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Examining the domains of AI-assisted learning and their relationship with academic performance among nursing and allied health students: a cross-sectional study

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Abstract

Background:

Artificial intelligence (AI) is increasingly integrated into health professions education, yet its impact on academic performance remains unclear. While previous studies have examined overall AI usage, limited research has explored how specific domains of AI-assisted learning influence student outcomes.

Methods:

A cross-sectional study was conducted among 176 first-semester nursing and allied health students at a training institute in Malaysia. A structured questionnaire assessed four domains of AI-assisted learning: cognitive, efficiency, academic, and adaptive. Academic performance was measured using standardized examination scores. Data were analyzed using descriptive statistics, Pearson correlation, and multiple linear regression.

Results:

Students reported high levels of engagement across all AI-assisted learning domains. However, Pearson correlation analysis revealed no significant relationship between AI domains and academic performance ($p > 0.05$). Multiple regression analysis further confirmed that none of the AI domains significantly predicted academic performance ($R^2 = 0.021$, $p = 0.453$).

Conclusion:

Despite widespread use of AI-assisted learning, no significant association with academic performance was observed. These findings suggest that while AI may support perceived learning, its effectiveness in improving measurable academic outcomes remains uncertain. Further research is needed to explore how AI can be integrated to enhance higher-order learning.

1. Introduction

The integration of artificial intelligence (AI) into health professions education has rapidly expanded, offering new opportunities to enhance student learning experiences (Zawacki-Richter et al., 2020; Crompton & Burke, 2023). AI-assisted tools, such as intelligent tutoring systems and generative AI platforms, are increasingly utilised to support conceptual understanding, facilitate problem-solving, and improve learning efficiency among students (Baig & Yadegaridehkordi, 2024; Giannakos et al., 2024). In nursing and allied health education, where students are required to master complex theoretical knowledge and clinical reasoning, AI has the potential to play a transformative role (Jallad, 2024; Ma, 2025).

Despite the growing adoption of AI in educational settings, evidence regarding its effectiveness in improving academic performance remains inconsistent. While some studies have reported positive associations between AI-assisted learning and student outcomes, others have found limited or no significant impact (Deng et al., 2025; Wang & Wenxiang, 2025). This inconsistency suggests that the relationship between AI usage and academic performance may be more complex than previously understood.

Most existing studies have focused on overall AI usage without examining how different dimensions of AI-assisted learning influence student outcomes. AI-assisted learning is a multidimensional construct encompassing cognitive support, learning efficiency, academic enhancement, and adaptive learning features (Chan & Tsi, 2023; O'Connor et al., 2023). Examining these domains individually may provide deeper insights into how AI contributes to learning processes.

Therefore, this study aims to examine the relationship between specific domains of AI-assisted learning and academic performance among nursing and allied health students. By moving beyond general usage patterns, this study seeks to provide a more nuanced understanding of how AI is utilised in educational contexts and its implications for student achievement. Furthermore, this study extends previous research by focusing on domain-specific AI-assisted learning behaviours, offering a more comprehensive understanding of AI utilisation in health professions education. To address these gaps, the present study was conducted.

Objectives

This study aims to:

1. Assess the level of AI-assisted learning across cognitive, efficiency, academic, and adaptive domains among nursing and allied health students.

2. Examine the relationship between AI-assisted learning domains and academic performance.

3. Determine whether AI-assisted learning domains significantly predict academic performance.

Hypotheses

H01: There is no significant relationship between AI-assisted learning domains and academic performance.

H11: There is a significant relationship between AI-assisted learning domains and academic performance.

H02: AI-assisted learning domains do not significantly predict academic performance.

H12: AI-assisted learning domains significantly predict academic performance.

2. Methods

2.1 Study design and setting

This study employed a cross-sectional design and was conducted at a Ministry of Health training institute in Kota Kinabalu, Malaysia.

2.2 Participants

A total of 176 first-semester nursing and diploma in healthcare students participated in this study. Participants were selected using a convenience sampling method.

2.3 Instrument

A structured questionnaire was developed to assess AI-assisted learning practices across four domains: cognitive, efficiency, academic, and adaptive. All items were measured using a Likert scale.

The questionnaire consisted of 20 items, with 6 items measuring cognitive, 5 efficiency, 3 academic, and 5 adaptive domains.

2.4 Data analysis

Data were analysed using IBM SPSS version 27. Descriptive statistics were used to summarize participant characteristics and AI usage patterns. Pearson correlation analysis was conducted to examine relationships between variables. Multiple linear regression analysis was performed to determine the predictive effects of AI-assisted learning domains on academic performance. The instrument demonstrated acceptable internal consistency, with Cronbach's alpha values exceeding 0.80 for all domains.

3. Results

3.1 Descriptive statistics

Descriptive analysis was conducted to examine the levels of AI-assisted learning across different domains. As shown in Table 1, all AI-assisted learning domains demonstrated high mean scores among students. The efficiency domain demonstrated the highest mean score (M = 4.55, SD = 0.53), followed by cognitive (M = 4.51, SD = 0.52), academic (M = 4.44, SD = 0.62), and adaptive domains (M = 4.40, SD = 0.65). These findings indicate that students perceived AI-assisted learning as highly beneficial, particularly in enhancing learning efficiency.

Table 1
Descriptive statistics of AI-assisted learning domains (N = 176)

Variable	Mean (M)	Standard deviation (SD)
Cognitive	4.51	0.52
Efficiency	4.55	0.53
Academic	4.44	0.62
Adaptive	4.40	0.65

3.2 Correlation analysis

Pearson correlation analysis was conducted to examine the relationships between AI-assisted learning domains and academic performance. As presented in Table 2, none of the AI-assisted learning domains were significantly correlated with academic performance. Specifically, cognitive ($r = 0.101$, $p = 0.181$), efficiency ($r = 0.121$, $p = 0.111$), academic ($r = 0.084$, $p = 0.267$), and adaptive ($r = 0.057$, $p = 0.453$) domains showed no significant association with examination scores.

However, strong and statistically significant positive correlations were observed among all AI-assisted learning domains ($r = 0.793–0.840$, $p < 0.01$), indicating that these domains are closely interrelated and may reflect a consistent pattern of AI-assisted learning behaviour among students.

Table 2
Pearson correlation matrix between AI-assisted learning domains and academic performance (N = 176)

Variable	1	2	3	4	5
1. Exam score	1				
2. Cognitive	.101	1			
3. Efficiency	.121	.840**	1		
4. Academic	.084	.813**	.793**	1	
5. Adaptive	.057	.821**	.819**	.817**	1

Note: Values represent Pearson correlation coefficients.

$p < 0.01$ (2-tailed).

3.3 Regression analysis

Multiple linear regression analysis was conducted to determine whether AI-assisted learning domains predict academic performance. As shown in Table 3, the overall regression model was not statistically significant, $F(4, 171) = 0.921$, $p = .453$, explaining only a small proportion of variance in academic performance ($R^2 = .021$, Adjusted $R^2 = −.002$).

Furthermore, none of the AI-assisted learning domains significantly predicted academic performance, including cognitive (β = .065, p = .689), efficiency (β = .185, p = .238), academic (β = .016, p = .914), and adaptive (β = −.161, p = .303). These findings indicate that AI-assisted learning domains do not significantly influence academic performance among students.

Table 3
Multiple linear regression analysis of AI-assisted learning domains predicting academic performance (N = 176)

Variable	B	SE	β	t	p
(Constant)	43.250	2.960	—	14.612	< .001
Cognitive	0.529	1.320	.065	0.401	.689
Efficiency	1.488	1.256	.185	1.184	.238
Academic	0.109	1.016	.016	0.108	.914
Adaptive	-1.063	1.029	− .161	-1.033	.303
Note: R^2 = .021, Adjusted R^2 = −.002, F(4, 171) = 0.921, p = .453.					

These findings indicate that although AI-assisted learning is widely used, its impact on measurable academic outcomes may be limited.

Overall, the findings addressed all study objectives by demonstrating high levels of AI-assisted learning, but no significant relationships or predictive effects on academic performance.

4. Discussion

This study examined the level of AI-assisted learning across cognitive, efficiency, academic, and adaptive domains, as well as their relationship with academic performance among nursing and allied health students. The findings indicate that although students reported high levels of AI-assisted learning across all domains, none of these domains were significantly associated with academic performance. Furthermore, AI-assisted learning domains did not significantly predict academic performance.

The high mean scores observed across all domains suggest that students perceive AI as a valuable learning tool, particularly in enhancing learning efficiency and supporting understanding. This finding is consistent with previous studies reporting widespread adoption of AI tools in higher education and positive perceptions of their usefulness in facilitating learning processes (Baig & Yadegaridehkordi, 2024; Giannakos et al., 2024). In health professions education, AI-assisted tools may help students manage large volumes of complex information, provide instant feedback, and support self-directed learning.

However, despite these perceived benefits, the absence of a significant relationship between AI-assisted learning domains and academic performance suggests that frequent or positive use of AI does not

necessarily translate into improved measurable academic outcomes. This finding aligns with studies that reported limited or inconsistent effects of AI-assisted learning on academic performance (Deng et al., 2025; Wang & Wenxiang, 2025). One possible explanation is that students may use AI primarily for task completion rather than for deep learning and knowledge construction.

Another important finding is the strong and significant correlations observed among the AI-assisted learning domains, indicating that these domains are closely interrelated. This suggests that students who frequently engage with AI in one aspect of learning are likely to utilise it across multiple domains. While this reflects consistent AI usage behaviour, it may also indicate a generalised reliance on AI tools rather than domain-specific strategic use.

From a theoretical perspective, these findings may be interpreted through the lens of constructivist learning theory, which emphasises active engagement and meaningful knowledge construction. Although AI can support learning processes, its effectiveness may depend on how students interact with the technology. Passive or surface-level use of AI may limit its impact on deeper understanding and academic achievement.

The findings have important implications for educational practice. Educators should not only encourage the use of AI-assisted tools but also guide students in using these tools effectively to promote critical thinking, reflection, and deeper learning. Structured integration of AI into teaching strategies, along with appropriate guidance on ethical and responsible use, may enhance its potential benefits.

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between AI-assisted learning and academic performance. Second, the study relied on self-reported data, which may be subject to response bias. Third, the study was conducted within a single institution, which may limit the generalisability of the findings.

Future research should consider longitudinal designs to examine the long-term impact of AI-assisted learning on academic outcomes. In addition, qualitative studies may provide deeper insights into how students use AI tools and how these behaviours influence learning processes and performance.

In conclusion, while AI-assisted learning is widely used and positively perceived among nursing and allied health students, it does not appear to significantly influence academic performance. These findings highlight the need for more effective integration of AI into educational practices to maximise its impact on student learning outcomes.

Limitations

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships. Second, the use of self-reported data may introduce response bias. Third, the study was conducted within a single institution, which may limit generalizability. Future research should consider longitudinal designs and diverse populations.

Implications for practice

The findings of this study suggest that educators should provide guidance on the effective use of AI tools to promote deeper learning. Institutions should also consider integrating AI literacy into the curriculum to ensure that students use AI responsibly and critically.

5. Conclusion

In conclusion, although AI-assisted learning is widely used among nursing and allied health students, it does not appear to significantly influence academic performance. Future research should explore how AI can be effectively integrated to enhance higher-order learning and student outcomes.

Declarations

Ethics approval and consent to participate

Permission to conduct the study was obtained from the Director of the training institute. The study involved a questionnaire-based survey among students and posed minimal risk to participants. All participants were informed about the purpose of the study, and informed consent was obtained prior to participation. Participation was voluntary, and confidentiality and anonymity of responses were ensured. The study was conducted in accordance with institutional guidelines for research involving human participants. Participation was anonymous, and no identifiable information was collected.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

NM conceptualized the study, conducted the data analysis, and drafted the manuscript. RGJ and JBH contributed to data collection, manuscript review, and intellectual input. All authors read and approved

the final manuscript.

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