows that increased frequency of AI tool usage is associated with greater assignment efficiency. These linear regression plots visually reinforce the findings from the correlation analysis and hypothesis testing, supporting the hypothesis that there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2).

The analysis of the data also revealed several key findings regarding the impact of reliance on AI tools for assignments on students' problem-solving skills. The descriptive statistics as shown in Table 8 demonstrate that the mean reliance on AI tools for assignments was 2.17, with a standard deviation of 1.25. In comparison, the mean score for problem-solving skills was 3.06, with a standard deviation of 1.39. These statistics indicate a moderate level of reliance on AI tools and a slightly above-average self-assessment of problem-solving abilities among students. The Pearson correlation analysis revealed a correlation coefficient of -0.712 between reliance on AI tools and problem-solving skills, with a p-value of less than 0.000000001. This indicates a statistically significant negative relationship, suggesting that as students rely more on AI tools for their assignments, their problem-solving skills tend to decrease.

Further examination through linear regression analysis showed that the model explained 50.7% of the variance in problem-solving skills, with an R-squared value of 0.507. The regression coefficient for reliance on AI tools was -0.7918, with a p-value of less than 0.001. This coefficient indicates that for each unit increase in reliance on AI tools, there is an associated decrease of approximately

Figure 1. Linear regression: AI tool usage vs. academic performance

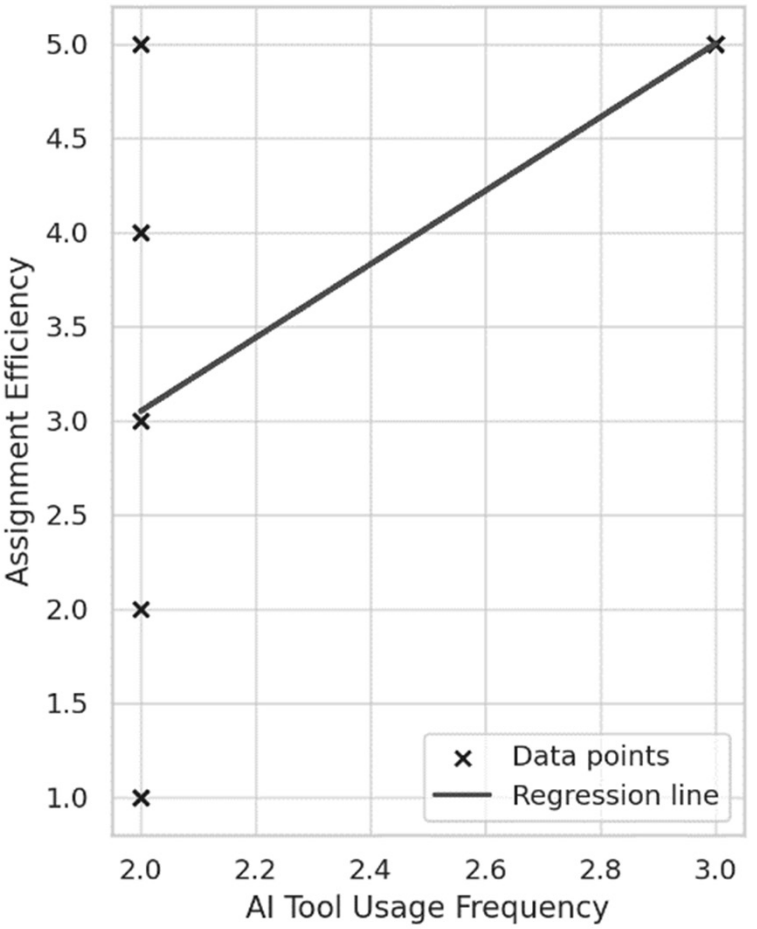


0.7918 units in problem-solving skills. The significant negative coefficient supports the hypothesis that increased reliance on AI tools negatively impacts problem-solving skills. The scatter plot shown in Figure 3 shows the correlation between reliance on AI tools for assignments and problem-solving skills. The scatter plot shows individual data points, and the black regression line indicates the negative correlation between the two variables. As reliance on AI tools increases, problem-solving skills tend to decrease, supporting the hypothesis (H3). Hypothesis testing using a t-test compared the levels of problem-solving skills among different levels of reliance on AI tools. The t-statistic was -2.618, with a p-value of 0.011, which is below the conventional threshold of 0.05. This result allows us to reject the null hypothesis and accept the alternative hypothesis (H3), confirming that reliance on AI tools for assignments significantly negatively impacts students' problem-solving abilities. The significant negative correlation and regression results underscore the importance of addressing the balance between using AI tools for efficiency and maintaining the development of independent problem-solving capabilities. These insights are critical for educators and policymakers aiming to integrate AI tools into educational practices without compromising essential cognitive skills.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Despite the valuable insights provided by this study, this study does have limitations that need to be addressed in future studies. Firstly, the sample size of 53 students, though sufficient for initial analysis, does not fully represent the diverse experiences and backgrounds of all university students in Albania. This limitation affects the generalizability of the findings. Future research should consider

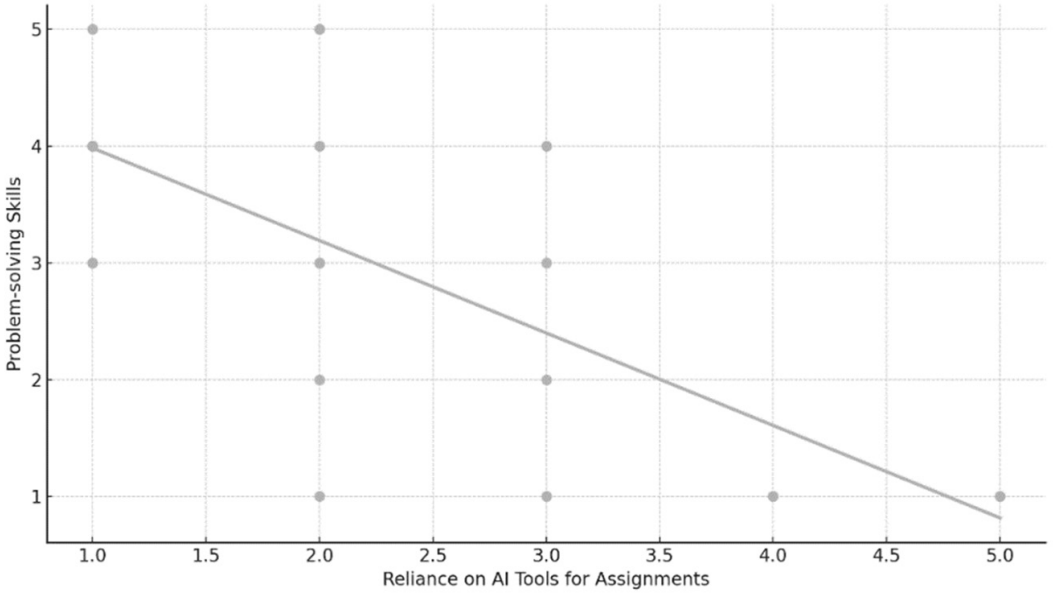
Figure 2. Linear regression analysis of AI tool usage frequency and assignment efficiency



larger and more diverse samples to enhance the robustness and applicability of the results. Secondly, the study relies on self-reported data, which can be subject to biases such as social desirability bias and inaccurate self-assessment. Students may overestimate or underestimate their critical thinking skills and problem-solving abilities. To mitigate this limitation, future studies could incorporate more objective measures of critical thinking and problem-solving skills, such as standardized tests or performance-based assessments. Thirdly, the study's cross-sectional design limits the ability to establish causality between AI tool usage and the development of critical thinking and problem-solving skills. Longitudinal studies are needed to examine how prolonged exposure to, and usage of AI tools affect these cognitive skills over time. Such studies would provide deeper insights into the long-term impacts of AI-assisted learning. Lastly, the study was conducted in a single private university in Albania, which may have unique characteristics that influence the findings. Future research should include multiple institutions, both public and private, across different regions to capture a broader perspective of the impact of AI tools on student learning.

Future studies should aim to include larger and more diverse samples, encompassing various educational levels, disciplines, and geographic locations. This approach would improve the generalizability of the findings and provide a more comprehensive understanding of the impact of AI tools on different student populations. Incorporating objective assessments of critical thinking

Figure 3. Scatter plot with linear regression line showing the impact of AI reliance on problem-solving skills



and problem-solving skills, such as standardized tests or practical problem-solving tasks, can provide more accurate evaluations of the impact of AI tool usage. These measures would complement self-reported data and offer a more reliable assessment of cognitive skill development. Conducting longitudinal research would allow for the examination of the long-term effects of AI tool usage on critical thinking and problem-solving skills. Such studies could track students over several years

Table 8. Combined descriptive, correlation, regression, and hypothesis testing statistics for AI reliance and problem-solving skills

Statistic	Value
Mean Reliance on AI	2.169811
Std Reliance on AI	1.251704
Mean Problem-solving Skills	3.056604
Std Problem-solving Skills	1.392495
Correlation Coefficient	-0.71175
p-value	<0.000000001
R-squared	0.507
Adj. R-squared	0.497
F-statistic	52.36
Prob (F-statistic)	<0.000000001
Coefficient (AI Reliance)	-0.7918
p-value (Coefficient)	<0.001
t-statistic	-2.618
p-value	0.011

to observe how continuous interaction with AI tools influences their cognitive development and academic performance. Future research should explore comparisons between different educational settings, such as public versus private institutions, and various countries with different levels of technological integration in education. Comparative studies would help identify contextual factors that influence the effectiveness of AI tools in enhancing or hindering cognitive skills. Investigating the impact of specific AI tools or features on student learning outcomes can provide more granular insights. Research could focus on different types of AI applications, such as intelligent tutoring systems, automated feedback mechanisms, and adaptive learning platforms, to determine which tools are most effective in promoting critical thinking and problem-solving skills. Incorporating the perspectives of both teachers and students can enrich the understanding of how AI tools are used in practice and their perceived benefits and drawbacks. Qualitative studies involving interviews or focus groups with educators and students can provide deeper insights into the practical challenges and opportunities associated with AI-assisted learning.

CONCLUSION

This study aimed to investigate the impact of AI-assisted learning on student critical thinking, problem-solving skills, and perceptions of academic performance and assignment efficiency within the context of Albania's educational landscape. By employing quantitative methodology and surveying 53 students from an educational institution in Albania, the study sought to understand the effects of AI tools on these essential cognitive skills. The analysis revealed no significant difference in critical thinking skills between students with prior exposure to AI tools and those without. Despite the expectation that prior exposure might enhance critical thinking, the data did not support this hypothesis, indicating that other factors may play a more critical role in developing these skills. The study found a statistically significant negative correlation between reliance on AI tools for assignments and students' problem-solving skills. Students who heavily relied on AI tools demonstrated lower problem-solving abilities, suggesting that excessive dependence on AI can hinder the development of independent problem-solving skills. There was a strong positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency. Students who used AI tools more frequently reported better academic performance and greater efficiency in completing assignments, highlighting the potential benefits of AI in enhancing these aspects of the educational experience. The findings of this study underscore the complex relationship between AI tool usage and cognitive skill development. While AI tools can significantly enhance academic performance and assignment efficiency, there is a risk that excessive reliance on these tools may impede the development of critical problem-solving skills. These insights suggest a need for balanced integration of AI in education, where AI tools are used to complement rather than replace traditional learning methods. Future research should address the limitations identified in this study by expanding sample sizes, incorporating objective measures of cognitive skills, and conducting longitudinal and comparative studies across different educational settings. Additionally, investigating the impact of specific AI tools and incorporating teacher and student perspectives can provide deeper insights into the practical applications and implications of AI in education.

CONFLICTS OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

FUNDING STATEMENT

No funding was received for this work.

PROCESS DATES

07, 2024

This manuscript was initially received for consideration for the journal on N/A, revisions were received for the manuscript following the double-anonymized peer review on 07/08/2024, the manuscript was formally accepted on 07/07/2024, and the manuscript was finalized for publication on 07/11/2024

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