

Abstracts of the WCMSR

01. ARTIFICIAL INTELLIGENCE (AI)-ASSISTED LEARNING AND CRITICAL THINKING: THE ROLE OF COGNITIVE ENGAGEMENT—A MULTI-INSTITUTIONAL CROSS-SECTIONAL STUDY AMONG MEDICAL STUDENTS IN KHARTOUM STATE, SUDAN.

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BACKGROUND: The rapid integration of generative artificial intelligence into higher education has transformed how students engage with knowledge, raising substantive concerns about its long-term impact on higher-order cognitive skills. While artificial intelligence-assisted learning offers measurable benefits in academic efficiency, increasing reliance on artificial intelligence-generated outputs may reduce cognitive engagement and impair critical thinking—a competency of particular importance in medical education, where sound clinical judgment is essential for patient safety. Although empirical evidence suggests a negative correlation between artificial intelligence dependence and critical thinking, to the best of our knowledge, this relationship remains unexamined among medical students in Sudan, where artificial intelligence literacy gaps and the absence of structured institutional policies further compound the concern. This study aimed to determine the extent of artificial intelligence-assisted learning use, examine the effect of artificial intelligence use on critical thinking among medical students in public universities in Khartoum State with particular attention to the mediating role of cognitive engagement, and assess students' attitudes toward institutional artificial intelligence policies and their willingness to comply with them.

METHODS: A cross-sectional analytical study was conducted among 403 medical students from four public universities in Khartoum State. Participants were selected through multistage stratified random sampling. Inclusion criteria were being aged 18 years or older, providing informed consent, and having prior experience with artificial intelligence use. Data were collected via a validated self-administered online questionnaire assessing artificial intelligence usage and dependency, critical thinking, cognitive engagement, and attitudes toward artificial intelligence policies. Statistical analysis included Pearson's correlation, linear regression, and bootstrapped mediation analysis performed using Statistical Package for the Social Sciences version 30 and Jamovi 2.6.44.

RESULTS: Moderate artificial intelligence dependency levels predominated among participants 55% (number = 222), while the majority reported daily artificial intelligence use 62.3% (number = 251). A statistically significant negative correlation was identified between artificial intelligence usage and critical thinking (correlation coefficient = -0.144 , $p = 0.004$). Cognitive engagement fully mediated this relationship, accounting for 74.4% of the total effect with 95% confidence interval: $[-0.375$ to $-0.1109]$. Students with higher grade point averages demonstrated lower artificial intelligence dependency, and pre-clinical students scored significantly higher in critical thinking than their clinical-year counterparts. Although 65.5% (number = 264) of participants supported institutional artificial intelligence regulation, only 29.7% (number = 120) believed that existing policies adequately preserve academic integrity.

CONCLUSION: Artificial intelligence-assisted learning is deeply embedded in medical students' academic practices and, while widespread use was not associated with severe dependency, it was linked to a modest but significant reduction in critical thinking, mediated through diminished cognitive engagement. Students with stronger academic performance demonstrated lower artificial intelligence dependency, suggesting that self-regulation and prudent artificial intelligence use may help preserve critical thinking abilities. Academic institutions should develop clear artificial intelligence governance frameworks alongside artificial intelligence literacy programs, and learning environments should be designed to sustain active cognitive engagement, ensuring that artificial intelligence functions as a tool that augments rather than undermines the intellectual development essential to medical training.

Key Words: Artificial intelligence; Critical thinking; Active learning; policies; Sudan.

Table 1: The Mediating Role of Cognitive Engagement in the Relationship Between AI-Assisted Learning and Critical Thinking Among Medical Students in Khartoum State, Sudan.

Effect	Path Label	Path Description	Estimate	95% CI (Lower – Upper)	p-value	% Mediation
Indirect	$a \times b$	AI usage & dependency → Cognitive engagement → Critical thinking	-0.2428	-0.375 to -0.1109	< .001	74.4%
Direct	c	AI usage & dependency → Critical thinking	-0.0836	-0.265 to 0.0982	0.367	25.6%
Total	$c + a \times b$	Overall effect of AI usage & dependency on critical thinking	-0.3265	-0.546 to -0.1068	0.004	100%
Path a	a	AI usage & dependency → Cognitive engagement	-0.2149	-0.328 to -0.1019	< .001	—
Path b	b	Cognitive engagement → Critical thinking	1.1300	0.976 to 1.2845	< .001	—