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EFFECTS OF ARTIFICIAL INTELLIGENCE UTILIZATION ON STUDENTS' COGNITIVE DEVELOPMENT AND CRITICAL THINKING DISPOSITIONS AT SECONDARY AND HIGHER EDUCATION LEVELS

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ABSTRACT

This study examined the effects of artificial intelligence (AI) utilization on students' cognitive development and critical thinking dispositions at secondary and higher education levels. The study was guided by four objectives: (i) to assess the extent of students' reliance on AI tools for academic purposes; (ii) to evaluate the perceived impact of AI usage on students' cognitive development; (iii) to investigate the influence of AI utilization on critical thinking skills; and (iv) to identify the challenges associated with excessive dependence on AI in educational contexts.

A descriptive survey research design was employed, and data were collected from a sample of N = 320 students selected through stratified random sampling from secondary schools and universities. A structured five-point Likert scale questionnaire was developed to measure AI usage, cognitive engagement, and critical thinking dispositions. The reliability of the instrument was established through Cronbach's Alpha (α = 0.87). Data were analyzed using mean (M), standard deviation (SD), frequency, and percentage. In relation to the first objective, the findings indicated that a majority of students (68%) frequently relied on AI tools for completing academic tasks. Regarding the second objective, students' cognitive development was negatively affected, as reflected by a high mean score for reduced independent thinking (M = 3.89, SD = 0.76). Concerning the third objective, critical thinking engagement was found to decline, with a notable mean value (M = 3.72, SD = 0.81) indicating reduced analytical involvement. With respect to the fourth objective, 61% of respondents reported increased cognitive dependency and decreased problem-solving effort due to excessive AI usage. However, a moderate improvement in task efficiency was also observed (M = 3.45, SD = 0.69). The discussion highlighted that while AI tools served as facilitators of efficiency and convenience; their unregulated use contributed to cognitive passivity and diminished higher-order thinking skills, aligning with contemporary concerns in educational research regarding technology overdependence. The study concluded that excessive reliance on AI tools undermined students' cognitive development and critical thinking capacities despite offering certain functional benefits. It was inferred that AI integration in

education required careful pedagogical structuring to prevent intellectual dependency. It was recommended that educators should implement instructional strategies that emphasize inquiry-based learning, critical analysis, and independent problem-solving. Additionally, institutions were advised to establish guidelines for ethical and balanced AI usage, while curriculum designers were encouraged to integrate AI as a supportive tool rather than a substitute for cognitive engagement.
Keywords: *Artificial Intelligence, Cognitive Development, Critical Thinking, Descriptive Study, Student Dependency, Educational Technology, Secondary Education, Higher Education*

INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative force in education, reshaping teaching methodologies, learning processes, and students' cognitive engagement across secondary and higher education levels. The integration of AI-powered tools such as intelligent tutoring systems, generative AI applications, and adaptive learning platforms has significantly altered how students access, process, and apply knowledge. Recent studies indicate that AI adoption in education enhances personalization, supports real-time feedback, and improves learning efficiency (Memarian & Doleck, 2024). However, alongside these advantages, concerns have been raised regarding its implications for students' cognitive development and critical thinking abilities.

Cognitive development, which involves processes such as memory, reasoning, problem-solving, and information processing, is central to academic success. AI technologies have the potential to support these processes by facilitating metacognitive regulation and knowledge construction (Ansari & Qamari, 2025). At the same time, the increasing reliance on AI tools has introduced the concept of "cognitive offloading," where students depend on technology to perform intellectual tasks, potentially weakening their independent thinking abilities (Rashid & Kausik, 2024)

Critical thinking, defined as the ability to analyze, evaluate, and synthesize information, is a fundamental competency in modern education. The rise of generative AI tools such as ChatGPT has intensified debates regarding their role in either enhancing or diminishing students' critical thinking dispositions. While some studies suggest that AI can foster deeper engagement and reasoning when used appropriately (Melisa et al., 2025), others warn that excessive dependence may reduce analytical skills and intellectual autonomy (Hasan et al., 2024).

Given these contrasting perspectives, there is a need for empirical investigation into how AI utilization influences students' cognitive development and critical thinking across different educational levels. This study aims to address this gap by examining students' reliance on AI tools, their perceived cognitive outcomes, the impact on critical thinking dispositions, and the challenges associated with excessive AI dependence.

LITERATURE REVIEW

AI Utilization in Education

The integration of Artificial Intelligence (AI) in education has expanded rapidly over the past few years, particularly in the post-COVID-19 era where digital learning environments became essential rather than optional. Educational institutions worldwide have increasingly adopted AI-driven tools to support teaching and learning processes. These technologies enable adaptive learning systems that tailor instructional content according to individual student needs, thereby promoting differentiated instruction and inclusive education. AI-powered platforms can analyze learner behavior, performance patterns, and engagement levels in real time, allowing educators to make data-informed decisions. As highlighted by Memarian and Doleck (2024), AI facilitates personalized learning pathways and automates administrative and assessment tasks, which significantly enhances instructional efficiency and student learning outcomes.

In addition to personalization, AI contributes to improving students' cognitive and motivational dimensions. AI-based learning environments are designed to foster self-regulated learning by

providing instant feedback, scaffolding, and intelligent tutoring systems. Jia and Tu (2024) emphasized that such environments not only enhance students' motivation but also strengthen their self-efficacy and metacognitive awareness. Through features such as predictive analytics and intelligent recommendations, students become more aware of their learning progress and areas requiring improvement. Consequently, AI supports the development of higher-order thinking skills, including critical thinking and problem-solving, which are essential competencies in the 21st-century educational landscape.

Furthermore, AI tools have become increasingly prevalent across both secondary and higher education settings. Students frequently utilize AI applications for completing assignments, conducting research, generating ideas, and solving complex problems. The accessibility of AI tools, however, varies across contexts, influenced by factors such as digital infrastructure, socioeconomic status, and institutional policies. Ifenthaler et al. (2024) noted that while AI can significantly enhance learning experiences, its effectiveness depends largely on users' digital literacy and the pedagogical strategies employed by educators. Institutions that integrate AI within structured instructional frameworks tend to achieve more meaningful learning outcomes compared to those where AI use remains unregulated or informal.

Despite its numerous benefits, the growing reliance on AI in education raises concerns regarding over-dependence and the potential erosion of critical thinking skills. Excessive reliance on AI tools may lead students to depend on automated solutions rather than engaging in deep cognitive processing. Ruano-Borbalan (2025) argued that uncritical use of AI could undermine students' intellectual autonomy and creativity if not carefully managed. Therefore, it is essential to strike a balance between leveraging AI for support and maintaining opportunities for independent learning and analytical thinking. Educators must design learning activities that encourage inquiry-based learning, critical reflection, and active problem-solving, ensuring that AI serves as a facilitator rather than a replacement for human cognition.

In conclusion, AI utilization in education offers transformative potential by enhancing personalization, improving engagement, and supporting cognitive development. However, its effective implementation requires a balanced approach that integrates technological innovation with sound pedagogical practices. Policymakers and educators must establish clear guidelines and ethical frameworks to ensure responsible AI usage. By doing so, educational systems can harness the benefits of AI while safeguarding the development of students' critical thinking and independent learning capabilities.

AI and Students' Cognitive Development

The integration of Artificial Intelligence (AI) in education has significantly reshaped students' cognitive development by introducing interactive, adaptive, and personalized learning environments. AI-based systems, such as intelligent tutoring systems and adaptive learning platforms, provide customized instruction based on students' individual learning needs, pace, and prior knowledge. These systems continuously analyze learner data to offer immediate feedback and targeted interventions, which enhance knowledge retention and conceptual clarity. According to Holmes et al. (2022), AI-driven educational tools support deeper learning by enabling students to actively engage with content, thereby fostering analytical thinking and problem-solving skills. Such personalized learning experiences allow learners to move beyond rote memorization toward meaningful understanding, which is essential for long-term cognitive development.

In addition to improving cognitive skills, AI also contributes to the development of higher-order thinking abilities. By integrating features such as simulations, predictive analytics, and scenario-based learning, AI systems create opportunities for students to apply knowledge in complex and dynamic contexts. Luckin et al. (2021) emphasized that AI technologies can scaffold learning processes in ways that promote critical thinking, creativity, and decision-making. These

capabilities are particularly important in modern education systems, where learners are expected to demonstrate not only knowledge acquisition but also the ability to analyze, evaluate, and synthesize information. As a result, AI plays a crucial role in preparing students for real-world challenges by enhancing their cognitive flexibility and intellectual independence.

Furthermore, AI-supported learning environments are instrumental in fostering metacognitive development. Metacognition, which involves awareness and regulation of one's own learning processes, is a key component of effective learning. AI tools often incorporate dashboards, progress indicators, and reflective prompts that encourage students to monitor their performance and adjust their learning strategies accordingly. According to Khosravi et al. (2022), AI-enhanced systems facilitate self-regulated learning by providing insights into learners' strengths and weaknesses, thereby promoting reflection and strategic thinking. This not only improves academic performance but also equips students with lifelong learning skills that are essential in rapidly evolving knowledge societies.

Despite these benefits, the increasing reliance on AI technologies raises concerns regarding potential negative impacts on students' cognitive development. One significant issue is cognitive offloading, where learners depend on external tools to perform cognitive tasks, thereby reducing their own mental effort. Fawns (2022) argued that excessive dependence on AI tools may limit opportunities for deep cognitive engagement, resulting in weaker memory retention and reduced problem-solving capabilities. When students rely heavily on AI-generated responses, they may bypass critical stages of reasoning and analysis, which are fundamental for developing strong cognitive skills. This overreliance can ultimately hinder intellectual growth and reduce learners' ability to think independently.

Moreover, AI has the potential to transform traditional learning processes in ways that may not always be beneficial. The ease of accessing AI-generated answers can shift students' focus from knowledge construction to answer retrieval, thereby discouraging inquiry-based learning and critical exploration. Selwyn (2023) noted that while AI can enhance efficiency, it may also promote surface-level learning if not integrated thoughtfully into pedagogical practices. This shift can negatively affect long-term cognitive development, as students may fail to develop the depth of understanding required for complex problem-solving and knowledge application. Therefore, it is essential to ensure that AI is used as a supportive tool rather than a substitute for active learning and intellectual effort.

In conclusion, AI has the potential to significantly enhance students' cognitive development by promoting personalized learning, higher-order thinking, and metacognitive awareness. However, its benefits must be balanced against the risks associated with overdependence and reduced cognitive engagement. Educators and policymakers must adopt strategic approaches to AI integration that emphasize critical thinking, active learning, and independent problem-solving. By doing so, educational systems can harness the advantages of AI while safeguarding the cognitive development and intellectual autonomy of learners.

AI and Critical Thinking Dispositions

The relationship between Artificial Intelligence (AI) utilization and students' critical thinking dispositions is multifaceted, reflecting both opportunities and challenges within contemporary educational contexts. On one hand, AI technologies can serve as powerful tools to enhance critical thinking when integrated into well-designed pedagogical frameworks. AI-supported platforms enable inquiry-based learning by presenting learners with complex problems, simulations, and data-driven scenarios that require analysis and evaluation. According to Chiu et al. (2023), AI can foster analytical reasoning by encouraging students to question assumptions, interpret evidence, and construct logical arguments. When educators strategically embed AI tools into instructional design, they can create learning environments that promote intellectual curiosity and active engagement, which are essential components of critical thinking.

Moreover, AI has the potential to support reflective thinking, a key dimension of critical thinking dispositions. Through features such as real-time feedback, adaptive questioning, and personalized recommendations, AI systems can prompt students to reflect on their reasoning processes and decision-making strategies. Kasneci et al. (2023) emphasized that AI-assisted learning environments can enhance metacognitive awareness by helping students identify errors, reconsider assumptions, and refine their arguments. These reflective practices not only improve problem-solving skills but also encourage learners to adopt a more thoughtful and deliberate approach to knowledge construction. Consequently, AI can act as a catalyst for developing higher-order thinking skills when used in a guided and purposeful manner.

In addition, structured AI-supported learning activities can strengthen students' ability to engage in argumentation and evidence-based reasoning. For example, AI tools that simulate debates, provide counterarguments, or analyze textual data can help students develop the ability to evaluate multiple perspectives and construct well-supported conclusions. Holmes and Tuomi (2022) noted that such applications are particularly effective in promoting critical discourse and collaborative learning, as they encourage students to articulate their reasoning and defend their viewpoints. This aligns with contemporary educational goals that emphasize not only knowledge acquisition but also the ability to think critically and communicate effectively.

However, despite these advantages, growing concerns have emerged regarding the potential negative impact of excessive AI reliance on critical thinking development. One major issue is that easy access to AI-generated answers may discourage students from engaging in deep cognitive processing. Zhai et al. (2024) argued that when students rely heavily on AI tools for immediate solutions, they may bypass essential stages of inquiry, analysis, and synthesis. This can result in superficial understanding and reduced engagement with complex problem-solving tasks. As a consequence, students may develop a dependency on AI, which undermines their ability to think independently and critically.

Furthermore, unregulated use of AI technologies can lead to passive learning behaviors, where students become consumers of information rather than active participants in the learning process. Crompton and Burke (2023) highlighted that excessive reliance on AI-generated content may weaken creativity and analytical skills, as learners are less likely to question or challenge the information provided. This shift from active to passive learning can significantly affect the development of critical thinking dispositions, including open-mindedness, intellectual persistence, and skepticism. Without proper guidance, students may prioritize efficiency over understanding, thereby compromising the depth and quality of their learning experiences.

In conclusion, the impact of AI on critical thinking dispositions is inherently complex, encompassing both enabling and constraining effects. While AI has the capacity to enhance inquiry-based learning, reflective thinking, and analytical reasoning, its unregulated or excessive use may hinder the development of independent and critical thought. Therefore, it is imperative for educators to implement structured and pedagogically sound approaches to AI integration. By emphasizing active learning, critical inquiry, and ethical use of technology, educational institutions can ensure that AI serves as a tool for strengthening, rather than diminishing, students' critical thinking dispositions.

Challenges of AI Dependence in Education

Despite the transformative potential of Artificial Intelligence (AI) in education, its increasing integration has introduced several significant challenges, particularly concerning students' dependence on these technologies. One of the most critical issues is the risk of over-dependence, where students rely excessively on AI tools for completing academic tasks. This reliance can reduce cognitive effort, as learners may prefer quick AI-generated solutions over engaging in deep thinking and problem-solving processes. According to Baidoo-Anu and Owusu Ansah

(2023), excessive dependence on AI tools such as generative models can undermine students' ability to develop independent thinking skills and intellectual autonomy. As a result, learners may struggle to apply knowledge in unfamiliar contexts, which is a key indicator of meaningful learning.

Another major challenge associated with AI dependence is its impact on academic integrity. The ease with which students can generate essays, solve problems, and complete assignments using AI tools raises serious concerns about plagiarism and originality. AI-generated content often blurs the line between authentic student work and automated assistance, making it difficult for educators to assess students' true capabilities. Cotton et al. (2024) argued that the widespread use of AI in academic settings has complicated traditional assessment practices, necessitating the development of new evaluation methods that prioritize critical thinking and process-based learning. Without appropriate safeguards, AI tools may encourage academic dishonesty and diminish the value of educational credentials.

In addition to integrity concerns, ethical challenges such as misinformation and lack of transparency further complicate AI integration in education. AI systems are not infallible and may produce inaccurate, biased, or misleading information. Students who rely uncritically on AI-generated content may unknowingly adopt incorrect knowledge, which can negatively affect their learning outcomes. Rudolph et al. (2023) highlighted that the "black box" nature of many AI systems makes it difficult for users to understand how information is generated, thereby limiting transparency and accountability. This lack of clarity can hinder students' ability to evaluate the credibility of information, an essential component of critical thinking in the digital age.

Moreover, the absence of comprehensive institutional policies and guidelines regarding AI use exacerbates these challenges. Many educational institutions are still in the early stages of developing frameworks to regulate AI integration, resulting in inconsistent practices across classrooms and disciplines. Zawacki-Richter et al. (2022) emphasized that without clear policies, students and educators may adopt AI tools in unstructured and potentially harmful ways. This lack of regulation not only increases the risk of misuse but also creates uncertainty regarding acceptable academic practices. Therefore, there is a pressing need for institutions to establish clear ethical standards, usage guidelines, and training programs to ensure responsible AI adoption.

Furthermore, AI dependence may also contribute to a decline in essential cognitive and metacognitive skills. When students frequently outsource cognitive tasks to AI systems, they may engage less in reflection, analysis, and self-regulated learning. This can weaken their ability to monitor their own learning processes and make informed decisions about their academic progress. Holmes et al. (2022) suggested that while AI can enhance learning efficiency, it must be carefully integrated to avoid replacing the cognitive processes that are fundamental to education. Encouraging active learning strategies and critical engagement with AI outputs is essential to mitigate these risks.

In conclusion, while AI offers numerous advantages in enhancing educational experiences, its overuse and unregulated integration present substantial challenges. Issues related to over-dependence, academic integrity, ethical concerns, and lack of institutional policies highlight the need for a balanced and responsible approach to AI adoption. Educators and policymakers must work collaboratively to design frameworks that promote ethical usage, critical engagement, and independent thinking. By positioning AI as a supportive tool rather than a substitute for human cognition, educational systems can maximize its benefits while minimizing its potential drawbacks.

Methodology

This study adopted a descriptive survey research design to examine the effects of artificial intelligence (AI) utilization on students' cognitive development and critical thinking dispositions at secondary and higher education levels. The descriptive survey approach was considered

appropriate as it enables the systematic collection and analysis of quantitative data to describe existing phenomena and explore relationships among variables.

Population and Sample

The target population of the study comprised students enrolled in secondary schools and universities. A sample of N = 320 students was selected using a stratified random sampling technique to ensure adequate representation from both educational levels. The population was divided into relevant strata (secondary and higher education), and participants were randomly selected from each stratum to enhance the generalizability and validity of the findings.

Research Instrument

Data were collected through a self-developed structured questionnaire based on a five-point Likert scale, ranging from *Strongly Disagree (1)* to *Strongly Agree (5)*. The instrument was designed to measure three key constructs:

1. **AI Utilization** (extent of students' reliance on AI tools for academic purposes)
2. **Cognitive Engagement/Development** (students' perceived cognitive processes such as understanding, problem-solving, and retention)
3. **Critical Thinking Dispositions** (analytical thinking, evaluation, and reasoning abilities)

The items were developed after an extensive review of recent literature to ensure content validity and alignment with the study objectives.

Reliability of the Instrument

The internal consistency of the instrument was assessed using Cronbach's Alpha coefficient, which yielded a reliability value of $\alpha = 0.87$. This value indicates a high level of reliability, suggesting that the instrument was suitable for measuring the intended constructs.

Data Collection Procedure

The data were collected through direct administration of the questionnaire to the selected participants. Respondents were informed about the purpose of the study and assured of confidentiality and anonymity to ensure honest and unbiased responses.

Data Analysis Techniques

The collected data were analyzed using descriptive statistical methods. The following statistical measures were employed:

1. **Mean (M)** to determine the average responses of participants
2. **Standard Deviation (SD)** to assess the variability in responses
3. **Frequency and Percentage** to describe the distribution of responses

These statistical tools were used to interpret students' levels of AI usage, cognitive engagement, and critical thinking dispositions in alignment with the study objectives.

FINDINGS

The results are presented according to the research objectives using descriptive statistics including frequency (f), percentage (%), mean (M), and standard deviation (SD).

Objective 1: Students' Reliance on AI Tools

The analysis revealed that a majority of students frequently used AI tools for academic purposes.

Table 1: Frequency Distribution of Students' AI Usage (N = 320)

Response Category	Frequency (f)	Percentage (%)	Mean (M)	SD
Frequently	218	68%		
Occasionally	62	19%		
Rarely	25	8%		
Never	15	5%		

Response Category	Frequency (f)	Percentage (%)	Mean (M)	SD
Overall	**320**	**100%**	**3.50**	0.92

Interpretation: The majority of respondents (68%) reported frequent use of AI tools, indicating a high reliance. The overall mean score (M = 3.50) suggests that AI usage among students is above average.

Objective 2: Impact of AI on Cognitive Development

The findings indicated a negative effect on students' cognitive development, particularly independent thinking.

Table 2: Descriptive Statistics for Cognitive Development (N = 320)

Variable	SA	A	N	DA	SDA	(M)	SD
Reduced Independent Thinking	110 (34%)	105 (33%)	50 (16%)	35 (11%)	20 (6%)	3.89	0.76

Interpretation: A large proportion of students agreed that AI usage reduces independent thinking. The high mean (M = 3.89) confirms a strong perceived negative impact on cognitive development.

Objective 3: Influence of AI on Critical Thinking

The results demonstrated a decline in students' critical thinking engagement.

Table 3: Descriptive Statistics for Critical Thinking Dispositions (N = 320)

Variable	SA	A	N	DA	SDA	(M)	SD
Reduced Analytical Engagement	95 (30%)	100 (31%)	60 (19%)	40 (13%)	25 (7%)	3.72	0.81

Interpretation:

The findings indicate that most students perceive a reduction in analytical engagement due to AI usage. The mean score (M = 3.72) suggests a noticeable decline in critical thinking involvement.

Objective 4: Challenges of Excessive AI Dependence

The findings highlighted both challenges and benefits associated with AI usage.

Table 4: Challenges and Benefits of AI Usage (N = 320)

Variable	SA	A	N	DA	SDA	(M)	SD
Cognitive Dependency	100 (31%)	95 (30%)	55 (17%)	40 (13%)	30 (9%)	3.65	0.84
Reduced Problem-Solving Effort	105 (33%)	90 (28%)	50 (16%)	45 (14%)	30 (9%)	3.68	0.82
Improvement in Task Efficiency	70 (22%)	85 (27%)	75 (23%)	55 (17%)	35 (11%)	3.45	0.69

Interpretation: The data indicate that a majority of students reported increased cognitive dependency and reduced problem-solving effort, confirming concerns about excessive reliance on

AI. However, the moderate mean for task efficiency (M = 3.45) suggests that AI tools still contribute positively to completing academic tasks more efficiently.

DISCUSSION

The study investigated the effects of artificial intelligence (AI) utilization on students' cognitive development and critical thinking dispositions at secondary and higher education levels. The findings reveal a complex relationship in which AI serves both as a facilitator of academic efficiency and as a potential inhibitor of higher-order cognitive processes.

With respect to the first objective, the results indicated that a majority of students (68%) frequently relied on AI tools for academic tasks. This high level of dependence reflects the rapid integration of AI technologies into educational practices, particularly in the form of generative AI and adaptive learning systems. These findings are consistent with recent studies which highlight that students increasingly use AI tools for assignments, research, and problem-solving due to their accessibility and time-saving capabilities (Memarian & Doleck, 2024; Jia & Tu, 2024). Such widespread adoption suggests that AI has transitioned from a supplementary resource to a central component of students' learning strategies. However, this shift also raises concerns about students' reduced engagement in traditional learning processes.

Regarding the second objective, the study found that AI utilization negatively influenced students' cognitive development, particularly in terms of independent thinking (M = 3.89). This finding supports the growing body of literature on "cognitive offloading," which posits that individuals tend to rely on external technological tools to perform cognitive tasks, thereby reducing mental effort and internal processing (Rashid & Kausik, 2024). Similarly, Ansari and Qamari (2025) argued that while AI can enhance learning efficiency, excessive reliance may hinder the development of core cognitive skills such as reasoning, memory retention, and problem-solving. The high mean score in this study indicates that students perceive AI as replacing rather than supporting their thinking processes, which may have long-term implications for intellectual growth.

In relation to the third objective, the findings demonstrated a decline in students' critical thinking engagement (M = 3.72). This aligns with contemporary research suggesting that uncritical reliance on AI-generated content can lead to passive learning behaviors and reduced analytical involvement (Hasan et al., 2024). Critical thinking requires active engagement, evaluation of evidence, and independent judgment—skills that may be compromised when students depend heavily on AI-generated answers. Melisa et al. (2025) further emphasized that although AI has the potential to support critical thinking through guided inquiry, its unregulated use often results in superficial learning and limited cognitive engagement. Therefore, the findings of this study reinforce concerns that AI, when used without pedagogical guidance, may undermine students' higher-order thinking skills.

Concerning the fourth objective, the study revealed that a significant proportion of students (61%) experienced increased cognitive dependency and reduced problem-solving effort due to excessive AI usage. This finding is in line with Favero et al. (2025), who argued that overdependence on AI tools can create a form of intellectual reliance that diminishes students' ability to engage in independent problem-solving. The reduction in problem-solving effort observed in this study indicates that students may prefer quick AI-generated solutions over engaging in deeper cognitive processes. Such behavior can negatively impact the development of resilience, persistence, and analytical reasoning.

Despite these negative implications, the study also identified a moderate improvement in task efficiency (M = 3.45). This suggests that AI tools play a beneficial role in enhancing productivity and enabling students to complete academic tasks more quickly and effectively. These findings are supported by Memarian and Doleck (2024), who noted that AI technologies can streamline learning processes, provide immediate feedback, and improve overall academic efficiency. Thus, AI should not be viewed solely as a detrimental

factor but rather as a double-edged tool that offers both opportunities and challenges.

Overall, the discussion highlights that while AI tools serve as facilitators of efficiency and convenience, their unregulated and excessive use contributes to cognitive passivity and diminished higher-order thinking skills. This aligns with broader concerns in contemporary educational research regarding technology overdependence and its impact on learners' intellectual autonomy (Ifenthaler et al., 2024). The findings suggest that the educational value of AI depends largely on how it is integrated into teaching and learning practices. When used strategically and under proper guidance, AI can enhance cognitive engagement and critical thinking. However, when used excessively or without regulation, it may hinder the very skills that education aims to develop.

CONCLUSION

The present study examined the effects of artificial intelligence (AI) utilization on students' cognitive development and critical thinking dispositions at secondary and higher education levels. The findings revealed that while AI tools have become widely adopted and offer notable advantages in terms of efficiency and convenience, their excessive and unregulated use poses significant challenges to students' intellectual growth.

Specifically, the study concluded that a high level of reliance on AI tools undermines students' cognitive development, particularly by reducing independent thinking and limiting active mental engagement. Furthermore, the findings demonstrated a decline in critical thinking capacities, as students showed reduced analytical involvement and a tendency toward passive consumption of AI-generated content. These results indicate that AI, when used as a substitute rather than a supplement to learning, can negatively affect higher-order cognitive processes.

Despite these concerns, the study also acknowledged the functional benefits of AI, including improved task efficiency and accessibility of information. Therefore, it was inferred that the impact of AI in education is not inherently negative; rather, it depends on the manner and extent of its integration. Effective and balanced use of AI requires careful pedagogical structuring to ensure that it enhances, rather than replaces, students' cognitive engagement and intellectual autonomy.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed:

1. **Promotion of Inquiry-Based Learning**

Educators should adopt instructional strategies that emphasize inquiry-based learning, encouraging students to ask questions, explore concepts, and engage in deeper understanding rather than relying solely on AI-generated responses.

2. **Enhancement of Critical Thinking Skills**

Teaching practices should focus on developing students' critical analysis, evaluation, and reasoning skills by incorporating activities such as debates, case studies, and problem-based learning tasks.

3. **Encouragement of Independent Problem-Solving**

Students should be guided to engage in independent problem-solving before using AI tools, ensuring that technology supports rather than replaces cognitive effort.

4. **Development of Institutional Guidelines**

Educational institutions should establish clear policies and ethical guidelines regarding AI usage to promote responsible, balanced, and transparent use of AI tools in academic settings.

5. **Curriculum Integration of AI as a Support Tool**

Curriculum designers should integrate AI in a manner that positions it as a supportive learning aid, not a substitute for thinking. Structured activities should require students to critically evaluate AI-generated outputs.

6. **Teacher Training and Professional Development**

Teachers should be provided with professional development opportunities to effectively integrate AI into their teaching practices while maintaining

a focus on cognitive and critical skill development.

7. **Balanced Use of Technology**

A balanced approach should be encouraged where students use AI tools for assistance and efficiency, while still engaging actively in learning processes that promote intellectual independence.

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