

Nursing Students' 21st-Century Learner Skills and Their Attitudes Toward Artificial Intelligence

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Abstract

Background: Artificial intelligence (AI) has increasingly become integrated into education and healthcare, as it has in many areas of modern life. Contemporary learners are considered 21st-century learners, and AI is beginning to play a significant role in nursing education.

Aim: This study aimed to examine the relationship between nursing students' 21st-century learner skills and their attitudes toward artificial intelligence.

Methods: This correlational study included 354 nursing students. Data were collected using an Information Form, the 21st-Century Learner Skills Utilization Scale, and the General Attitude Toward Artificial Intelligence Scale. Data collection was conducted face-to-face by the researchers. The Kolmogorov-Smirnov test and Spearman's correlation analysis were used for data analysis. Statistical significance was set at $p < 0.05$.

Results: Of the participants, 83.9% were female, and the mean age was 20.54 ± 2.67 years. The mean score for the positive attitude subscale of the General Attitude Toward Artificial Intelligence Scale was 3.64 ± 0.56 , while the mean score for the negative attitude subscale was 3.01 ± 0.69 . Students' use of 21st-century learner skills was above the moderate level [3.68 ± 0.44]. A positive correlation was found between students' positive attitudes toward artificial intelligence and their use of 21st-century learner skills.

Conclusion: Integrating artificial intelligence into nursing education programs, in alignment with the structure of the discipline, may support the development of various 21st-century skills by leveraging the opportunities provided by AI.

Keywords: Artificial intelligence, learning, nursing students

Introduction

The 21st century is characterized by rapidly evolving information technologies and ongoing digital transformation, which are reshaping professions, educational processes, and expectations regarding professional competencies.^{1,2} Within this context, 21st-century skills—such as critical thinking, problem-solving, creativity, collaboration, information literacy, digital competence, flexibility, and self-direction—are considered essential for success in both education settings and professional practice.^{3,4} These competencies, emphasized by educational institutions and the modern workforce, are particularly crucial in the dynamic and continuously evolving field of healthcare. In this field, students are expected to adapt to emerging technologies, critically evaluate technology-driven information, and effectively integrate this knowledge into clinical decision-making.² Accordingly, it is imperative that nursing students not only acquire technical knowledge but also develop 21st-century competencies, including proficiency in digital tools, the ability to make critical judgments, and the capacity to adapt rapidly to changing practices.^{3,5}

Technological advancements, particularly in computer science, data infrastructure, and artificial intelligence (AI), have increasingly influenced both healthcare delivery and the education of health professionals.⁶⁻⁸ AI is now applied in a wide range of areas, including early and accurate diagnosis, clinical decision support systems, patient monitoring, risk prediction, data analytics, and personalized learning environments.⁹⁻¹¹ Furthermore, AI-enhanced simulations, virtual reality applications, and robotic assistants serve as valuable tools for improving clinical skill acquisition and supporting students' critical thinking and decision-making processes.^{8,9,12} These technological developments are closely associated with 21st-century competencies: digital competence and information literacy facilitate the informed and responsible use of AI, while critical thinking and problem-solving skills enable accurate interpretation of AI outputs and their application in ethically sound practice.¹³ Consequently, strengthening 21st-century skills in nursing education is considered essential for the effective integration and use of AI-based applications.¹⁴

Although the potential of AI in nursing practice continues to expand, existing research indicates that factors such as knowledge levels, attitudes, educational exposure, and AI-related anxiety significantly influence the adoption of AI technologies.^{6,7} Therefore, assessing nursing students' knowledge, attitudes, and anxiety related to AI is essential for guiding the development and refinement of educational programs that aim to integrate both AI and 21st-century competencies into nursing curricula.^{9,11}

Cite this article as: Çalışkan F, Çayır A. Nursing Students' 21st-Century Learner Skills and Their Attitudes Toward Artificial Intelligence. J Educ Res Nurs. 2026;23(2):119-122.

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Received: August 11, 2025

Accepted: April 24, 2026

Publication Date: June 01, 2026



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Identifying learner characteristics is crucial for keeping pace with changes in educational processes and enhancing the effectiveness of teaching. In this context, examining nursing students' general attitudes toward 21st-century learning skills and artificial intelligence, as well as the relationship between these variables, is expected to contribute to the sustainable development of 21st-century competencies and the design of educational programs that effectively integrate AI. Although previous studies have explored nursing students' general attitudes toward AI^{7,15,16} and 21st-century learner skills,¹⁷⁻¹⁹ separately, no study has examined the relationship between these two constructs. This gap highlights not only a lack of evidence regarding the association between nursing students' modern learner skills and their perspectives on AI but also underscores the need to better understand this relationship to prepare a workforce capable of navigating and leading technology-driven transformations in healthcare. Accordingly, the aim of this study was to determine the relationship between nursing students' 21st-century learning skills and their attitudes toward artificial intelligence.

Study Question

The study sought to answer the following research question:

1. Is there a relationship between nursing students' 21st-century learner skills and their general attitudes toward AI?

Materials and Methods

Design

This study was designed as a correlational research model to examine the relationships among variables.

Population and Sample

The study population consisted of 1,448 nursing students enrolled at two universities: Konya Necmettin Erbakan (n=665) and Trakya University (n=783). The sample size was calculated using the formula for finite populations, based on a 95% confidence level [Z=1.96], a margin of error of 5% (d=0.05), and an assumed population proportion of p=0.50 (q=0.50):

$$N = \frac{z^2 \cdot p \cdot (1-p)}{e^2} \cdot \left[1 + \frac{z^2 \cdot p \cdot (1-p)}{e^2 \cdot N} \right]$$

The required sample size was determined to be 305 students. To account for potential data loss, the target sample size was increased to 340 by incorporating a 10% attrition rate.²⁰ At the end of data collection, complete and analyzable data were obtained from 354 students, all of whom were included in the analyses.

To ensure that the sample adequately represented the population by class level, proportionate stratified sampling was employed. Students were first stratified by university and then by class level. The number of participants selected from each stratum was calculated using the formula $nh = \frac{N_h}{N} \times n$, based on the proportion of each stratum within the population. Consequently, the final sample consisted of 354 nursing students, including 160 from Konya Necmettin Erbakan University and 194 from Trakya University. The inclusion criteria were defined as being enrolled as a nursing student at Konya Necmettin Erbakan or Trakya University during the study period, being 18 years of age or older, and voluntarily agreeing to participate in the study. The exclusion criteria included not being a nursing student at these universities during the study period, being under 18 years of age, or declining to participate.

Data Collection Tools

Research data were collected using the Information Form, the 21st-Century Learner Skills Utilization Scale, and the General Attitude Toward Artificial Intelligence Scale.

Information Form: This form was developed by the researchers based on the relevant literature. It consists of eight questions designed to collect data on age, gender, university, class level, daily internet use, knowledge of the concept of AI, awareness of AI use in healthcare, and the use of AI-based applications.^{7,9,15,16}

21st-Century Learner Skills Utilization Scale: Developed by Orhan Gökşun and Kurt,²¹ this scale consists of 31 items and four subscales: cognitive, autonomous, collaboration, and flexibility and innovation skills. There are no reverse-scored items. The total score is calculated by summing the responses to all items and dividing by the number of items. The scores for both the subscales and the overall scale range from 1 to 5. The original study reported an internal consistency coefficient of 0.87.²¹ In the present study, Cronbach's alpha was 0.89.

General Attitude Toward Artificial Intelligence Scale: Developed by Schepman and Rodway²² and adapted into Turkish by Kaya et al.,²³ this scale consists of two subscales measuring positive and negative attitudes toward artificial intelligence. The scale includes 20 items: 12 assessing positive attitudes and eight assessing negative attitudes. Items in the negative subscale are reverse-coded; thus, lower scores indicate stronger negative attitudes toward AI. Scores for the positive attitude subscale range from 12 to 60, while scores for the negative attitude subscale range from 8 to 40. In the Turkish adaptation, Cronbach's alpha values were 0.82 for the positive subscale and 0.84 for the negative subscale.²³ In the present study, Cronbach's alpha coefficients were 0.85 for the positive subscale and 0.81 for the negative subscale.

Procedures

Data were collected between October 2024 and November 2024 from nursing students who voluntarily agreed to participate in the study. To avoid potential instructor-student conflicts of interest, the researchers involved in data collection were not responsible for the participants' academic evaluation or grading. Data collection was conducted in classroom settings within the nursing departments of the participating universities, outside regular class hours, to minimize any perceived pressure or influence on participation. Written and verbal informed consent was obtained from all participants. Prior to data collection, participants were informed about the purpose of the study, the voluntary nature of participation, and their right to withdraw at any time without academic consequences. Student identities were kept confidential to prevent any potential impact on responses. No identifying information was collected, and all data were treated confidentially to ensure anonymity. Participants were instructed to complete the data collection forms accurately and fully. The researchers reviewed all forms during data collection to minimize missing data. There was no time limit for completing the forms; on average, completion took approximately 20 minutes.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics [Version 22.0; IBM Corp., Armonk, NY, USA]. Descriptive statistics were presented as means, standard deviations, medians, minimum and maximum values for continuous variables, and as frequencies and percentages for categorical variables. The normality of data distributions was assessed using the Kolmogorov-Smirnov test, with $p < 0.05$ indicating deviation from normality. However, because this test is sensitive to minor deviations, particularly in large samples,²⁴ normality was also evaluated using descriptive statistics. The results indicated that the data were not normally distributed. Therefore, nonparametric statistical methods were applied, and relationships between variables were examined using Spearman's rank-order correlation analysis. Statistical significance was set at $p < 0.05$ for all analyses.

Ethical Considerations

Ethical approval was obtained from the Trakya University Social Sciences and Humanities Research Ethics Committee [Approval Number: 08/48, Date: 08.10.2024]. Institutional permission and authorization for the use of data collection tools were also secured. The study was conducted in accordance with the principles of the Declaration of Helsinki, ensuring voluntary participation and informed consent. All participants provided both written and verbal consent prior to participation.

Results

A total of 354 nursing students participated in the study. Of these, 83.9% (n=297) were female, and the mean age was 20.54±2.67 years. Regarding academic year distribution, 23.7% (n=84) were first-year students, 26.3% (n=93) were second-year students, 27.1% (n=96) were third-year students, and 22.9% (n=81) were fourth-year students. The mean daily internet use duration was 5.38±2.44 hours.

As shown in Table 1, 61.6% of the nursing students reported having knowledge of the concept of AI, while 33.6% reported partial knowledge. Additionally, 45.5% indicated partial knowledge of AI use in healthcare. A majority of students [66.4%] reported using AI-based applications, whereas 20.9% reported that they did not use such applications.

As presented in Table 2, the mean score on the Positive Attitude subscale of the General Attitude Toward Artificial Intelligence Scale was 3.64±0.56, while the mean score on the Negative Attitude subscale was 3.01±0.69. The overall mean score on

Table 1. Nursing students' views on artificial intelligence (n=354)

		n	%
Knowledge of the concept of artificial intelligence	Yes	218	61.6
	No	17	4.8
	Partially	119	33.6
Knowledge of the use of artificial intelligence in healthcare	Yes	133	37.6
	No	60	16.9
	Partially	161	45.5
Use of artificial intelligence-based applications	Yes	235	66.4
	No	74	20.9
	Not sure	45	12.7

Table 2. Mean scores of the General Attitude Toward Artificial Intelligence Scale and the 21st-Century Learner Skills Utilization Scale (n=354)

	Subscale	Number of items	Mean±SD	Min–Max
GAAIS	Positive attitude	12	3.64±0.56	1.5–5
	Negative attitude	8	3.01±0.69	1.1–4.8
21 st CLSUS	Cognitive skills	17	3.98±0.48	2.2–5
	Autonomous skills	6	3.37±0.57	1.6–5
	Collaboration and flexibility skills	6	3.15±0.69	1.1–5
	Innovation skills	2	3.66±0.80	1–5
	Total	31	3.68±0.44	2.2–4.9

SD: Standard deviation, Min: Minimum, Max: Maximum, GAAIS: General Attitude Toward Artificial Intelligence Scale, 21st CLSUS: 21st-Century Learner Skills Utilization Scale.

the 21st-Century Learner Skills Utilization Scale was 3.68±0.44. Examination of the subscales indicated that the highest mean score was observed in the Cognitive Skills subscale (3.98±0.48), whereas the lowest mean score was found in the Collaboration and Flexibility Skills subscale (3.15±0.69). The mean scores for the Autonomous Skills and Innovation Skills subscales were 3.37±0.57 and 3.66±0.80, respectively.

A weak but statistically significant positive correlation was found between the Positive Attitude subscale of the General Attitude Toward Artificial Intelligence Scale and the Cognitive Skills [$r=0.327$; $p=0.000$], Autonomous Skills [$r=0.332$; $p=0.000$], Collaboration and Flexibility Skills [$r=0.221$; $p=0.000$], Innovation Skills [$r=0.365$; $p=0.000$] subscales, as well as the total score [$r=0.386$; $p=0.000$] of the 21st-Century Learner Skills Utilization Scale (Table 3).

A very weak but statistically significant positive correlation was identified between the Negative Attitude subscale and the Innovation Skills [$r=0.138$; $p=0.009$]. However, no statistically significant relationships were found between the Negative Attitude subscale and the Cognitive Skills [$r=0.041$; $p=0.438$], Autonomous Skills [$r=0.059$; $p=0.268$], Collaboration and Flexibility Skills [$r=-0.088$; $p=0.099$], or the total scale score [$r=-0.008$; $p=0.878$] of the 21st-Century Learner Skills Utilization Scale (Table 3).

Discussion

In this study, more than half of the nursing students reported being familiar with the concept of artificial intelligence, approximately half indicated partial knowledge regarding its use in healthcare, and the majority stated that they had used AI-based applications. These findings suggest that nursing students possess a generally moderate level of awareness and practical exposure to AI. However, given the rapidly expanding role of AI in healthcare and the varying levels of prior exposure reported, these results highlight the need to incorporate structured AI education into nursing curricula.

The scores obtained from the General Attitude Toward Artificial Intelligence Scale indicate that nursing students' attitudes toward artificial intelligence are generally at a moderate level. Consistent with this finding, studies by Lukić et al.²⁵ involving

Table 3. Correlation between the General Attitude Toward Artificial Intelligence Scale and the 21st-Century Learner Skills Utilization Scale (n=354)

Subscale		GAAIS	
		Positive attitude	Negative attitude
Cognitive skills	r	0.327*	0.041
	p	0.000	0.438
Autonomous skills	r	0.332*	-0.059
	p	0.000	0.268
Collaboration and flexibility skills	r	0.221*	-0.088
	p	0.000	0.099
Innovation skills	r	0.365*	0.138*
	p	0.000	0.009
21 st CLSUS total	r	0.386**	-0.008
	p	0.000	0.878

*: Correlation is significant at the 0.01 level. r: Spearman's correlation coefficient. 21st CLSUS: 21st-Century Learner Skills Utilization Scale, GAAIS: General Attitude Toward Artificial Intelligence Scale.

first-year nursing students and by Cho and Seo²⁶ involving nurses also reported moderate levels of AI acceptance. In contrast, Wang et al.,²⁷ in a study of nurses in China, and Khaled and Elborai,²⁸ in a study of nursing students in Egypt, found that most participants held positive attitudes toward AI. Conversely, Sheela²⁹ reported that the majority of nursing students exhibited negative attitudes toward AI. In the present study, the coexistence of moderately positive and moderately negative attitudes may indicate that, while students are interested in technological innovations, they may also experience uncertainty or insecurity due to insufficient knowledge about AI. As AI becomes increasingly integrated into both healthcare and education, nursing students' attitudes are likely to play a critical role in their future professional practice after graduation.

In the present study, nursing students demonstrated above-moderate use of 21st-century learner skills, including cognitive, autonomous, collaboration and flexibility, and innovation skills. While Kaya et al.¹ and Ötün et al.¹⁶ reported moderate levels of these skills among nursing students and nurses, respectively, Kocaağalar Akince et al.¹⁹ found that Generation Z nursing students exhibited very high levels of these competencies. The above-moderate levels observed in the present study should be interpreted not only as an outcome of nursing education but also in light of the characteristics of the current student population, often described as digital natives with extensive exposure to technology. In this context, both educational experiences and generational characteristics may contribute to the development of 21st-century learner skills among nursing students. These findings suggest that nursing students demonstrate a relatively high level of competence in 21st-century learner skills, which may support their ability to cope with challenges in both personal and professional contexts and contribute to their overall professional development.

A positive relationship was identified between students' positive attitudes toward AI and their use of 21st-century learner skills. Specifically, students with more positive attitudes toward AI tended to demonstrate higher levels of cognitive, autonomous, collaboration and flexibility, and innovation skills. In contrast, higher levels of negative attitudes toward AI were associated with lower use of innovation skills. These findings indicate a meaningful association between attitudes toward artificial intelligence and the utilization of 21st-century skills. This relationship suggests that positive attitudes of nursing students toward AI may facilitate the development of various 21st-century competencies by enabling students to engage more effectively with the opportunities provided by AI technologies. Conversely, the finding that increased negative attitudes toward AI are associated with reduced use of innovation skills is particularly noteworthy and requires careful consideration. Negative perceptions of emerging technologies such as AI may hinder students' willingness to adopt these tools and limit their engagement in innovative practices. As a result, this may restrict their ability to keep pace with technological advancements in healthcare. Therefore, nursing education should incorporate strategies aimed at reducing negative attitudes toward technology.

Limitations

The generalizability of the findings is limited, as the study was conducted within a specific time frame, included undergraduate students from only two universities, and relied on self-reported data. The cross-sectional design of the study does not allow for the examination of changes in students' attitudes toward 21st-century learner skills and artificial intelligence over time. Furthermore, the results reflect only the relationships between variables and do not permit causal inferences.

Conclusion

The findings indicate that nursing students' familiarity with artificial intelligence and their use of 21st-century learner skills are generally at moderate to above-moderate levels. Enhancing students' positive attitudes toward AI may support the development of key 21st-century competencies, including cognitive, autonomous, collaboration and flexibility, and innovation skills. Conversely, reducing negative attitudes toward AI may help increase the use of innovation skills and contribute to overall professional competence.

The integration of AI into nursing education has the potential to enhance students' clinical skills, improve clinical decision-making, foster critical thinking, and increase effectiveness in patient care. The use of these technologies in nursing education may enable future nurses to deliver care more competently, efficiently, and effectively, while also strengthening their critical thinking abilities. In this context, AI can serve as an important tool in supporting the development of 21st-century skills. Overall, this study demonstrates that nursing students' attitudes toward AI play a significant role in their effective use of 21st-century learner skills. Negative attitudes, in particular, may hinder the development of innovation skills. Therefore, adopting educational strategies that promote positive attitudes toward technology is essential for facilitating skill development. Based on these findings, incorporating AI-related activities and exercises into nursing education programs may enhance students' cognitive, autonomous, collaboration and flexibility, and innovation skills. The structured integration of AI tools into course content can provide practical opportunities for students to develop these competencies in a targeted way.

Ethics Committee Approval: The study was approved by the Trakya University Social Sciences and Humanities Research Ethics Committee (Approval Number: 08/48, Date: 08.10.2024).

Informed Consent: Written informed consent was obtained from the nursing students.

Conflict of Interest: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study received no financial support.

Author Contributions: Concept – F.Ç., A.Ç.; Design – F.Ç., A.Ç.; Supervision – F.Ç., A.Ç.; Resource – F.Ç., A.Ç.; Materials – F.Ç., A.Ç.; Data Collection and/or Processing – F.Ç., A.Ç.; Analysis and/or Interpretation – F.Ç., A.Ç.; Literature Review – F.Ç., A.Ç.; Writing – F.Ç., A.Ç.; Critical Review – F.Ç., A.Ç.

Peer-review: Externally peer-reviewed.

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