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Research

The predictive effect of nursing students' attitudes and acceptance towards artificial intelligence on their clinical competencies

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ABSTRACT

Background: AI integration in education is gaining interest, including in nursing, as students seek formal training on its healthcare applications and limitations.
Aim: To evaluate the predictive effect of nursing students' attitudes and acceptance of artificial intelligence on their clinical competencies.
Methods: This descriptive-correlational study was conducted at 2 universities (February–June 2024) with 441 nursing students. Full-time students in clinical practice participated; those absent or on leave were excluded. The Nursing Students Competency Scale, General Attitudes to Artificial Intelligence Scale, and Generative Artificial Intelligence Acceptance Scale were used. Descriptive statistics and linear regression were used.
Results: The main factors affecting nursing students' clinical competence were "facilitating conditions," "social influence," and "negative attitudes" toward AI. A weak correlation was found between positive AI attitudes and acceptance, which explained 8.6% of the competency levels.
Conclusion: Positive perceptions of AI may increase competence, while skepticism may deepen engagement and critical learning. Strategies to improve the acceptance and use of AI are crucial to maximize its benefits in nursing education and practice.

Introduction

The term "Artificial Intelligence" (AI) describes the intelligence exhibited by machines, particularly computer systems. It is a field of research in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximize their chances of achieving defined goals (Russell & Norvig, 2016). Integrating AI into educational environments has generated considerable interest across various disciplines, including nursing education. Successful implementation of this technology will require that nursing students understand their perceptions and acceptance of the technology (Buchanan et al., 2021). Studies have shown that students' attitudes towards AI are influenced by several factors, including perceived benefits, potential for social progress, and willingness to engage with AI concepts (Sit et al., 2020; Buchanan et al., 2021). These studies also found positive student attitudes toward incorporating AI into medical education, indicating wider acceptance of AI in specific educational settings (Sit et al., 2020; Buchanan et al., 2021). Furthermore, there is a growing awareness among nursing students of the importance of formal education in understanding the applications and limitations of AI in healthcare (Buchanan et al., 2021).

Nursing students' attitudes toward the adoption of AI are multifaceted. They are influenced by various factors, including their perception of the utility of AI and their willingness to interact with AI-related concepts (Buchanan et al., 2021). Exploring the predictive power of nursing students' attitudes and acceptance of AI in determining professional competence is essential (Kwak et al., 2022). Studies have highlighted the need to understand nursing students' attitudes, self-efficacy, and intentions toward using AI to prepare them for the evolving technological landscape in healthcare (Kwak et al., 2022). To prepare nursing students for the integration of AI into nursing practice, it is crucial to assess their digital health literacy levels and perceptions of AI applications, and nursing educators have an essential role in the preparation of nursing students for the integration of AI into their practice (Hassan Mekawy et al., 2020).

Values clarification exercises have been suggested as an effective strategy to support nursing students in the ethical integration of AI into their practice (Gagné, 2023). Furthermore, to successfully adapt to technological advances in healthcare, it is essential to develop nursing students' digital proficiency, knowledge, attitudes, and skills

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in digital transformation and AI applications (Hashish, 2024). By establishing ethical guidelines, promoting AI literacy, and setting clear expectations, nurse educators can guide the responsible use of GAI in nursing education (Lane, 2024). Nursing students often begin their education with stereotypical views of the nursing profession. These evolve throughout their education (Chauke et al., 2015). Understanding the factors influencing nursing students' perceptions of the nursing profession is crucial for nursing educators and managers to address misconceptions and promote a positive image among students (Zhang & Petrini, 2008). Furthermore, to prepare nursing students for the future of healthcare, it is essential to integrate AI education into nursing schools and highlight areas where AI can enhance nursing care (Jeong, 2020).

Background

Integrating AI in nursing education presents opportunities and challenges, particularly in shaping students' attitudes and acceptance of emerging technologies (Labrague et al., 2023a). AI applications in healthcare are transforming clinical decision-making, patient monitoring, and administrative processes, necessitating a workforce that is not only technologically literate but also open to adopting AI-driven solutions (Lukić et al., 2023). Understanding nursing students' perceptions of AI is essential to developing educational strategies that foster competency and readiness for AI-integrated healthcare environments (Labrague et al., 2023b).

Nursing students' attitudes and acceptance of artificial intelligence enhance their professional competence (Tarsuslu et al., 2025). To ensure that nursing students are well-prepared for the technological advancements shaping the future of healthcare, nursing educators must focus on developing students' digital literacy, knowledge, and skills in AI (Kwak et al., 2022). By integrating AI education, promoting the ethical use of AI, and addressing misconceptions about the nursing profession, nursing educators can enable students to use AI as a valuable tool in their practice. Consequently, there is a growing need for studies focusing on the predictive power of nursing students' attitudes and acceptance towards AI and their impact on professional competence (Kwak et al., 2022). Despite growing interest in AI in healthcare education, research on how nursing students perceive, accept, and engage with AI-based technologies remains limited. Addressing this gap is crucial for refining nursing curricula and optimizing competency-based learning approaches (Buchanan et al., 2021). This study was designed to determine the power of nursing students' attitudes and acceptance of artificial intelligence in predicting their professional competencies. By doing so, this study seeks to provide insights that can enhance educational programs, improve student support practices, and prepare future nurses for AI-enhanced healthcare environments. To achieve this objective, the study employs 2 key theoretical frameworks: the Technology Acceptance Model (TAM) and the Competency-Based Education (CBE) Model.

Theoretical framework combining the technology acceptance model & and competency-based education model

TAM is derived from Fishbein and Ajzen's Theory of Reasoned Action and serves as a foundational framework for understanding how individuals adopt and use technology (Venkatesh, 2000). The model highlights 2 primary factors influencing technology acceptance: perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a user believes that using a particular technology enhances performance, while perceived ease of use reflects the effort required to engage with the technology (Ibrahim & Shiring, 2022). TAM has been widely applied across various disciplines, including healthcare and education, to explore factors influencing technology adoption (Sari et al., 2022; Kim et al., 2014; Dong et al., 2022). In nursing education, TAM has been instrumental in evaluating students' responses to digital learning tools, online platforms, and simulation-based training (Elwood et al., 2006; Sani et al., 2022). The model has also been extended to include user motivation and value clarification variables, further enhancing its applicability in understanding how learners engage with innovative educational technologies (Lawani et al., 2021; Sufyan & Mas'ud, 2022). Given its extensive use in predicting technology adoption, TAM is well-suited for this study, as it provides a structured approach to evaluating nursing students' acceptance of AI and the factors that influence their willingness to integrate AI into their learning and professional practice. Complementing TAM, the Competency-Based Education (CBE) Model shifts educational paradigms from a knowledge-based structure to an outcomes-driven framework, emphasizing the acquisition and demonstration of specific competencies necessary for professional practice (Hoge et al., 2005). In healthcare education, CBE is widely used to structure curricula that align with clinical competencies, accountability, and measurable learning outcomes. By integrating CBE with AI education, this study explores how nursing students' attitudes and acceptance of AI relate to their ability to acquire relevant competencies. AI has the potential to enhance clinical decision-making, patient care strategies, and workflow efficiencies, making it imperative to assess how students' perceptions of AI influence their competency development. Understanding this relationship will help educators design targeted interventions that bridge the gap between AI adoption and professional competency, ensuring that nursing graduates are well-prepared for an AI-enhanced healthcare environment. By employing TAM and CBE, this study offers a comprehensive approach to analyzing nursing students' engagement with AI, ultimately contributing to developing more effective educational strategies that align technology acceptance with essential professional competencies. This study was designed to determine the power of nursing students' attitudes and acceptance of artificial intelligence to predict their professional competencies. Combining TAM and CBE offers a holistic perspective on AI's role in nursing education, contributing to developing effective strategies that align technological advancements with essential clinical competencies (Fig. 1).

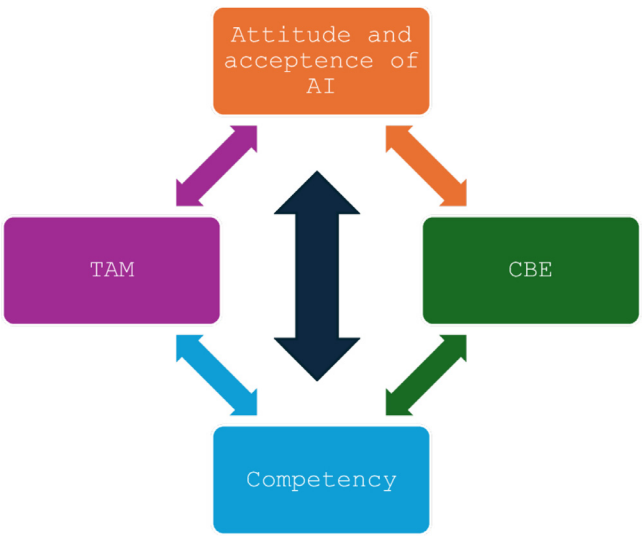

Fig. 1. Framework models of the study.

Study questions

1. What is the relationship between nursing students' attitudes and acceptance towards artificial intelligence and their professional competencies?
2. What is the predictive power of nursing students' attitudes and acceptance towards artificial intelligence and their professional competencies?

Methods

Study design

This study was designed with a descriptive and correlational approach. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guideline was used for reporting the study (Von Elm et al., 2014).

Study setting

This study was conducted at Bilecik Şeyh Edabili University, Faculty of Health Sciences, Department of Nursing, and Koç University, Faculty of Nursing, during the Spring Semester (February 2024–June 2024). These institutions are in Istanbul and Bilecik provinces in the Marmara and Central Anatolia Regions of Turkey and are known for their contributions to nursing education and research. The students were enrolled in the Bachelor of Science in Nursing Program. These programs comprise clinical education, theoretical courses, and technology integration into health education and create appropriate environments for individuals.

Study participant

The inclusion criteria for this study were being a full-time undergraduate nursing student enrolled in 1 of the 2 participating universities in Turkey and actively participating in nursing practice in hospital settings.

The exclusion criterion included students who were absent or on academic leave during the data collection period.

For this study, a correlation of 0.20 was anticipated between the nursing students' GAAIS and GAIAS scores. The sample size is calculated based on an α error probability of 0.05 and power of 0.95. The number of required participants is 314. With the 20% dropout rate increase, the minimum number of participants was 377. It was determined that there were a total of 503 students who met the inclusion criteria. These students 62 were not included because they were absent during the data collection tools. A total of 441 nursing students participated in this study. The rate of participation in the study was found to be 87.67%.

Data collection tools

Questionnaire form

The form was created by the researcher and includes eleven descriptive questions such as age, gender, class, taking courses on AI, taking part in activities related to AI, etc.

Nursing Students Competency Scale (CINS)

The scale was developed by Hsu and Hsieh (2013), and Turkish validity and reliability were assessed by Ülker (2018). The scale is a 7-point Likert-type scale with 43 items. It consists of 6 sub-dimensions: clinical biomedical science (5 items), general clinical skills (7 items), critical thinking and reasoning (4 items), care (6 items), ethics and responsibility (15 items), and lifelong learning (6 items). The total score obtained from the scale varies between 43-301. A high score on the scale indicates a good level of competence according to the student's self-assessment (Hsu & Hsieh, 2013; Ülker, 2018). In the Turkish validity and reliability study, for content validity, 5 experts in nursing education reviewed the scale using the Davis technique. Construct validity was assessed through factor analysis, with the Kaiser-Meyer-Olkin (KMO) value calculated as 0.969, indicating excellent sampling adequacy. Bartlett's test of sphericity was significant ($p < 0.05$), confirming the dataset's suitability for factor analysis. Confirmatory factor analysis (CFA) was conducted to examine the factor structure, revealing a 6-factor model that explained 73.48% of the total variance. The model fit indices indicated a good fit ($\chi^2/df = 2.021$, RMSEA = 0.055, CFI = 0.943), supporting the scale's construct validity. The Cronbach's alpha values of the sub-dimensions of the scale ranged between 0.79 and 0.97, and the total Cronbach's alpha value was 0.97 (Ülker, 2018). In this study, Cronbach's alpha coefficient was found to be 0.97 for the total scale and between 0.84 and 0.96 for the sub-dimensions.

General Attitudes to Artificial Intelligence Scale (GAAIS)

The scale developed by Schepman and Rodway (2020) was adapted into Turkish by Kaya et al. (2024). A high score on the GAAIS indicates a more positive attitude towards artificial intelligence. The GAAIS consists of 2 subscales, positive attitudes and negative attitudes, with 20 questions. Questions between 1 and 12 constitute the positive subscale, and items 13-20 the negative subscale. Higher scores on the positive subscale reflect greater excitement and interest in AI, recognizing its usefulness, economic potential, and ability to improve various aspects of life. Higher scores on the negative subscale (reverse-scored) indicate less concern about AI-related risks, meaning the respondent is more accepting and less skeptical of AI technology. For the scoring, negative items should be reverse-scored, and overall means for the positive and negative items should be calculated separately. It is graded on a 5-point Likert scale. In the Turkish validity and reliability study, factor loadings ranged from 0.40 to 0.71 for the Positive GAAIS and from 0.41 to 0.76 for the Negative GAAIS, indicating moderate to strong item-factor relationships. CFA supported the 2-dimensional structure in the Turkish sample, with acceptable model fit indices ($\chi^2 = 557.01$, df = 169, $\chi^2/df = 3.30$, CFI = 0.92, NNFI = 0.91, SRMR = 0.067, RMSEA = 0.081). The internal consistency was found to be satisfactory, with Cronbach's $\alpha = 0.82$ for the Positive GAAIS and $\alpha = 0.84$ for the Negative GAAIS. Additionally, the split-half reliability coefficients were calculated as r = 0.77 for the Positive GAAIS and r = 0.83 for the Negative GAAIS, demonstrating adequate reliability. Cronbach's Alpha values were between 0.82 and 0.88; the reliability values were 0.77 for positive attitude and 0.83 for negative attitude (Kaya et al., 2024). In this study, Cronbach's alpha coefficient was found to be 0.89 for the positive attitude, and 0.86 for the negative attitude.

Generative Artificial Intelligence Acceptance Scale (GAIAS)

The scale developed by Yılmaz et al. (2023). It was designed to evaluate university students' acceptance levels of Generative AI applications and based on the Unified Theory of Acceptance and Use of Technology model. The scale consists of 7 items for performance expectancy, 5 for effort expectancy, 3 for facilitating conditions, and 5 for social influence. The responses ranged from "strongly agree" to "strongly disagree" on a 5-item Likert scale. The positive scales capture positive attitudes toward the benefits of AI, with higher scores indicating more positive attitudes. The negative subscale is reverse scored, making higher scores on the negative GAAIS indicative of more forgiving attitudes toward AI drawbacks. To assess the validity and reliability of the scale, both exploratory factor analysis and CFA were conducted by the developers. KMO measure was computed as 0.949, indicating excellent sampling adequacy, while Bartlett's test of

sphericity yielded a significant result ($\chi^2(190) = 6302.080$, $p < 0.001$), confirming the dataset's suitability for factor analysis. Exploratory factor analysis results showed that the scale explained 78.349% of the cumulative variance, demonstrating strong construct representation. CFA was performed to verify the factor structure, yielding good model fit indices ($\chi^2/df = 2.113$, CFI = 0.97, GFI = 0.88, IFI = 0.97, TLI = 0.97, RMSEA = 0.067, SRMR = 0.0332). Factor loadings ranged from 0.84 to 0.93, indicating strong relationships between items and their respective factors. The sub-dimensions of the scale ranged from 0.550 to 0.768 and were statistically significant at $p < 0.01$, further supporting the scale's construct validity. Reliability values were calculated as follows: 0.96 for performance expectancy, 0.96 for effort expectancy, 0.96 for facilitating conditions, 0.87 for social influence, and 0.97 for the total scale. In the test-retest total scale coefficient was found to be 0.97. This study found Cronbach's alpha coefficient between 0.70 and 0.91 for the sub-scales.

Data collection process

This study was conducted with nursing students at Bilecik Şeyh Edabali University, Faculty of Health Sciences, Department of Nursing, and Koç University, Faculty of Nursing during the Spring Term of the 2024 Academic Year (February – June 2024). Participants were recruited through announcements made via institutional email, student communication platforms, and in-class briefings by faculty members. In addition, recruitment was carried out during mandatory courses, where permissions were obtained from the respective course instructors. At the beginning of these classes, students were informed about the study's purpose, procedures, and ethical considerations, including assurances of confidentiality and voluntary participation.

The data collection process involved distributing a structured questionnaire that included the Nursing Students' Competency Scale, the GAAIS, and the Generative Artificial Intelligence Acceptance Scale. The questionnaire was developed based on a literature review and designed to be completed in approximately 15 minutes. The surveys were distributed to volunteer students in the classroom setting. To encourage participation, students were given a 1-week window to complete the questionnaire, and follow-up reminders were sent via email and student communication groups to postrespondents. Before completing the questionnaire, students were informed that their responses would be used strictly for scientific research purposes and would remain anonymous. Participation was voluntary, and students provided informed consent before the survey.

Data analysis

The IBM 28 SPSS (Statistical Package for Social Science) for Windows package program was used to analyze the data. Mean, standard deviation, frequency, and percentage distributions were used to evaluate descriptive data, and correlation analysis was used to evaluate the relations between the variables. Linear regression analysis was used to predict the level of clinical competence of nursing students' attitudes and acceptance towards artificial intelligence. In determining which independent variables to include in the model (to assess multicollinearity), tolerance, VIF (variance inflation factor), and condition index values were utilized. Independent variables with a VIF value of <10, a tolerance value of >0.2, and a condition index value of <15 were included in the regression analysis. The results were evaluated at a 95% confidence interval and significance level of $p < 0.05$.

Ethical approach

This study was approved by the Koc University Ethical Committee of Social Sciences (Approval No. 2024.038.IRB3.021). Written permissions were obtained from the dean's offices of both universities. Written informed consent was obtained from all nursing students who voluntarily agreed to participate in the study. The consent process ensured that participants understood the study's purpose, methods, and potential risks and benefits. The right of participants to withdraw consent at any time without reprisal was also emphasized.

Results

The mean age of the students in the study was 21.33 ± 2.29 years, 71.2% of them were female, and 28.8% were male. Of the students participating in the study, 29% were first, 23.6% were second, 22.7% were third, and 24.7% were fourth-grade students. The descriptive characteristics of the nursing students participating in the study are presented in Table 1.

The mean "CINS" total score and "clinical biomedical science," "general clinical skills," "critical thinking and reasoning," "caring," "ethics and accountability," and "lifelong learning" sub-scales were 249.40 ± 36.55, 25.33 ± 5.67, 39.66 ± 7.22, 21.80 ± 4.51, 35.96 ± 6.29, 92.37 ± 14.94 and 34.19 ± 6.09, respectively. The mean scores of the students on the "performance expectancy," "effort expectancy," "facilitating conditions," and "social influence" sub-scales of the "Generative Artificial Intelligence (AI) Acceptance Scale" were 27.50 ± 4.50, 18.10 ± 3.86, 11.40 ± 2.16 and 16.57 ± 4.63, respectively. The mean scores of the students on the "positive attitudes" and "negative attitudes" sub-scales of the "GAAIS" were 43.45 ± 8.18 and 25.71 ± 6.52, respectively.

Correlation values between "CINS" total and sub-scale scores and "Generative Artificial Intelligence (AI) Acceptance Scale" sub-scale scores were presented in Table 2. CINS Total Score is weakly

Table 1
Descriptive characteristics of the nursing students.

		Mean	SD
Age		21.33	2.29
		n	%
Gender	Female	314	71.2
	Male	127	28.8
School year	1	128	29.0
	2	104	23.6
	3	100	22.7
	4	109	24.7
Receiving an education in the use of artificial intelligence	Yes	18	4.1
	No	423	95.9
Knowledge about the use of artificial intelligence	Yes	218	49.4
	No	223	50.6
Participation in activities for the use of artificial intelligence	Yes	59	13.4
	No	382	86.6
Use of artificial intelligence in daily life	Yes	367	83.2
	No	74	16.8
Thinking that the use of artificial intelligence is useful in any subject	Yes	299	67.8
	No	142	32.2
Situations where artificial intelligence is used	Create text	34	7.7
	Create a visual	6	1.4
	Preparing a presentation	35	7.9
	Creating a video	16	3.6
	Preparing homework	66	15.0
	Other	49	11.1
	A few of them	212	48.1
	All of them	23	5.2
Openness to using Artificial Intelligence applications	Definitely Not Using	5	1.1
	Probably Not Using	34	7.7
	Neutral	111	25.2
	Possibly Using	193	43.8
	Definitely Using	98	22.2
Consideration of the trustworthiness of artificial intelligence applications	Very Reliable	4	0.9
	Reliable	85	19.3
	Neutral	239	54.2
	Unreliable	78	17.7
	Very Unreliable	35	7.9

SD, Standard deviation.

Table 2
Correlation between variables.

Variables		CINS							Generative AI Acceptance Scale				GAAIS	
		Total	Clinical biomedical science	General clinical skills	Critical thinking and reasoning	Caring	Ethics and accountability	Lifelong learning	Performance Expectancy	Effort Expectancy	Facilitating Conditions	Social Influence	Positive attitudes	Negative attitudes
CINS	Total	1												
	Clinical biomedical science	0.598*	1											
	General clinical skills	0.852*	0.598*	1										
	Critical thinking and reasoning	0.774*	0.555*	0.736*	1									
	Caring	0.895*	0.426*	0.706*	0.654*	1								
	Ethics and accountability	0.898*	0.324*	0.651*	0.542*	0.815*	1							
	Lifelong learning	0.731*	0.300*	0.497*	0.504*	0.615*	0.614*	1						
Generative AI Acceptance Scale	Performance Expectancy	0.218*	0.057	0.216*	0.175*	0.171*	0.208*	0.184*	1					
	Effort Expectancy	0.149*	0.105*	0.197*	0.205*	0.083	0.073	0.147*	0.543*	1				
	Facilitating Conditions	0.246*	0.105*	0.272*	0.224*	0.214*	0.192*	0.196*	0.677*	0.635*	1			
	Social Influence	0.056	0.090	0.056	0.138*	−0.007	−0.010	0.115*	0.546*	0.534*	0.472*	1		
GAAIS	Positive attitudes	0.142*	0.077	0.143*	0.132*	0.128*	0.117*	0.091	0.655*	0.532*	0.569*	0.635*	1	
	Negative attitudes	0.084	0.011	0.006	0.043	0.102*	0.095	0.115*	−0.048	−0.069	−0.066	−0.035	−0.154*	1

* Correlation is significant at the 0.01 level.
CINS, The Competency Inventory of Nursing Students Scale; AI, Artificial intelligence; GAAIS, General Attitudes to Artificial Intelligence Scale

correlated with Performance Expectancy (r = 0.218), Effort Expectancy (r = 0.149), and Facilitating Conditions (r = 0.246). There is no correlation between CINS Total Score and Social Influence (r = 0.056). There are weak positive correlations between Clinical Biomedical Science and Effort Expectancy (r = 0.105) and Facilitating Conditions (r = 0.105). There are no significant correlations with other GAAIS dimensions. There are weak positive correlations between General Clinical Skills and Performance Expectancy (r = 0.216), Effort Expectancy (r = 0.197), and Facilitating Conditions (r = 0.272). There are no significant correlations with other GAAIS dimensions. There are weak positive correlations between Critical Thinking and Reasoning and Performance Expectancy (r = 0.175), Effort Expectancy (r = 0.205), Facilitating Conditions (r = 0.224), and Social Influence (r = 0.138). There are weak positive correlations between Caring and Performance Expectancy (r = 0.171) and facilitating Conditions (r = 0.214). There are no significant correlations with other GAAIS dimensions. There are weak positive correlations between Ethics and Accountability and Performance Expectancy (r = 0.208) and Facilitating Conditions (r = 0.192). There are no significant correlations with other GAAIS dimensions. There are weak positive correlations between Lifelong Learning and Performance Expectancy (r = 0.184), Effort Expectancy (r = 0.147), Facilitating Conditions (r = 0.196), and Social Influence (r = 0.115) (Table 2).

Correlation values between “CINS” total and sub-scale scores and “GAAIS” sub-scale scores were presented in Table 2. CINS Total Score is weakly correlated with Positive Attitudes towards AI (r = 0.142). There is no correlation between CINS Total Score and Negative Attitudes towards AI (r = 0.084). There are weak positive correlations between General Clinical Skills and Positive Attitudes toward AI (r = 0.143). There are weak positive correlations between Critical Thinking and Positive Attitudes toward AI (r = 0.132). No significant correlation with Negative Attitudes toward AI. There are weak positive correlations between Caring and Positive Attitudes toward AI (r = 0.128). There are weak positive correlations between Ethics and Positive Attitudes toward AI (r = 0.117). Weak positive correlations exist between Lifelong Learning and Positive Attitudes toward AI (r = 0.091). No significant correlation with Negative Attitudes toward AI (Table 2).

One model was established between the “CINS” total score and “Generative Artificial Intelligence (AI) Acceptance Scale” and “GAAIS” sub-scale scores with multiple regression analysis. Model 1, created according to the relationship between the variables, found that nursing students’ attitudes and acceptance towards artificial intelligence explained and significantly affected their clinical competence levels by 8.6% ($p < 0.001$, Table 3). In Model 1, an increase in the average scores of the Generative Artificial Intelligence (AI) Acceptance Scale for “Performance Expectancy,” “Effort Expectancy,” “Facilitating Conditions,” and the Generative AI Attitude Scale (GAAIS) subscales for “Positive Attitudes” and “Negative Attitudes” was found to increase the clinical competence level of nursing students by 0.131 ($\beta = 0.131$), 0.010 ($\beta = 0.010$), 0.199 ($\beta = 0.199$), 0.040 ($\beta = 0.040$), and 0.105 ($\beta = 0.105$) times, respectively. An increase in the average scores of the "Social Influence" subscale of the Generative Artificial Intelligence (AI) Acceptance Scale decreases the clinical competence level of nursing students by 0.137 ($\beta = -0.137$) times. Additionally, the Generative AI Acceptance Scale “Facilitating Conditions,” “Social Influence,” and GAAIS “Negative Attitudes” variables were found to have a statistically significant effect on the clinical competence level of nursing students ($p < 0.05$). In contrast, the other variables did not significantly predict nursing students’ clinical competence level ($p > 0.05$).

Discussion

This study examined the relationship between nursing students’ attitudes and acceptance of AI and their clinical competence levels.

Table 3
The predictive power of nursing students' attitudes and acceptance towards artificial intelligence to predict clinical competence levels.

Variables	Model 1						
	CINS						
	B	SE	β	t	p	95% CI	
						Lower	Upper
Constant	176.737	13.168		13.421	0.000	150.855	202.618
Generative AI Acceptance Scale Performance Expectancy	1.065	0.574	0.131	1.854	0.064	−0.064	2.193
Generative AI Acceptance Scale Effort Expectancy	0.096	0.603	0.010	0.159	0.874	−1.090	1.281
Generative AI Acceptance Scale Facilitating Conditions	3.367	1.177	0.199	2.860	***0.004***	1.053	5.682
Generative AI Acceptance Scale Social Influence	−1.078	0.497	−0.137	−2.167	***0.031***	−2.056	−0.100
GAAIS Positive attitudes	0.178	0.312	0.040	0.572	0.568	−0.435	0.792
GAAIS Negative attitudes	0.588	0.261	0.105	2.249	***0.025***	0.074	1.102
R = 0.293 R^2 =0.086 F = 6.795 p = 0.000 DW = 1.816							

B, Unstandardized Beta; SE, Standard Error; β, Standardized Beta β; CI, Confidence Interval; R, Correlation; R2: Correlation Coefficient (Explained Variance Rate); F, Model Statistic; p, Significance Level; DW, Durbin Watson; CINS, The Competency Inventory of Nursing Students Scale; AI, Artificial Intelligence; GAAIS, General Attitudes to Artificial Intelligence Scale.

The findings indicate that "Facilitating Conditions" and "Social Influence" from the Generative Artificial Intelligence Acceptance Scale, as well as "Negative Attitudes" from the General Attitudes to Artificial Intelligence Scale, significantly influenced nursing students' clinical competence levels. However, the overall impact of AI acceptance and attitudes on clinical competence was weak, with these factors explaining only 8.6% of the variance. A weak correlation was found between positive attitudes toward AI and nursing competency levels. These findings suggest that while AI is recognized as a valuable tool in healthcare, its integration into nursing education has not yet significantly influenced professional competence.

This study was designed to determine the extent to which nursing students' attitudes and acceptance of artificial intelligence predict their professional competencies. The results indicate that while students acknowledge AI's potential, their acceptance and attitudes have a minor impact on their professional competencies. These findings align with Ronquillo et al. (2021), who emphasized that AI enhances nursing through improved decision-making and patient care but also noted challenges such as ethical concerns and the need for proper training. Similarly, De Gagne (2023) highlighted the role of AI in nursing education, particularly in providing personalized learning experiences and efficient teaching methods, while also underscoring barriers such as data privacy, ethical considerations, and resistance from educators. The weak correlations in this study suggest that while nursing students generally accept AI, this acceptance has not yet translated into significant improvements in their competencies. This finding is consistent with Lukic et al. (2023), who reported that first-year nursing students demonstrated a weak positive attitude toward AI, indicating an openness to using AI but a lack of immediate competency enhancement. These results reinforce the idea that mere acceptance of AI is insufficient to drive competency development, and structured curriculum integration is necessary for AI to have a meaningful impact on nursing education. Furthermore, while the statistical relationships found in this study are significant, their practical implications remain limited. The low explanatory power (8.6%) suggests that many other factors influence clinical competence beyond AI acceptance and attitudes. As such, future research should explore additional moderating and mediating variables, such as prior technological experience, self-efficacy, and educational exposure to AI, to better understand the relationship between AI and nursing competencies. These findings provide important insights into the current role of AI in nursing education. While students recognize the potential benefits of AI, its practical impact on their competencies is still developing. As highlighted by previous research, addressing training gaps, ethical concerns, and data privacy challenges is crucial to maximizing AI's potential in nursing education.

The results of the multiple regression analysis examining the influence of nursing students' attitudes and acceptance of AI on their clinical competence levels revealed several key findings. Model 1 indicated that "Facilitating Conditions," "Social Influence," and "Negative Attitudes" collectively explained 8.6% of the variance in clinical competence levels, highlighting a significant yet modest impact. These results align with existing literature emphasizing the potential of AI to enhance clinical skills while acknowledging that its integration and perceived benefits are still evolving (Buchanan et al., 2021). Among the positive predictors of clinical competence, "Facilitating Conditions" emerged as a strong influencer, emphasizing the significance of adequate resources and support systems for effective AI utilization in clinical settings (Buchanan et al., 2021). This finding is similar to Ronquillo et al. (2021), who emphasized the importance of infrastructure and support to harness the potential of AI in nursing. Additionally, the positive impacts of "Performance Expectancy" and "Effort Expectancy" underscored that students' belief in AI's performance-enhancing abilities and ease of use contribute to higher competence levels (Buchanan et al., 2021). These insights are consistent with De Gagne's (2023) findings, highlighting the crucial roles of perceived benefits and ease of integration in AI acceptance and application in nursing education (Wilson et al., 2023). The findings of this study are consistent with the TAM, which suggests that perceived usefulness and ease of use are critical determinants of technology acceptance. The study's results confirm that nursing students' perceptions of AI's usefulness and ease of use significantly influence their clinical competence. However, the low explanatory power of the model suggests that other factors outside the scope of TAM may also play essential roles in determining their competence levels. Furthermore, the CBE Model emphasizes the importance of acquiring and demonstrating specific competencies in professional practice. Findings suggest that although AI can improve nursing competencies, its impact is currently limited by factors such as the availability of facilitating conditions and students' attitudes towards AI.

The 'Social Influence' was found to negatively affect clinical competence, suggesting that external pressures or societal expectations regarding AI may create stress or resistance among students and hinder the effective integration of AI into practice. This finding

underscores the delicate balance between external influences that either promote technology adoption or lead to apprehension and decreased self-efficacy if not managed effectively (Simsek-Cetinkaya & Karaveli Cakir, 2023; Gado et al., 2022). A study conducted with medical students explored the behavioral intentions of medical students to adopt an AI-based Diagnosis Support System. It was revealed that using an AI-based diagnosis support system with social influence played a significant role in this decision (Tran et al., 2021). In contrast, the postsignificant effects of other variables indicate their limited individual predictive power. This highlights the need for an approach that considers supporting and inhibiting factors in integrating AI into nursing education (Buchanan et al., 2021; Mousavi Baigi et al., 2023). This multifaceted relationship between AI acceptance and clinical competence underscores the importance of targeted educational strategies and supportive environments to maximize AI's potential in nursing education (Simsek-Cetinkaya & Karaveli Cakir, 2023; Tam et al., 2023). As the study reveals, the negative impact of 'Social Influence' on clinical competence highlights the challenges within the TAM framework, particularly affecting the perceived usefulness and ease of use of AI technologies. External pressures and societal expectations may lead learners to view AI as less useful or more complex, thus hindering its adoption and effective integration into practice. This is also in line with the CBE model, where such pressures can hinder the development of necessary competencies. These findings suggest that both TAM and CBE frameworks point to the need for an educational environment that increases the acceptance and utility of AI in nursing education while mitigating these negative effects, ensuring that technology adoption supports rather than hinders the development of clinical competence.

In this study, 'Negative Attitudes' towards AI also had a positive, albeit smaller, effect on clinical competence. This suggests that a critical view of AI may lead students to engage more deeply with the technology to reduce risks and increase their competence. This finding reflects the ongoing discourse in nursing, where optimism and skepticism coexist and shape a cautious approach to AI adoption (Simsek-Cetinkaya & Karaveli Cakir, 2023). Lukic et al. (2023) investigated first-year nursing students' attitudes toward AI. They found that nursing students' attitudes towards artificial intelligence were slightly positive and negative about the "practical advantages of artificial intelligence." On the contrary, Labrague et al. (2023a) stated that perceived AI utilization in nursing practice significantly influenced student nurses' attitudes toward AI and their intention to adopt AI technology. Additionally, attitudes towards AI partially mediated the relationship between perceived AI utilization in nursing practice and the intention to adopt AI technology. A study by Labrague et al. (2023b) stated that nursing students' attitudes can be influenced by their readiness, including self-assessed technological skills, understanding of AI technologies, and the perceived use of AI in nursing practice. Similarly, a systematic review and meta-analysis emphasized that students' positive attitudes indicate a promising acceptance of AI technology. However, discussions are needed around ethics education in AI and the dynamics of human-AI collaboration (Amiri et al., 2024). The study highlights the relationship between nursing students' attitudes towards AI and their clinical competence. Despite generally positive attitudes towards AI, 'Negative Attitudes' also positively influenced clinical competence, indicating that a critical view may lead students to engage more deeply with AI technology to mitigate risks and enhance their skills. A systematic review by Martinez-Ortigosa et al. (2023) identified applications of AI in nursing that cover several areas: improvements in early disease detection and clinical decision-making, AI-based support systems in nursing for patient monitoring and workflow optimization, and AI for nursing education and training. The relationship between negative attitudes and increased competence through cautious and informed engagement reflects an integration of TAM and CBE insights. While TAM factors such as perceived ease of use and usefulness influence the acceptance of AI, the CBE model's focus on competence development ensures that these technologies are used to enhance professional skills. This integration also emphasizes the importance of educational strategies that address both the psychological (attitudinal) and practical (competency-based) aspects of AI adoption in nursing.

Strength and limitation

One of the strengths of this study is its comprehensive analysis of the relationship between nursing students' attitudes toward and acceptance of AI and their level of clinical competence. Using multiple regression analysis, the study effectively quantifies the impact of various dimensions of AI acceptance on clinical competence, providing insightful information on how specific attitudes and beliefs influence skill development. Additionally, the large sample size strengthens the generalizability of the findings to the broader nursing student population. However, this study is not without limitations. The first limitation of this study is the potential for selection bias due to the exclusion of absent participants in this cross-sectional design. Since cross-sectional studies capture data at a single point in time, excluding students based on their absence may have disproportionately eliminated certain subgroups, potentially affecting the generalizability of the findings. Future research should consider strategies to mitigate this bias, such as longitudinal designs or alternative data collection methods, to ensure a more representative sample. Another limitation is that, while statistically significant, the model's explanatory power is modest ($R^2 = 0.086$), indicating that other unmeasured factors contribute to clinical competence beyond AI attitudes and acceptance. Future research should consider incorporating additional predictor variables such as prior technological experience, self-efficacy, digital literacy, and exposure to AI training to better account for the complex interplay between AI acceptance and clinical competence. Additionally, the finding that Negative Attitudes toward AI positively influenced competence was unexpected and counterintuitive. This result suggests that students who expressed skepticism toward AI may still develop competence, possibly through critical engagement with AI technologies. Future studies should explore this relationship in greater depth using qualitative methods, such as interviews or focus groups, to gain richer insights into students' perspectives, concerns, and adaptive strategies when integrating AI into their learning. The study did not examine how cultural and institutional factors may have influenced the negative predictive role of Social Influence on AI acceptance. Future research should conduct subgroup analyses to determine whether institutional norms, educational culture, or broader societal perceptions of AI contribute to this relationship. Lastly, students' academic performance and nursing experience may have influenced their attitudes toward AI and perceived competence. Future research should employ longitudinal designs to capture how AI acceptance and competency evolve over time and incorporate a more comprehensive set of predictors to strengthen the explanatory power of the model.

Conclusion

This study emphasizes the complex relationship between nursing students' attitudes toward AI and their clinical competencies and highlights that, although the correlation is modest, the effect remains statistically significant. The key positive predictors, such as Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Positive Attitudes toward AI, significantly increased nursing students' competency levels. Conversely, social influence and negative attitudes did not directly and expectedly influence competence. An unexpected yet noteworthy finding was that Negative Attitudes

toward AI positively influenced clinical competence. This counterintuitive result suggests that students who are skeptical or cautious about AI may engage more critically with the technology, prompting them to develop a deeper understanding of its risks and limitations. Such an approach could lead to more deliberate and reflective learning, where students actively work to navigate and mitigate the potential risks of AI technologies in clinical practice. This highlights the importance of fostering critical digital literacy in nursing education, ensuring that students are not only accepting of AI but also capable of using it responsibly and effectively. These findings reinforce the need for structured AI integration into nursing curricula, ensuring students receive theoretical and practical exposure to AI-driven healthcare innovations. Future research should explore these relationships further, mainly through qualitative methods, to better understand how positive and negative attitudes shape AI engagement and clinical competence over time. Nursing education can better prepare students to confidently and competently integrate AI into their future practice by incorporating targeted AI training, ethical discussions, and real-world applications.

Implications for nursing practice and health policy

These findings call for creating supportive educational environments that consider enabling and inhibiting social dynamics to effectively integrate AI into nursing education. It is crucial to emphasize both attitude and skill development in the context of AI adoption. TAM emphasizes the importance of perceived usefulness and ease of use in technology adoption and suggests that positive perceptions can lead to better integration and competence development. At the same time, the CBE framework points to aligning AI tools with specific competencies, ensuring that learners are ready to use these technologies and skilled in their application. Therefore, educational strategies that increase the acceptance and effective use of AI are essential to maximize its potential benefits in nursing education and practice. This balanced approach will equip nursing students with the competencies to use AI effectively in their future professional roles.

Declaration of competing interest

We, the undersigned, declare that this manuscript is original, has not been previously published, and is not currently under consideration for publication elsewhere. We confirm that all named authors have read and approved the manuscript and that no other individuals meet the criteria for authorship without being listed. Additionally, we confirm that the order of authors as listed in the manuscript has been agreed upon by all of us. We acknowledge that the Corresponding Author serves as the primary contact for the editorial process and is responsible for communicating with co-authors regarding progress, submission of revisions, and final approval of proofs.

Author contributions

Conceptualization: E.Ş, R.S.; data curation: E.Ş., R.S.; formal analysis: A.A.K; investigation: E.Ş., R.S., A.A.K.; methodology: R.S., E.Ş., A.A.K.; resources: E.Ş. R.S., A.A.K.; software: R.S., E.Ş.; supervision: R.S., A.A.K.; validation: E.Ş., R.S.; visualization: E.Ş., R.S.; writing-original draft preparation: R.S., and E.Ş.; writing-review and editing: E.Ş., R.S., and A.A.K; all authors have read and approved the final manuscript.

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