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Association of AI Academic Dependency and AI Self-Efficacy with Clinical Reasoning Among Clinical Practicum Students with Experience Using Generative AI: The Role of AI Ethical Awareness

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Abstract

Background/Objectives: This study aimed to investigate the mediating and moderating roles of AI ethical awareness in the relationships of AI academic dependency and AI self-efficacy with clinical reasoning among clinical practicum students with experience using generative AI. **Methods:** This cross-sectional survey study included 135 students from a university in Daejeon, South Korea. Participants were university students who had used generative AI for academic purposes and had completed a clinical practicum within the previous six months. Data were collected using an online questionnaire on Google Forms between 17 June and 6 July 2026. **Results:** AI ethical awareness showed evidence consistent with significant mediating (indirect effect = −0.047, 95% CI: −0.089 to −0.010) and moderating ($B = -0.012$, $p = 0.015$, $\Delta R^2 = 0.039$) roles in the association between AI academic dependency and clinical reasoning. However, in the association between AI self-efficacy and clinical reasoning, neither the mediating (indirect effect = −0.018, 95% CI: −0.054 to 0.008) nor the moderating (interaction $B = 0.004$, $p = 0.339$) roles of AI ethical awareness were significant. **Conclusions:** Our findings suggest that AI ethical awareness is associated with the relationship between AI academic dependency and clinical reasoning, potentially serving as both a mediator and a moderator. The negative association between AI academic dependency and clinical reasoning varies according to the level of AI ethical awareness. Future studies are needed to explore the complex role of AI ethical awareness and to determine how educational interventions related to AI ethics may influence students' learning and clinical reasoning processes.

Keywords: artificial intelligence; AI self-efficacy; AI academic dependency; AI ethics; clinical reasoning

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1. Introduction

Generative artificial intelligence (GenAI) refers to AI systems trained on large datasets to generate content, such as text, images, audio, and video [1]. Since the release of ChatGPT in 2022, GenAI has spread rapidly worldwide, and its use has increased from 33% in 2023 to 79% in 2025 [2]. In South Korea, AI use has more than doubled from 13.7% in 2024 to 31.6% in 2025 [3]. GenAI use is even more prevalent among university students. One study of 1054 university students in the UK reported that the proportion of students using GenAI for coursework had increased rapidly from 53% in 2024 to 94% in 2026 [4], while

another study of 498 students at a single university in South Korea in 2023 reported a high GenAI usage rate of 88% [5]. In 2024, the World Health Organization (WHO) suggested that GenAI-based models could support medical workers' decision-making and medical and nursing education [6]. Other studies of students in healthcare-related majors in South Korea reported that 50% to 97% of students used GenAI for learning and coursework [7–9].

Clinical reasoning is an essential competency for students in healthcare disciplines to collect and integrate patients' subjective and objective data, investigate clinical problems, and make decisions regarding patient diagnosis, prognosis, interventions, and management [10–12]. This allows healthcare workers to choose appropriate clinical actions in uncertain or time-restricted situations, which are critical for patient safety and independent work performance [10,13]. Thus, clinical reasoning is a core competency that students need to develop before they start performing their work independently [13].

Various factors have been found to affect clinical reasoning in previous studies, including age, satisfaction with one's major, academic achievement, clinical experience, self-efficacy in clinical performance, learning behavior, self-directed learning, and education on AI use [14–20]. A scoping review of six studies using AI in clinical reasoning showed that GenAI significantly improved clinical reasoning in four studies [14]. However, these studies mostly focused on the effects of AI-generated feedback or the development and use of complex clinical scenarios for clinical reasoning. Limited research has been conducted on the relationship between clinical reasoning and learners' psychological and behavioral characteristics when using GenAI. Specifically, the effects of learners' AI academic dependency, AI self-efficacy, and AI ethical awareness on their clinical reasoning have not been investigated.

AI academic dependency is the psychological or behavioral tendency to delegate analysis and judgment to AI or accept AI output without thoroughly reviewing it when performing academic tasks [21]. In studies of university students, overdependence on GenAI was negatively correlated with critical thinking, which is a major aspect of clinical reasoning [22,23]. In a quasi-experimental study of 99 nursing students, the GenAI-using group showed lower nursing curriculum-based clinical reasoning than the textbook-using group [24].

AI self-efficacy is the extent to which individuals believe they can effectively use and interact with AI technology [25]. In a study of 206 Korean nursing students, academic self-efficacy and self-regulatory efficacy were positively correlated with clinical reasoning [16].

AI ethical awareness refers to the degree to which individuals recognize and consider ethical principles such as responsibility, stability, transparency, and human-centeredness when using AI [26,27]. In the clinical reasoning process, AI ethical awareness may form a basis for critically reviewing errors and biases in AI output and maintaining human responsibility for the final judgments [5]. AI ethical awareness reduces noncritical dependence on GenAI and helps maintain independent clinical reasoning [28]. Thus, it may function as a mediating factor to explain how learners' AI-use characteristics, such as AI academic dependency and AI self-efficacy, are connected to their clinical reasoning [28].

Learners with similar levels of AI academic dependency or AI self-efficacy could show different approaches to validating or accepting AI-generated outputs according to their level of AI ethical awareness. Previous research found that ethical awareness moderated the relationship between AI attitudes and innovative work behavior among nurses [29], indicating that ethical awareness can shape how individuals translate AI-related perceptions and attitudes into professional behaviors. Therefore, there is a need to examine whether AI ethical awareness acts as a mediating factor explaining the processes linking AI academic dependency and AI self-efficacy to clinical reasoning, and whether it also acts as a moderating factor altering the strength or direction of those relationships.

Accordingly, this study aimed to examine the associations of AI academic dependency and AI self-efficacy with clinical reasoning among clinical practicum students with experience using GenAI, and to investigate the mediating and moderating roles of AI ethical awareness in these relationships.

2. Materials and Methods

2.1. Study Design

This cross-sectional survey study aimed to investigate the mediating and moderating roles of AI ethical awareness in the associations of AI academic dependency and AI self-efficacy with clinical reasoning among clinical practicum students with experience using GenAI.

2.2. Participants

Participants included 135 students from a single university in Daejeon, South Korea. Inclusion criteria were enrollment as a university student, experience using GenAI for academic work, and experience in clinical practicums during the last 6 months. The required sample size was calculated using G*Power 3.1.9.7 [30], assuming a regression significance level of 0.05, effect size of 0.15, power of 0.85, and 11 predictors. The minimum sample size required was 135 participants. To account for an anticipated 10% rate of unusable responses [31], data collection was planned until 149 completed questionnaires had been obtained. Recruitment was discontinued once 149 responses had been received. Of the 149 completed questionnaires, 14 were excluded during data screening due to missing data, response patterns indicating low response reliability, or extreme outlier values. Consequently, data from 135 participants were included in the final analysis.

2.3. Measures

2.3.1. General Characteristics

For the participants' general characteristics, we recorded sex, age, major, grade point average (GPA), satisfaction with their major, duration of clinical practicum, frequency of GenAI use in learning for their major, and experience with AI-related ethics education.

2.3.2. AI Academic Dependency

In this study, AI academic dependency was conceptualized as cognitive reliance on AI and avoidance of independent evaluation rather than mere frequency of AI use. AI academic dependency was measured using a GenAI academic dependency scale for university students developed by Kim et al. [21]. This scale consists of 19 items across 4 subdomains: cognitive outsourcing (6 items), overreliance on AI (5 items), evaluation avoidance tendency (4 items), and cognitive helplessness (4 items). The possible score range was 19–95 points, and the total score was used in this study. Each item was measured on a 5-point Likert scale (1 = completely disagree, 5 = strongly agree), with higher scores indicating higher GenAI academic dependency. In terms of reliability, Cronbach's α was 0.89 for the original instrument [21] and 0.91 in our study.

2.3.3. AI Self-Efficacy

To measure AI self-efficacy, we obtained permission to translate the AI Self-Efficacy Scale developed by Wang and Chuang into Korean [25]. We confirmed semantic equivalence with the original instrument through forward- and back-translation, and the content validity was verified by a panel of three nursing professors. This instrument consisted of 22 items across 4 subdomains: assistance (7 items), anthropomorphic interaction (5 items),

comfort with AI (6 items), and technological skills (4 items). The possible score range was 22–154 points, and the total score was used in this study. Each item was measured on a 7-point Likert scale (1 = completely disagree, 7 = strongly agree), with higher scores indicating higher AI self-efficacy. In terms of reliability, Cronbach's α was 0.96 for the original instrument [25] and 0.90 for the instrument used in our study.

2.3.4. AI Ethical Awareness

AI ethical awareness was measured using the Test for Artificial Intelligence Ethics Awareness developed by Kim and Shin [27]. This instrument consisted of 24 total items across 8 subdomains: responsibility (3 items), stability and reliability (3 items), no discrimination (3 items), transparency and explainability (3 items), people-centric service (3 items), employment (3 items), permission and limitations (3 items), and robot rights (3 items). The possible score ranged from 24 to 120 points, and the total score was used in this study. Each item was measured on a 5-point Likert scale (1 = completely disagree, 5 = strongly agree). After adjusting for reverse-scored items, higher total scores indicated stronger AI ethical awareness. In terms of reliability, Cronbach's α was 0.81 for the original instrument [27] and 0.77 in our study.

2.3.5. Clinical Reasoning

Clinical reasoning was measured using the Korean Short Diagnostic Thinking Inventory (DTI-SK) [32]. This Korean version was adapted from the 12-item Diagnostic Thinking Inventory (DTI) [33] and validated in the context of Korean medical education by Si [32]. Initially, the measurement was developed by Bordage et al. [34] and was later adapted by Edgar et al. [33] for optometry. To improve the applicability of the DTI-SK to healthcare-related students, we further tested the content validity with a panel of three nursing professors before use.

The DTI-SK is a self-report instrument that measures the cognitive aspects of clinical reasoning. It consists of 14 total items across 2 subdomains: flexibility in thinking and evidence of memory structure. The possible score range was 14–84 points, and the total score was used in this study. Each item consisted of an initial statement, followed by two continuations of this statement, representing two extremes along a spectrum. Responses were indicated on a continuous 1–6-point scale between these two extremes. After adjusting for reverse-scored items, higher scores indicated stronger clinical reasoning. In terms of reliability, Cronbach's α was 0.90 in the study by Si [32] and 0.74 in our study.

2.4. Data Collection and Ethical Considerations

Before commencing the study, we received approval from the institutional review board (IRB No. KYU202605023-UE001). Data were collected via an online questionnaire using Google Forms between 17 June and 6 July 2026. To recruit participants, we posted a study participation information sheet and a questionnaire link to the noticeboards of online communities (academic department communities, university communities, and social networking service) frequently used by students from healthcare-related majors where clinical practicum is a required course. Participation was voluntary, and before starting the questionnaire, all participants were provided with information about the study objectives, autonomy of participation and withdrawal, and guarantees of anonymity and privacy of personal information. Only those who consented via an online study consent form continued to participate in the questionnaire. Participants who completed the questionnaire were given a mobile coffee coupon.

2.5. Data Analysis

The collected data were analyzed using SPSS/WIN 28.0, and SPSS PROCESS macro-4.2. Frequencies, percentages, means, and standard deviations were calculated for the participants' general characteristics, AI academic dependency, AI self-efficacy, AI ethical awareness, and clinical reasoning. Differences in clinical reasoning according to general characteristics were analyzed using independent *t*-tests and one-way analysis of variance. Participant characteristics were considered for inclusion as covariates; however, because none showed a significant association with clinical reasoning in the preliminary analyses, they were not included in the mediation and moderation models. Correlations among AI academic dependency, AI self-efficacy, AI ethical awareness, and clinical reasoning were examined using Pearson's correlation coefficients. The mediating and moderating roles of AI ethical awareness were tested by using PROCESS Model 4 for mediation analysis and Model 1 for moderation analysis. The Johnson–Neyman technique was used to analyze the conditional effect at different levels of the moderator. The significance of the effects was tested using bootstrapping (5000 iterations), and bias-corrected 95% confidence intervals were calculated. The reliability of the research instruments was assessed using Cronbach's α.

3. Results

3.1. Differences in Clinical Reasoning According to Participant Characteristics

Of the 149 completed questionnaires, 14 responses were excluded because they contained missing data, low response reliability, and outliers. Thus, the final analysis included 135 participants.

Regarding general characteristics, most participants were female (n = 102, 75.6%), and the most common age group was 22–23 years (n = 53, 39.3%). Most participants were nursing majors (n = 96, 71.1%), and the most frequent GPA was ≥3.5 and <4.0 (n = 58, 43.0%). Regarding satisfaction with their major, more students were "satisfied" (n = 93, 68.9%) than "dissatisfied or unsure." The most frequent practicum duration was <3 months (n = 96, 71.1%). As for AI use frequency, the most common response was 1–4 times per week (n = 67, 49.6%), and 55 participants (40.7%) responded "almost every day." Eighty-one participants (60.0%) responded "yes" when asked if they had experience with AI ethics education.

When we analyzed differences in clinical reasoning according to the participants' general characteristics, no statistically significant differences were observed in clinical reasoning according to sex, age, major, GPA, satisfaction with major, practicum duration, frequency of AI use, or experience with AI ethics education (Table 1).

Table 1. Differences in clinical reasoning according to participant characteristics (N = 135).

Variables	Categories	*n* (%)	Mean ± *SD*	Clinical Reasoning		
				Mean ± *SD*	*t*/*F*	*p*
Sex	Female	102 (75.6)		53.99 ± 8.22	1.654	0.101
	Male	33 (24.4)		56.81 ± 9.48		
Age (years)	≤21	41 (30.4)	23.06 ± 2.41	53.59 ± 8.40	0.611	0.544
	22–23	53 (39.3)		54.63 ± 8.59		
	≥24	41 (30.4)		55.57 ± 8.87		
Major	Nursing	96 (71.1)		55.59 ± 9.03	1.955	0.053
	Others *	39 (28.9)		52.44 ± 7.01		
GPA	<3.5	39 (28.9)		54.74 ± 10.00	1.136	0.337
	≥3.5–<4	58 (43.0)		53.50 ± 7.20		
	≥4	38 (28.1)		56.42 ± 8.92		

Table 1. *Cont.*

Variables	Categories	*n* (%)	Mean ± *SD*	Clinical Reasoning		
				Mean ± *SD*	*t*/*F*	*p*
Satisfaction with major	Satisfied Others (Dissatisfied or unsure)	93 (68.9) 42 (31.1)		55.15 ± 8.98 53.64 ± 7.67	−0.943	0.347
Practicum duration (months)	<3 ≥3	96 (71.1) 39 (28.9)		54.89 ± 8.49 56.18 ± 8.94	0.431	0.667
Frequency of AI use	≤3 times/month 1–4 times/week Almost every day	13 (9.6) 67 (49.6) 55 (40.7)		54.85 ± 7.74 54.10 ± 8.48 55.35 ± 9.01	0.291	0.748
Experience with AI ethics education	Yes No	81 (60.0) 54 (40.0)		54.38 ± 7.97 55.13 ± 9.51	−0.493	0.623

SD = standard deviation; GPA = grade point average; AI = artificial intelligence; *t*/*F* = *t* tests and ANOVA. * Others: Medicine, radiological science, physical therapy, occupational therapy, emergency medical services, dental hygiene, and biomedical laboratory science.

3.2. Levels of AI Academic Dependency, AI Self-Efficacy, AI Ethical Awareness, and Clinical Reasoning

The participants' mean score for AI academic dependency was 58.82 ± 13.30 points (mean item score 3.10 ± 0.70), that for AI self-efficacy was 102.34 ± 18.50 points (mean item score 4.65 ± 0.84), and that for AI ethical awareness was 84.52 ± 9.86 points (mean item score 3.52 ± 0.41). Their mean score for clinical reasoning was 54.68 ± 8.59 points (mean item score 3.91 ± 0.61; Table 2).

Table 2. Levels of AI academic dependency, AI self-efficacy, AI ethical awareness, and clinical reasoning (*N* = 135).

Variables	*M* ± *SD* (Total)	Min–Max (Total)	M ± *SD* (Item)	Min–Max (Item)
AI academic dependency	58.82 ± 13.30	24–94	3.10 ± 0.70	1–5
AI self-efficacy	102.34 ± 18.50	41–140	4.65 ± 0.84	1–7
AI ethical awareness	84.52 ± 9.86	68–108	3.52 ± 0.41	1–5
Clinical reasoning	54.68 ± 8.59	31–79	3.91 ± 0.61	1–6

M = mean; *SD* = standard deviation.

3.3. Correlations Among the Study Variables

Clinical reasoning showed a significant negative correlation with AI academic dependency ($r = -0.27$, $p = 0.001$), and significant positive correlations with AI self-efficacy ($r = 0.18$, $p = 0.038$) and AI ethical awareness ($r = 0.30$, $p < 0.001$). In addition, AI academic dependency was positively correlated with AI self-efficacy ($r = 0.18$, $p = 0.034$; Table 3).

Table 3. Correlations among major variables (*N* = 135).

Number	Variables	1	2	3	4
		r (*p*)			
1	AI academic dependency	1			
2	AI self-efficacy	0.18 (0.034)	1		
3	AI ethical awareness	−0.30 (<0.001)	−0.12 (0.164)	1	
4	Clinical reasoning	−0.27 (0.001)	0.18 (0.038)	0.30 (<0.001)	1

r = Pearson correlation coefficient; *p* = *p*-value (statistical significance).

3.4. Mediating and Moderating Roles of AI Ethical Awareness in the Relationship Between AI Academic Dependency and Clinical Reasoning

To investigate the mediating role of AI ethical awareness on the relationship between participants' AI academic dependency and their clinical reasoning, we used Model 4 in the Hayes PROCESS macro [35]. AI academic dependency showed a statistically significant negative relationship with AI ethical awareness ($B = -0.221$, $p < 0.001$), and AI ethical awareness showed a statistically significant positive relationship with clinical reasoning ($B = 0.212$, $p = 0.005$). The direct effect of AI academic dependency on clinical reasoning was also statistically significant and negative ($B = -0.129$, $p = 0.020$). The mediating role was assessed by examining the indirect effect using bootstrapping (5000 iterations, 95% confidence interval). In the relationship between AI academic dependency and clinical reasoning, the indirect effect of AI ethical awareness was −0.047, and the 95% confidence interval did not include zero, indicating that AI ethical awareness had a partial mediating role in the association between AI academic dependency and clinical reasoning (Table 4).

Table 4. Mediating and moderating roles of AI ethical awareness in the relationship between AI academic dependency and clinical reasoning.

	Path		*B*	*SE*	*t*	*p*	R^2	ΔR^2	*F* (*p*)
Mediating effect of AI ethical awareness	Step 1	X → M	−0.221	0.061	−3.593	<0.001	0.088		12.907 (<0.001)
	Step 2	X → Y	−0.129	0.055	−2.346	0.020	0.128		9.707 (<0.001)
		M → Y	0.212	0.074	2.863	0.005			
	Indirect effect	X → M → Y		*B*		Bootstrap *SE*		Bootstrap 95% CI	
				−0.047		0.020		−0.089 to −0.010	
Moderating effect of AI ethical awareness		X → Y	−0.136	0.054	−2.511	0.013			
		W → Y	0.177	0.074	2.381	0.019	0.167		8.762 (<0.001)
		X × W → Y	−0.012	0.005	−2.474	0.015		0.039	6.120 (0.015)

X = AI academic dependency (independent variable); M = AI ethical awareness (mediator); W = AI ethical awareness (moderator); Y = clinical reasoning (dependent variable); *B* = unstandardized regression coefficient; CI = confidence interval, *SE* = standard error; *t* = t statistic; *p* = *p*-value; R^2 = coefficient of determination; ΔR^2 = change in *R*.

To investigate the moderating role of AI ethical awareness in the relationship between participants' AI academic dependency on AI and clinical reasoning, we used Model 1 in the Hayes PROCESS macro [35]. After mean centering of AI academic dependency (independent variable) and AI ethical awareness (moderating variable), in a simultaneous-entry regression analysis, the interaction term between the independent variable and the moderating variable was significant ($B = -0.012$, $p = 0.015$; Table 4).

When the potential conditional moderating effect of AI ethical awareness on the relationship between AI academic dependency and clinical reasoning was tested, the moderation effect was not maintained when the value of the moderating variable was low ($B = -0.014$, $p = 0.846$). By contrast, when the value of the moderating variable was moderate, as the independent variable increased, the dependent variable decreased significantly ($B = -0.136$, $p = 0.013$). Likewise, when the value of the moderating variable was high, the dependent variable decreased significantly as the independent variable increased ($B = -0.257$, $p = 0.001$). In summary, when AI ethical awareness (moderating variable) was higher, the negative association of AI academic dependency with clinical reasoning was even greater (Table 5).

Table 5. Conditional effects of AI academic dependency on clinical reasoning at different levels of AI ethical awareness.

Variable	Effect	*SE*	*t*	*p*
−1 SD	−0.014	0.071	−0.194	0.846
Mean	−0.136	0.054	−2.511	0.013
+1 SD	−0.257	.075	−3.438	0.001

SE = standard error; *t* = t statistic; *p* = *p*-value.

In the Johnson–Neyman analysis, the threshold for AI ethical awareness was −2.236 on the centered scale, corresponding to 82.28 points on the original scale. This finding indicates that the negative association of AI academic dependency with clinical reasoning became statistically significant when AI ethical awareness exceeded this level. Specifically, in the interval where AI ethical awareness was above −2.236 (53.3%), the negative association of AI academic dependency with clinical reasoning was statistically significant, whereas in the interval below −2.236 (46.7%), the association was not statistically significant. Additionally, as the level of AI ethical awareness improved, the strength of the negative association of AI academic dependency with clinical reasoning gradually increased (Table 6).

Table 6. Conditional effect of AI academic dependency on clinical reasoning across levels of AI ethical awareness.

AI Ethical Awareness (Moderator)	*B*	Bootstrap *SE*	t	*p*	LLCI	ULCI
−16.519	0.068	0.096	0.710	0.479	−0.122	0.259
−14.519	0.044	0.088	0.495	0.622	−0.131	0.218
−12.519	0.019	0.081	0.235	0.814	−0.140	0.178
−10.519	−0.006	0.073	−0.078	0.938	−0.151	0.140
−8.519	−0.030	0.067	−0.454	0.651	−0.163	0.102
−6.519	−0.055	0.062	−0.894	0.373	−0.177	0.067
−4.519	−0.080	0.057	−1.389	0.167	−0.194	0.034
−2.519	−0.105	0.055	−1.906	0.059	−0.213	0.004
−2.236	−0.108	0.055	−1.978	0.050	−0.216	0.000
−0.519	−0.129	0.054	−2.396	0.018	−0.236	−0.023
1.481	−0.154	0.055	−2.805	0.006	−0.263	−0.045
3.481	−0.179	0.058	−3.104	0.002	−0.293	−0.065
5.481	−0.203	0.062	−3.293	0.001	−0.326	−0.081
7.481	−0.228	0.067	−3.395	0.001	−0.361	−0.095
9.481	−0.253	0.074	−3.436	0.001	−0.398	−0.107
11.481	−0.277	0.081	−3.438	0.001	−0.437	−0.118
13.481	−0.302	0.088	−3.419	0.001	−0.477	−0.127
15.481	−0.327	0.096	−3.388	0.001	−0.518	−0.136
17.481	−0.352	0.105	−3.351	0.001	−0.559	−0.144
19.481	−0.376	0.114	−3.313	0.001	−0.601	−0.152
21.481	−0.401	0.122	−3.274	0.001	−0.643	−0.159
23.481	−0.426	0.132	−3.237	0.002	−0.686	−0.166

B = unstandardized regression coefficient; *t* = t statistic; *p* = *p*-value; LLCI, lower-limit confidence interval; ULCI, upper-limit confidence interval.

3.5. Mediating and Moderating Roles of AI Ethical Awareness in the Relationship Between AI Self-Efficacy and Clinical Reasoning

When the mediating roles of AI ethical awareness on the relationship between AI self-efficacy and clinical reasoning were investigated (5000 iterations, 95% confidence interval), the indirect mediation effect was −0.018, and in the distribution of indirect effects from bootstrap samples, the 95% bootstrap confidence interval included zero, indicating that the indirect effect was not statistically significant. To investigate the moderating role of AI ethical

awareness in the relationship between AI self-efficacy and clinical reasoning, after mean centering of AI self-efficacy (independent variable) and AI ethical awareness (moderating variable), in an analysis using the simultaneous-entry method, the interaction term between the independent variable and the moderating variable was $B = 0.004$ ($p = 0.339$), indicating that the interaction effect was not statistically significant (Table 7).

Table 7. Mediating and moderating roles of AI ethical awareness in the relationship between AI self-efficacy and clinical reasoning.

	Path		*B*	*SE*	*t*	*p*	R^2	ΔR^2	*F* (*p*)
Mediating effect of AI ethical awareness	Step 1	X → M	−0.064	0.046	−1.398	0.164	0.014		1.955 (0.164)
	Step 2	X → Y	0.101	0.038	2.681	0.008	0.139		10.632 (<0.001)
		M → Y	0.287	0.071	4.048	<0.001			
	Indirect effect	X → M → Y	*B*		Bootstrap *SE*		Bootstrap 95% CI		
			−0.018		0.016		−0.054 to 0.008		
Moderating effect of AI ethical awareness		X → Y	0.114	0.040	2.846	0.005			
		W → Y	0.305	0.073	4.157	<0.001	0.167		7.391 (<0.001)
		X × W → Y	0.004	0.004	0.960	0.339		0.006	0.921 (0.339)

X = AI self-efficacy (independent variable); M = AI ethical awareness (mediator); W = AI ethical awareness (moderator); Y = clinical reasoning (dependent variable); *B* = unstandardized regression coefficient; CI = confidence interval, *SE* = standard error; *t* = t statistic; *p* = *p*-value; R^2 = coefficient of determination; ΔR^2 = change in *R*.

4. Discussion

In this study, the mean clinical reasoning score of students with experience using GenAI was 54.68 points. Previous studies using the same instrument reported mean scores of 55.60 and 58.27 among third- and fourth-year medical students, respectively [32]. As all participants in this study had recent clinical practicum experience, and clinical practicum at the study institution is limited to third- and fourth-year students, these findings provide a useful reference point for comparison. However, direct comparisons should be interpreted cautiously because the study populations and educational contexts differed.

In another study using the Diagnostic Thinking Inventory for Optometry Short (DTI-OS), mean item scores increased from 3.46 among second-year optometry students to 4.66 among practicing professionals [33]. Direct comparison with the present study is not appropriate because a different version of the instrument was used, and further studies are needed to confirm whether clinical reasoning develops progressively with educational and clinical experience.

In our study, AI ethical awareness appeared to play a partial mediating role in the association between AI academic dependency and clinical reasoning. These results are consistent with a previous study on graduate students, where AI ethical awareness showed a complete mediating effect on the relationship between AI use and academic outcomes, of which critical thinking was a core element [36]. This finding is also consistent with another report showing significant relationships between academic dependency, ethical awareness, and critical thinking skills [37]. Accordingly, AI ethical awareness may be statistically associated with the relationship between AI academic dependency and clinical reasoning. Therefore, consideration of AI ethical awareness in clinical practicum education may be useful when supporting students' critical judgment regarding AI use. However, the participant characteristics in previous studies were different, and because earlier research

did not examine the mediating role of AI ethical awareness in the relationship between AI academic dependency and clinical reasoning within the same variable framework, further replication studies are needed to confirm the relationships between variables.

In our study, AI ethical awareness appeared to play a moderating role in the relationship between AI academic dependency and clinical reasoning. Specifically, the negative association between AI academic dependency and clinical reasoning became stronger as AI ethical awareness increased. This finding suggests that AI ethical awareness may play a more complex role than a simple protective or buffering factor. One possible explanation, although not directly tested in this study, is that students with higher AI ethical awareness may be more aware of the potential risks and limitations associated with excessive reliance on AI, making the negative relationship between dependency and clinical reasoning more apparent.

These results are broadly consistent with a previous study on nurses, where AI ethical awareness functioned as a moderating variable in the effects of positive attitudes toward AI on innovative work behavior [29]. Although the outcome variables differed, both studies suggest that AI ethical awareness influences how AI-related perceptions and behaviors are translated into professional or learning outcomes. However, direct comparisons are limited because the participants were different in the two studies, and the previous study did not directly test the moderating effects of AI ethical awareness on the relationship between AI academic dependency and clinical reasoning. Nevertheless, previous studies have consistently shown that higher AI academic dependency is associated with poorer clinical reasoning, whereas higher AI ethical awareness is associated with more desirable learning and decision-making outcomes [22,23]. Taken together, these findings support the possibility that AI ethical awareness has an important contextual role in the relationship between AI-related characteristics and clinical reasoning.

Given the limited number of studies examining this relationship, caution is warranted when interpreting the findings. Furthermore, because this study used a cross-sectional design, the direction of the observed relationships cannot be determined. It is possible that students with lower levels of clinical reasoning may rely more heavily on generative AI tools, rather than AI academic dependency leading to lower clinical reasoning. Additionally, as our findings primarily reflect one educational context, further research involving diverse populations and longitudinal designs is needed to verify the observed moderation pattern and clarify the underlying mechanisms. Moreover, although the moderating effect was statistically significant, its magnitude was relatively small, indicating that the interaction between AI academic dependency and AI ethical awareness explained an additional 3.9% of the variance in clinical reasoning. This finding suggests that AI ethical awareness is only one of several factors that may be associated with clinical reasoning.

In our study, neither the mediating nor the moderating role of AI ethical awareness was statistically significant in the relationship between AI self-efficacy and clinical reasoning. Previous studies have reported that self-efficacy is a significant influencing factor on clinical reasoning [16], and AI ethical awareness showed a relationship with clinical reasoning, but AI self-efficacy did not play a mediating or moderating role in the relationship between the two variables. This finding suggests that higher AI self-efficacy may encourage more active participation in information searching and problem solving using AI, leading to improved clinical reasoning; however, these patterns may not be fully explained by AI ethical awareness. As previous studies testing the relationships between AI self-efficacy, AI ethical awareness, and clinical reasoning are limited, future studies employing diverse participants are needed to replicate these findings and to examine the generalizability of the observed relationships.

Despite the contributions of this study, several limitations should be considered when interpreting the results. First, because this study employed a cross-sectional design, causal relationships among AI academic dependency, AI ethical awareness, and clinical reasoning cannot be established. Second, participants were recruited from a single university and consisted of clinical practicum students in healthcare-related majors; therefore, caution is required when generalizing the findings to other student populations or educational settings. Third, although previously validated instruments were used, the factor structure of the translated and adapted scales was not re-examined, and all variables were measured using self-reported questionnaires at a single time point. Accordingly, the possibility of measurement error and common method bias cannot be completely excluded. In addition, although participant characteristics were examined in preliminary analyses and were not significantly associated with clinical reasoning, residual confounding by unmeasured or uncontrolled variables cannot be completely ruled out. Future studies should include more diverse student populations and educational environments, employ longitudinal or prospective designs, and further evaluate the psychometric properties and cross-disciplinary applicability of the instruments. In addition, potential contextual factors, such as the extent of clinical practicum experience, level of AI use, and educational environment, should be considered to better understand the mechanisms linking AI academic dependency, AI ethical awareness, and clinical reasoning.

5. Conclusions

In conclusion, this study examined the mediating and moderating roles of AI ethical awareness in the relationship between AI academic dependency and clinical reasoning among clinical practicum students with experience using GenAI. The findings indicate that AI ethical awareness was associated with this relationship, potentially serving as both a mediator and a moderator. In particular, the strength of the negative association between AI academic dependency and clinical reasoning varied according to the level of AI ethical awareness, suggesting that AI ethical awareness may play a complex role in how AI academic dependency relates to clinical reasoning.

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Abbreviations

The following abbreviations are used in this manuscript:

GenAI	Generative artificial intelligence
DTI	Diagnostic Thinking Inventory
DTI-SK	Korean Short Diagnostic Thinking Inventory
DTI-OS	Diagnostic Thinking Inventory for Optometry Short

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