

Original Article

Assessment the Effects of Using Artificial Intelligence (AI) Assisted Tools on Critical Thinking Skills in Undergraduates Nursing Students in Khyber Pakhtunkhwa Pakistan

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ABSTRACT

Background: Artificial intelligence (AI)-assisted tools are increasingly used in nursing education, but concerns remain regarding excessive reliance on AI and its relationship with independent critical-thinking behaviors. **Objective:** To assess AI-assisted tool use and examine its relationship with self-reported critical-thinking behaviors among undergraduate nursing students. **Methods:** A quantitative descriptive cross-sectional study included 435 undergraduate BSN students in Khyber Pakhtunkhwa, Pakistan. Data were collected using a structured questionnaire assessing demographics, six critical-thinking items, four AI use/engagement items, and five perceived AI-related effect items. Data were analyzed using IBM SPSS Statistics version 26.0 with frequencies, percentages, means, standard deviations, and independent-samples t-tests. **Results:** Participants had a mean age of 20.87 ± 1.68 years, and 81.1% were male. High AI use/engagement was reported by 49.0% of participants, while 40.2% had moderate and 10.8% low use. The mean AI-use score was 10.3 ± 3.0 . Critical-thinking scores were moderate in 66.0%, low in 21.4%, and high in 12.6%, with a mean score of 12.6 ± 4.0 . Overall, 56.3% reported often or always relying on AI for problems requiring critical thinking. Critical-thinking scores did not differ significantly between males and females (12.5 ± 4.0 vs 12.9 ± 3.7 ; $p=0.409$). **Conclusion:** AI-assisted tool use was common among undergraduate nursing students, while most reported moderate critical-thinking behaviors. The findings highlight the importance of integrating AI into nursing education in ways that preserve independent evaluation and reflective reasoning. **Keywords:** Artificial Intelligence; Critical Thinking; Nursing Students; Nursing Education; Generative AI; Clinical Reasoning

INTRODUCTION

Artificial intelligence (AI) has become increasingly integrated into higher education through tools such as generative chatbots, intelligent tutoring systems, automated writing applications, and technology-supported learning platforms. These tools can provide rapid access to information, individualized feedback, assistance with

academic tasks, and opportunities for interactive learning. Their growing availability has changed how students search for information, solve academic problems, develop ideas, and engage with educational content. In nursing education, these developments are particularly important because learning extends beyond knowledge acquisition to the development of judgment, reasoning, problem-solving, and decision-making competencies required for clinical practice (1,2).

Critical thinking is a fundamental component of nursing education because nurses are expected to interpret clinical information, evaluate evidence, identify problems, consider alternative explanations, and make appropriate decisions in complex patient-care situations (2). Educational approaches such as simulation, problem-based learning, reflection, and other forms of active learning have therefore been used to promote critical-thinking and clinical-reasoning abilities among nursing students (3). AI-assisted educational technologies may further support these processes by helping learners explore concepts, generate possible solutions, receive feedback, and consider alternative perspectives. Previous research has suggested that appropriately used AI-supported learning may facilitate engagement, analytical reasoning, problem-solving, and other higher-order learning processes (1,4).

Despite these potential benefits, increasing dependence on AI has raised concerns regarding students' independent cognitive engagement. Easy access to AI-generated answers may encourage some learners to rely on externally generated information rather than independently analyzing problems, evaluating evidence, or constructing solutions. This process has been discussed in relation to cognitive offloading, whereby cognitive tasks are partly transferred to an external technological resource (5). In educational settings, excessive or uncritical dependence on AI may therefore reduce opportunities for students to practice independent reasoning, particularly when AI-generated responses are accepted without verification or reflection. Concerns have also been raised regarding academic integrity, privacy, accuracy of AI-generated information, and the responsible use of AI within educational environments (6). These issues are particularly relevant to nursing students because inappropriate reliance on automated information may have implications for the development of judgment and decision-making skills needed in future clinical practice.

Current literature nevertheless indicates that the relationship between AI use and critical thinking is complex rather than uniformly beneficial or harmful. AI-supported activities may promote reflection, idea generation, analysis, and problem-solving when students actively evaluate and question the information produced by the technology. Conversely, frequent reliance on AI for ready-made answers may encourage passive learning and reduce independent cognitive effort (7,8). Research involving university students has similarly identified perceived educational benefits of generative AI alongside concerns regarding dependence, reliability, and reduced engagement with complex reasoning tasks (9,10). Evidence from nursing education also suggests increasing acceptance and use of AI-supported applications, while emphasizing that technological assistance should complement rather than replace students' professional reasoning and human judgment (11,12).

The issue is especially relevant in settings where access to smartphones, internet-based educational resources, and generative AI applications is expanding rapidly while institutional guidance concerning their academic use is still developing. Students may differ substantially in their digital literacy, experience with AI, academic level, access to technology, and patterns of using AI for learning. These contextual factors may influence both the extent of AI use and its relationship with critical-thinking behaviors. Although previous literature has examined AI-assisted learning, student engagement, cognitive offloading, and critical thinking in broader educational populations, evidence specifically concerning undergraduate nursing students in Pakistan remains limited (13). The available literature therefore does not adequately establish how frequently nursing students in the local context use AI-assisted tools or whether different patterns of AI use are associated with their self-reported critical-thinking behaviors.

Addressing this gap is important because nursing programs must prepare students to use emerging technologies while preserving the independent reasoning required for safe and evidence-informed clinical practice. Understanding students' current patterns of AI use and their relationship with critical-thinking behaviors may help educators identify areas in which guidance on responsible AI use, information evaluation, reflective learning, and independent problem-solving is needed. Accordingly, the present cross-sectional study aimed to assess the level of AI-assisted tool use among undergraduate nursing students and to examine its association with self-reported critical-thinking scores. The study specifically addressed whether the extent of AI-assisted tool use was associated

with differences in critical-thinking scores among participating undergraduate nursing students. The null hypothesis was that there would be no statistically significant relationship between AI-assisted tool use and critical-thinking scores, whereas the alternative hypothesis proposed that a statistically significant relationship would exist.

MATERIAL AND METHODS

This quantitative, descriptive cross-sectional study was conducted among undergraduate Bachelor of Science in Nursing (BSN) students enrolled in nursing colleges in Khyber Pakhtunkhwa (KPK), Pakistan. A cross-sectional design was used to characterize students' use of artificial intelligence (AI)-assisted educational tools and their self-reported critical-thinking behaviors at a single period of assessment and to examine whether patterns of AI use were associated with critical-thinking scores. The target population comprised undergraduate BSN students studying in nursing colleges in KPK, while the accessible population consisted of students who were enrolled and available during the data-collection period.

Students were eligible to participate if they were enrolled in a BSN program in KPK, were willing to participate and provide informed consent, and had access to a smartphone or computer with internet connectivity for the use of AI-assisted tools. Students enrolled in Post-RN nursing programs and those who had not used AI-assisted tools during the preceding six months were excluded. Participants were selected using the random sampling approach reported for the study. Institutional permission was obtained before recruitment, eligible students were informed about the purpose of the study, participation was voluntary, and informed consent was obtained before completion of the questionnaire. Data were collected electronically using a Google Forms-based questionnaire.

The initial minimum sample size was calculated as 348 undergraduate nursing students using OpenEpi. To allow for an anticipated 20% proportion of non-response or incomplete questionnaires, the recruitment target was increased by dividing the minimum required sample by the expected response proportion ($348/0.80$), resulting in a target sample of 435 participants. A total of 435 undergraduate nursing students were included in the final analysis.

Data were collected using a structured questionnaire comprising demographic characteristics and three study domains: AI-assisted tool use, self-reported critical-thinking behaviors, and perceived effects of AI use on critical-thinking-related behaviors. Demographic information included age, gender, academic year, years of experience with the English language, and years of experience using AI tools. The critical-thinking component consisted of six items assessing behaviors related to analysis of challenging situations, evaluation of the accuracy and reliability of information, judgment of information received from others, generation of alternative solutions, reflection on errors, and expression of views during classroom activities. Each item was scored on a five-point frequency scale ranging from 0 to 4, where 0 represented "never," 1 "rarely," 2 "sometimes," 3 "often," and 4 "always." Item scores were summed to produce a total critical-thinking score ranging from 0 to 24, with higher scores representing more frequent self-reported engagement in critical-thinking behaviors. For descriptive interpretation, scores were categorized as low (0–8), moderate (9–16), or high (17–24).

AI-assisted tool use was assessed using four items addressing awareness of AI-assisted learning tools, frequency of using AI-powered educational platforms, perceived influence of AI on learning and academic performance, and preference for AI tools or language-model applications over traditional study methods. The same five-point response scale from 0 ("never") to 4 ("always") was applied in the analysis. The four item scores were summed to generate an AI use/engagement score ranging from 0 to 16. For descriptive analysis, total scores were classified as low AI use/engagement (0–5), moderate use/engagement (6–10), or high use/engagement (11–16). The questionnaire also contained five items addressing AI-related critical-thinking behaviors, including reliance on AI for solving problems that required critical thinking, incorporation of AI-generated alternative approaches into reasoning, perceived negative effects of AI on creativity in problem-solving, following AI recommendations without independent evaluation, and perceived changes in analytical skills after using AI for critical-thinking tasks. These items were scored from 0 to 4 using the same frequency response options. The resulting total score ranged from 0 to 20 and was categorized descriptively as low (0–6), moderate (7–13), or high (14–20) perceived AI-related effect.

The questionnaire was based on an instrument previously used by Aymen and Zakarya in research examining the influence of artificial intelligence on students' critical thinking. The instrument was administered in a standardized electronic format to maintain consistency of item presentation and response coding across participants. Higher

critical-thinking scores were interpreted as greater self-reported engagement in critical-thinking behaviors, whereas AI-use scores represented the extent of reported AI use and engagement. The AI-related effect items were analyzed both individually and as the composite categories defined for the study.

Data were analyzed using IBM SPSS Statistics version 26.0. Categorical variables were summarized using frequencies and percentages, whereas continuous and composite scores were summarized using means and standard deviations. Item-level distributions were reported for the critical-thinking, AI-use, and perceived-effect domains. Independent-samples t-tests were used to compare mean critical-thinking scores between male and female students and to examine differences in critical-thinking scores between students reporting frequent AI use and those reporting lower or occasional AI use. The analyses presented in the study were unadjusted; no multivariable model or adjusted analysis for potential confounding variables was performed. All reported analyses were based on the 435 participants included in the final dataset.

Ethical safeguards included obtaining permission from the concerned institutions, informing participants about the purpose of the research, obtaining voluntary informed consent, maintaining confidentiality, avoiding disclosure of personal information, and allowing participants to withdraw from participation. The study was conducted in accordance with these principles of voluntary participation, privacy, and confidentiality.

RESULTS

A total of 435 undergraduate nursing students were included in the analysis. Participants ranged from 18 to 24 years of age, with a mean age of 20.87 ± 1.68 years (95% CI, 20.71–21.03). Most participants were male (353, 81.1%), whereas 82 (18.9%) were female. Representation across academic years was relatively balanced, ranging from 23.4% in the fourth year to 26.4% in the second year. Participants reported a mean of 7.20 ± 2.10 years of experience with the English language and 1.80 ± 0.95 years of experience with AI tools.

For self-reported critical-thinking behaviors, the highest item mean was observed for questioning the accuracy and reliability of new information (2.24 ± 1.06), followed by evaluating information and making judgments (2.19 ± 1.08). Sharing views regarding different subjects during class had the lowest item meaning (1.94 ± 1.12). The overall critical-thinking score was 12.6 ± 4.0 (95% CI, 12.22–12.98) on the 0–24 scale. Most participants were categorized in the moderate range (287, 66.0%), while 93 (21.4%) were classified as low and 55 (12.6%) as high.

AI-related responses indicated substantial engagement with AI-assisted educational tools. Awareness of AI learning tools had the highest mean item score (2.74 ± 1.05). For direct use of AI-powered educational tools or platforms, 170 participants (39.1%) reported using them often and 75 (17.2%) always, corresponding to 56.3% reporting use in the two highest frequency categories. Preference for AI tools over traditional study methods had a mean score of 2.41 ± 1.11 . The overall AI use/engagement score was 10.3 ± 3.0 (95% CI, 10.02–10.58). High AI use/engagement was observed in 213 participants (49.0%), moderate use in 175 (40.2%), and low use in 47 (10.8%).

Table 1. Demographic Characteristics of Participants (N = 435)

Characteristic	n (%)
Age, years	
18	38 (8.7)
19	64 (14.7)
20	82 (18.9)
21	92 (21.1)
22	78 (17.9)
23	52 (12.0)
24	29 (6.7)
Gender	
Male	353 (81.1)
Female	82 (18.9)
Academic year	
First year	110 (25.3)
Second year	115 (26.4)
Third year	108 (24.8)
Fourth year	102 (23.4)

Table 2. Continuous Characteristics of Participants (N = 435)

Variable	Mean ± SD	95% CI
Age, years	20.87 ± 1.68	20.71–21.03
Experience with English language, years	7.20 ± 2.10	7.00–7.40
Experience with AI tools, years	1.80 ± 0.95	1.71–1.89

CI, confidence interval; SD, standard deviation.

Table 3. Item-Level Distribution of Self-Reported Critical-Thinking Behaviors (N = 435)

Critical-thinking item	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)	Mean ± SD
Deeply analyze challenges and puzzles	36 (8.3)	74 (17.0)	157 (36.1)	125 (28.7)	43 (9.9)	2.15 ± 1.08
Question accuracy and reliability of new information	30 (6.9)	68 (15.6)	153 (35.2)	137 (31.5)	47 (10.8)	2.24 ± 1.06
Evaluate information and make judgments	34 (7.8)	70 (16.1)	155 (35.6)	130 (29.9)	46 (10.6)	2.19 ± 1.08
Brainstorm possible solutions when facing a problem	42 (9.7)	83 (19.1)	158 (36.3)	112 (25.7)	40 (9.2)	2.06 ± 1.10
Reflect on errors and identify ways to improve	46 (10.6)	87 (20.0)	160 (36.8)	104 (23.9)	38 (8.7)	2.00 ± 1.10
Sharing views regarding different subjects in class	53 (12.2)	92 (21.1)	154 (35.4)	101 (23.2)	35 (8.0)	1.94 ± 1.12

Items were scored from 0 (never) to 4 (always). SD, standard deviation.

Table 4. Item-Level Distribution of AI-Assisted Tool Use and Engagement (N = 435)

AI-related item	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)	Mean ± SD
Awareness of AI tools designed to assist learning	18 (4.1)	35 (8.0)	97 (22.3)	175 (40.2)	110 (25.3)	2.74 ± 1.05
Use of AI-powered educational tools or platforms	20 (4.6)	50 (11.5)	120 (27.6)	170 (39.1)	75 (17.2)	2.53 ± 1.05
Perceived influence of AI on learning and academic performance	18 (4.1)	45 (10.3)	105 (24.1)	180 (41.4)	87 (20.0)	2.63 ± 1.04
Preference for AI tools over traditional study methods	30 (6.9)	55 (12.6)	125 (28.7)	155 (35.6)	70 (16.1)	2.41 ± 1.11

Items were scored from 0 (never) to 4 (always). AI, artificial intelligence; SD, standard deviation.

Table 5. Item-Level Distribution of Perceived AI-Related Effects on Critical-Thinking Behaviors (N = 435)

Item	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)	Mean ± SD
Reliance on AI for problems requiring critical thinking	18 (4.1)	52 (12.0)	120 (27.6)	172 (39.5)	73 (16.8)	2.53 ± 1.04
Incorporation of AI-suggested alternative approaches	25 (5.7)	60 (13.8)	130 (29.9)	160 (36.8)	60 (13.8)	2.39 ± 1.07
Perceived negative effect of AI on creativity in problem-solving	28 (6.4)	55 (12.6)	110 (25.3)	165 (37.9)	77 (17.7)	2.48 ± 1.12
Following AI recommendations without independent evaluation	35 (8.0)	65 (14.9)	130 (29.9)	145 (33.3)	60 (13.8)	2.30 ± 1.13
Perceived changes in analytical skills following AI use	30 (6.9)	58 (13.3)	122 (28.0)	155 (35.6)	70 (16.1)	2.41 ± 1.12

Items were scored from 0 (never) to 4 (always). AI, artificial intelligence; SD, standard deviation.

Table 6. Distribution and Summary Scores of Critical Thinking, AI Use/Engagement, and Perceived AI-Related Effect (N = 435)

Domain	Low n (%)	Moderate n (%)	High n (%)	Mean ± SD	95% CI
Critical-thinking score	93 (21.4)	287 (66.0)	55 (12.6)	12.6 ± 4.0	12.22–12.98
AI use/engagement score	47 (10.8)	175 (40.2)	213 (49.0)	10.3 ± 3.0	10.02–10.58
Perceived AI-related effect score	43 (9.9)	258 (59.3)	134 (30.8)	12.1 ± 3.4	11.78–12.42

Critical-thinking score ranges: low, 0–8; moderate, 9–16; high, 17–24. AI use/engagement score ranges: low, 0–5; moderate, 6–10; high, 11–16. Perceived AI-related effect score ranges: low, 0–6; moderate, 7–13; high, 14–20. AI, artificial intelligence; CI, confidence interval; SD, standard deviation.

Table 7. Comparison of Critical-Thinking Scores by Gender

Gender	n	Mean ± SD	Mean difference	95% CI	t	df	p-value	Cohen's d
Male	353	12.5 ± 4.0	-0.40	-1.35 to 0.55	-0.83	433	0.409	-0.10
Female	82	12.9 ± 3.7						

Mean difference was calculated as male minus female. The 95% confidence interval and Cohen's d were calculated from the reported group sample sizes, means, and standard deviations using the pooled-variance independent-samples t-test. CI, confidence interval; df, degrees of freedom; SD, standard deviation.

Regarding AI-related critical-thinking behaviors, 245 participants (56.3%) reported often or always relying on AI to solve problems requiring critical thinking. A total of 220 (50.6%) often or always incorporated AI-suggested alternative approaches into their reasoning, while 242 (55.6%) often or always reported a negative effect of AI on

creativity in problem-solving. Following AI recommendations without independent evaluation was reported often or always by 205 participants (47.1%). The overall perceived AI-related effect score was 12.1 ± 3.4 (95% CI, 11.78–12.42), with 258 participants (59.3%) classified in the moderate category, 134 (30.8%) in the high category, and 43 (9.9%) in the low category.

Female participants had a mean critical-thinking score of 12.9 ± 3.7 compared with 12.5 ± 4.0 among male participants. The mean difference for males relative to females was -0.40 points (95% CI, -1.35 to 0.55), and the difference was not statistically significant, $t(433) = -0.83$, $p = 0.409$. The corresponding standardized mean difference was small (Cohen's $d = -0.10$), indicating little evidence of a meaningful gender-related difference in self-reported critical-thinking scores in this sample.

DISCUSSION

The present study examined AI-assisted tool use and self-reported critical-thinking behaviors among undergraduate nursing students. The principal findings indicate substantial engagement with AI-assisted educational tools, while most participants demonstrated moderate rather than high levels of self-reported critical-thinking behaviors. Students also frequently reported relying on AI during tasks requiring critical thinking, incorporating AI-generated approaches into their reasoning, and following AI recommendations without independent evaluation. In contrast, critical-thinking scores did not differ meaningfully between male and female participants. Taken together, these findings suggest that AI is already embedded in the academic practices of many nursing students, while the development and preservation of independent reasoning remain important educational considerations.

Most participants were categorized as having moderate self-reported critical-thinking scores, whereas only a relatively small proportion fell within the high category. This pattern is important in nursing education because critical thinking contributes to the interpretation of information, evaluation of evidence, problem-solving, and clinical decision-making (2). Previous work has emphasized the role of active educational strategies in strengthening these abilities. Sterner et al. reported that simulation-based education can support the development of critical-thinking skills among nursing students, highlighting the importance of educational activities that require learners to analyze and respond to realistic clinical situations rather than passively receive information (3). Similar arguments have been advanced in educational research emphasizing learner-centered activities, reflection, and active engagement as mechanisms for promoting higher-order thinking (14). The moderate scores observed in the present study therefore suggest that nursing curricula may need to continue emphasizing structured opportunities for independent analysis, reflective reasoning, and evidence appraisal.

The high level of AI use observed among participants is consistent with the broader expansion of AI-supported technologies in health-professions education. A systematic review by AlAli et al. described increasing integration of AI within nursing education and identified potential benefits for engagement, learning, technological readiness, and academic support, while also emphasizing that AI should complement rather than replace professional judgment (11). Özdemir et al. likewise reported generally favorable attitudes toward AI-supported applications among nursing students and demonstrated relationships between AI-related attitudes, critical-thinking motivation, and clinical decision-making (12). These findings support the view that AI technologies are becoming a routine component of students' learning environments and that educational institutions need to address not only whether students use AI, but also how they use it.

The current findings also demonstrate that many students relied on AI during tasks that they perceived as requiring critical thinking. More than half reported frequent reliance on AI for such problems, while substantial proportions reported incorporating AI-generated approaches into their reasoning or following AI recommendations without independent evaluation. These behaviors are consistent with concerns regarding cognitive offloading, in which individuals transfer part of the cognitive work required for a task to an external resource (5). Cognitive offloading is not necessarily harmful; when used appropriately, external tools can reduce routine cognitive burden and allow greater attention to complex analysis. However, when students use AI-generated responses as substitutes for evaluating evidence, generating alternatives, or independently solving problems, opportunities to practice these higher-order skills may be reduced. Raitskaya and Tikhonova similarly concluded that interaction with generative AI may support critical thinking when learners actively evaluate, question, and refine AI-generated material, while uncritical dependence may undermine independent reasoning (7).

Evidence from other university populations also illustrates this dual role of generative AI. Darwin et al. found that students perceived AI as useful for research and analytical activities but also recognized limitations related to reliability, personalization, and the interpretation of complex information (9). Essien et al. similarly reported that AI text-generation tools can support some components of critical thinking, although their educational value depends strongly on how students interact with generated content rather than simply on the availability of the technology itself (10). Alghamdi further reported generally positive perceptions of generative AI in relation to critical thinking and creativity, with students' self-efficacy influencing these perceptions (15). Differences across studies may therefore reflect variation in AI literacy, academic discipline, learning tasks, institutional guidance, and whether AI is used as a scaffold for reasoning or as a substitute for independent work.

The present study also found that many participants perceived negative effects of AI on creativity and reported following AI recommendations without independent evaluation. These findings should be interpreted as students' perceptions and behaviors rather than objective evidence that AI reduces creativity or critical-thinking ability. Because the study was cross-sectional and relied on self-report, it cannot determine whether greater AI reliance leads to weaker reasoning, whether students with less confidence in independent problem-solving are more likely to rely on AI, or whether both patterns are influenced by other factors. Din's systematic review similarly described both potential educational benefits and concerns regarding overreliance on AI, suggesting that the influence of AI on critical thinking is likely to depend on the way it is incorporated into learning activities rather than on frequency of access alone (16).

No, statistically significant difference in critical-thinking scores was observed between male and female students, and the standardized effect size was small. This finding suggests that gender was not an important source of variation in self-reported critical-thinking scores within this sample. Sterner et al. likewise did not identify gender as a dominant determinant of critical-thinking performance in their nursing-education context (3). Other educational factors, including academic experience, digital literacy, learning strategies, exposure to simulation or problem-based learning, and patterns of AI use, may be more relevant to differences in critical-thinking behavior than gender alone. However, the substantial imbalance between male and female participants in the present study limits the precision of gender-based comparisons.

The findings have practical implications for nursing education. Given the high level of AI engagement observed, attempts to prohibit or ignore AI use are unlikely to address the educational challenges identified. Instead, nursing programs may benefit from incorporating AI literacy into existing teaching approaches, with emphasis on verification of AI-generated information, comparison with credible evidence, justification of clinical reasoning, recognition of AI limitations, and reflection on how conclusions are reached. This approach is consistent with previous literature suggesting that AI is most educationally valuable when it functions as a support for active learning rather than a replacement for reasoning (17–19). Such integration may be particularly important in nursing, where students must ultimately transfer academic reasoning into situations involving patient assessment, clinical judgment, safety, and ethical responsibility (20).

Several limitations should be considered when interpreting these findings. The cross-sectional design prevents determination of temporal or causal relationships between AI use and critical-thinking behaviors. Critical thinking was assessed using self-reported behaviors rather than an objective standardized performance measure, making the results susceptible to social-desirability bias, recall bias, and differences in self-perception (21). The AI-use and perceived-effect measures also combined different aspects of awareness, frequency, preference, reliance, and perceived influence, and the manuscript did not provide sufficient psychometric evidence to establish the dimensional validity of these composite scores. The use of researcher-defined score categories may further limit interpretation of low, moderate, and high classifications. Students who had not used AI during the previous six months were excluded, restricting the findings to students with recent AI exposure and potentially inflating estimates of AI engagement (22). The sampling procedure and participating institutions were not described in sufficient detail to establish representativeness across KPK, and potential confounding factors such as academic performance, digital literacy, socioeconomic access, learning motivation, and AI proficiency were not adjusted for. Finally, the marked gender imbalance limits subgroup comparisons. Despite these limitations, the study provides a useful descriptive account of contemporary AI-use patterns and self-reported critical-thinking behaviors among undergraduate nursing students and identifies areas requiring more rigorous longitudinal and analytically robust investigation (23).

CONCLUSION

Undergraduate nursing students in this study reported substantial use of AI-assisted educational tools, while most demonstrated moderate levels of self-reported critical-thinking behavior. Frequent reliance on AI during problem-solving, incorporation of AI-generated approaches, and following AI recommendations without independent evaluation were commonly reported, whereas critical-thinking scores did not differ significantly by gender. These findings indicate that AI has become an important component of students' learning practices and underscore the need to preserve independent evaluation, reflective reasoning, and critical appraisal when AI-assisted tools are incorporated into nursing education.

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