

RESEARCH

Open Access



Knowledge, attitudes, and practices toward AI technology (ChatGPT) among nursing students at Palestinian universities

Nisreen Salama^{1*}, Rebhi Bsharat², Abdallah Alwawi³ and Zuheir N. Khlaif⁴

Abstract

Background AI can improve medical practice, address staff shortages, and enhance diagnostic efficiency. The ChatGPT of Open AI, launched in 2022, uses AI in medical education. However, the long-term impact is uncertain, and integration varies globally, particularly in the Middle East.

Aim To explore the knowledge, practices, and attitudes of nursing students in Palestinian universities regarding AI, specifically the use of ChatGPT.

Methodology A cross-sectional design was used to conduct this study. The study was performed at 8 private and governmental universities in the West Bank, Palestine, from 1st May 2024 to 30 May 2024, and 304 nursing students participated.

Results The study revealed that 84.5% of nursing students at Palestinian universities were aware of AI technology, yet 69.9% lacked formal education or training related to ChatGPT. Despite this gap, 79% supported the integration of AI into nursing curricula and specialized training programs, reflecting strong optimism about its role in education and healthcare. While 58.6% had used AI in their coursework and 68.1% felt comfortable with technology, disparities in proficiency and access remain key barriers to effective AI integration. Major challenges to AI adoption in Palestine include insufficient training, the absence of AI-focused curricula, and financial constraints, underscoring the need for institutional and pedagogical reforms. Concerns about AI's reliability, costs, and potential diagnostic errors persist, emphasizing the complexities of its integration into nursing education and practice.

Conclusion This study highlights the knowledge, attitudes, and practices of Palestinian nursing students regarding AI and ChatGPT. It reveals that, despite growing awareness, the lack of formal education on AI underscores the need for comprehensive curricula. While students express optimism about AI's potential in healthcare, concerns about its reliability and integration persist. The study also reveals that barriers such as inadequate training, limited curricula, and financial constraints must be addressed to effectively integrate AI into nursing education and prepare students for its expanding role in healthcare.

Keywords Knowledge, Attitudes, Practices, AI technology, ChatGPT, Nursing, Students university, Artificial intelligence in nursing education, Middle East healthcare technology

*Correspondence:

Nisreen Salama

nisreen.salama@aaup.edu

Full list of author information is available at the end of the article



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Introduction

Artificial intelligence (AI) is transforming multiple industries, including healthcare and medical education, by enhancing diagnostic accuracy, supporting clinical decision-making, and addressing workforce shortages [1, 2]. AI-powered applications, such as machine learning algorithms and natural language processing models, are increasingly integrated into medical training programs to improve educational outcomes. Among these innovations, OpenAI's ChatGPT, launched in November 2022, has demonstrated potential in assisting medical students by generating text-based responses, facilitating knowledge acquisition, and providing real-time feedback [3]. However, despite AI's promise, its long-term impact on medical education remains uncertain, and its integration varies significantly across regions.

AI adoption in healthcare education has progressed rapidly in technologically advanced countries such as the United States, Canada, and Germany, where institutions have incorporated AI-driven simulations, virtual standardized patients, and clinical decision-support systems into curricula [4]. These implementations have been associated with increased learning efficiency, improved diagnostic accuracy, and enhanced problem-solving skills among students [5]. However, in developing regions, including the Middle East, AI integration remains limited due to disparities in infrastructure, institutional readiness, and faculty expertise [6–8].

In Palestine, the use of AI in nursing education is still in its early stages, with significant barriers hindering its widespread adoption. Limited institutional support, inadequate training opportunities, and financial constraints have restricted the systematic integration of AI tools into nursing curricula [9]. While some Palestinian universities have begun exploring AI applications in medical education, there is little research assessing how nursing students perceive and engage with these technologies. Understanding students' knowledge, attitudes, and practical experiences with AI is essential for developing educational strategies that effectively incorporate AI into nursing training.

This study aims to explore the knowledge, attitudes, and practices (KAP) of nursing students at Palestinian universities regarding AI, with a specific focus on ChatGPT. By identifying the factors influencing students' engagement with AI, the findings of this study can inform strategies for integrating AI into nursing education in Palestine and similar contexts.

Research question

What is the level of knowledge, attitudes, and practical use of AI technologies, specifically ChatGPT, among nursing students at Palestinian universities, and how do

these factors influence their academic studies and professional experiences?

Knowledge and attitudes toward AI and ChatGPT among health care professionals

The integration of AI in medical education is gaining traction worldwide, with studies highlighting its potential to revolutionize learning and clinical training. For example, Khumrina, Ryanb [10] demonstrated the efficacy of case-based e-learning systems in enhancing medical students' diagnostic skills. Similarly, Maicher, Zimmerman [5] reported that virtual standardized patient systems can effectively mimic real patient interactions, providing a valuable tool for developing clinical and communication skills. However, the knowledge and attitudes of medical students toward AI vary significantly. In Lebanon, research by Doumat, Daher [7] has shown that while there is a growing awareness of AI's potential in medicine, the actual application and integration of AI into the curriculum remain limited. This lack of integration often leads to gaps in knowledge and negative attitudes toward AI among students. Similarly, a study in Jordan highlighted that while students recognize the importance of AI, their practical exposure and understanding are insufficient due to curriculum limitations [6]. In Palestine, there is a notable gap in the literature regarding the knowledge of health profession students toward AI [11, 12].

Ahmed et al. [13] surveyed doctors and medical students in Pakistan and reported that while 74% possessed basic AI knowledge, only 27.3% were aware of its medical applications. Nonetheless, a significant majority supported AI's inclusion in medical curricula, recognizing its relevance in fields. Similarly, a study by Labrague, Aguilar-Rosales [14] explored the attitudes and intentions of 200 nursing students toward AI in nursing practice, revealing generally favorable perceptions and strong intentions to incorporate AI. The findings advocate the integration of AI-centric coursework and experiential learning in nursing education.

Ajlouni, Wahba [15] assessed students' attitudes toward the use of ChatGPT as an educational tool and noted high behavioral and cognitive engagement but moderate affective responses. Despite positive overall attitudes, 20.7% of the students expressed concerns about usability and data accuracy. These insights underscore the importance of the cautious integration of AI tools such as ChatGPT in educational settings. A recent study explores how AI used to develop assessments in the medical education including nurses which is consider a crucial part of the educational system [16].

Irwin, Jones [17] discuss the broader implications of AI in higher education, particularly in nursing and

midwifery programs, addressing ongoing ethical, moral, and legal debates. They highlight AI's potential to revolutionize healthcare education by enhancing patient outcomes and safety. ChatGPT, for example, can act as a virtual tutor, providing study materials and fostering critical thinking in simulated environments [18].

Impact of AI on career choices and educational experiences

The influence of AI on medical students' career choices is a topic of ongoing debate. Park, Choi [19] reported that the fear of AI replacing certain medical roles could deter students from pursuing careers in specialties. Conversely, Pinto dos Santos, Giese [20] reported that many students believe that AI will augment rather than replace physicians, suggesting a more optimistic outlook. These differing perspectives underscore the importance of comprehensive AI education to inform students accurately about the future implications of AI in healthcare.

In terms of educational experience, studies have shown that AI can significantly enhance learning outcomes. For example, Randhawa and Jackson [4] highlighted how AI-powered tools can provide personalized learning experiences, cater to individual student needs and improve overall academic performance. This personalized approach is particularly beneficial in medical education, where diverse learning paces and styles are common.

Methodology

Study design and sample size

A cross-sectional design was used to conduct this study. A key advantage of the cross-sectional design is that it allows for the collection of data at a single point in time, without the need for long-term data collection, providing a snapshot of the current state of knowledge, attitudes, and practices. The study was performed at 8 private and governmental universities in the West Bank, Palestine, from 1st May 2024 to 30 May 2024. The target population in the present study included all nursing students from nongovernmental and governmental universities in the West Bank, Palestine. After Raosoft was used to determine the appropriate sample size, the researchers reported that a sample of 367 participants would be needed on the basis of a 5% margin of error, 95% confidence level, and 50% response distribution. A total of 304 individuals, including nursing students from various universities in Palestine, responded to the survey. The sample population was selected via a convenience sampling technique. Convenience sampling has drawbacks, including sampling bias, which can compromise data accuracy. The sample is not representative of the population being studied, and conclusions rely on subjective judgments and motivations, leading to further survey bias. Researchers may also be subjective in their selection.

Pilot study

The researchers ran a pilot study with 35 people to assess the survey's validity and reliability, find any potential ambiguities, gauge how long it would take to complete, and adjust the phrasing depending on participant input. The participants thought the questionnaire was understandable and offered no significant changes. Minor adjustments were made, though, to increase consistency and clarity. For example, several items were reworded to make them easier to understand, and the survey's vocabulary was kept consistent. Because of the small population size and requirement for independent data, these people were not included in the main study. The final data analysis took into consideration their previous exposure to the survey in order to reduce bias.

Study instruments

The questionnaire was developed through a multi-phase process to ensure its validity and reliability in assessing nursing students' knowledge, attitudes, and practices (KAP) regarding artificial intelligence (AI) and ChatGPT. The development stages included:

1. Literature review and conceptual framework

A comprehensive literature review was conducted to identify existing validated instruments related to AI and ChatGPT adoption in healthcare education. The identified frameworks guided the design of the questionnaire to ensure it covered essential dimensions of AI knowledge, attitudes, and practices.

2. Initial questionnaire drafting

Based on the literature review, an initial pool of questions was generated by three independent researchers with expertise in nursing education, artificial intelligence, and survey methodology. The questionnaire was designed to encompass four key sections:

- Demographic information (gender, age, university level, institution, etc.)
- Knowledge of AI and ChatGPT (definitions, applications, and exposure to AI).
- Attitudes toward AI and ChatGPT (perceived benefits, concerns, and potential integration into curricula).
- Practical use of AI and ChatGPT (experience using AI technologies and comfort level in incorporating AI tools into clinical practice).

3. Content validation by experts

The draft questionnaire was reviewed by a panel of five subject-matter experts, including faculty mem-

bers in medical education, nursing informatics, and AI applications in healthcare. They evaluated the questionnaire for relevance, clarity, and comprehensiveness. Their feedback led to modifications in question wording, restructuring of sections, and elimination of redundant items.

4. Cognitive testing

A small group of 10 nursing students from different academic levels participated in cognitive testing. They were asked to complete the questionnaire while providing feedback on any unclear or ambiguous items. Minor linguistic refinements were made to improve readability and ensure that students from diverse backgrounds could interpret the questions accurately.

5. Pilot testing for reliability assessment

To ensure internal consistency and reliability, a pilot study was conducted with 35 nursing students who were not included in the final sample. The reliability of the knowledge, attitudes, and practices sections was tested using Cronbach's alpha, yielding acceptable values:

- Knowledge Section: $\alpha = 0.78$.
- Attitudes Section: $\alpha = 0.81$.
- Practice Section: $\alpha = 0.76$.

These values indicate a good level of internal reliability, suggesting that the questionnaire items measured consistent constructs.

6. Final refinements and ethical approval

After incorporating insights from the pilot study, a final revision of the questionnaire was conducted. Ethical approval was obtained from the Institutional Review Board (IRB) of Modern University College. Participants were assured of anonymity and confidentiality, and informed consent was secured before data collection.

7. Data collection and administration

The data collection process was designed to ensure accuracy, reliability, and ethical compliance. An online, self-administered questionnaire was distributed via Google Forms to nursing students at participating universities, from 1st May 2024 to 30 May 2024. The survey link was shared through official university channels, faculty email lists, and social media platforms such as WhatsApp and Facebook groups dedicated to nursing education. The survey was open for four weeks, with two reminder emails sent at two-week intervals to encourage participation and maximize response rates.

Ensuring data quality and reliability

Several measures were taken to enhance the accuracy, reliability, and validity of the collected data:

1. Pilot testing and refinement

Before the full-scale data collection, a pilot study was conducted with 35 nursing students who were not included in the final sample. The pilot study helped identify potential ambiguities in the questionnaire, assess response clarity, and refine wording where necessary. The final questionnaire was revised based on pilot feedback to ensure that questions were clear, unbiased, and contextually relevant.

2. Standardization of data collection process

To minimize bias and ensure consistency, the questionnaire was self-administered, eliminating interviewer influence. Instructions were standardized, ensuring that all participants received the same information on how to complete the survey.

3. Double data entry and error checking

After responses were collected, data entry was performed using the double-entry method to detect and correct inconsistencies. Two independent researchers cross-checked the entered data to identify any discrepancies, which were resolved by referring to the original survey responses.

4. Automated data validation features

The online questionnaire was designed with automated validation rules, including required fields and response constraints (e.g., preventing multiple submissions from the same respondent) to reduce missing or invalid data.

5. Training of data reviewers

Although data collection was self-administered, research team members involved in data verification and analysis underwent training on data validation, error detection, and handling incomplete responses to ensure methodological rigor.

6. Anonymity and confidentiality measures

To enhance response honesty and data integrity, participants were assured of full anonymity and confidentiality. No personally identifiable information was collected, and all responses were stored in a secure, password-protected system accessible only to authorized researchers.

Ethical approval

The study received approval from Institutional Review Board (IRB)-Modern University Collage. To ensure the confidentiality of participants, several measures were implemented throughout the data collection and

analysis process. First, no personally identifiable information (e.g., names, student IDs, or contact details) was collected, ensuring that responses remained anonymous. The online questionnaire was designed to be self-administered, and participants were informed that their responses would be used solely for research purposes.

All responses were collected via a secure and encrypted platform, preventing unauthorized access or data breaches. To further safeguard confidentiality, the data were stored in a password-protected file, accessible only to the primary researcher and designated team members. Additionally, data were aggregated and analyzed collectively, ensuring that individual responses could not be traced back to specific participants.

In compliance with ethical research standards, participants were assured of their right to withdraw from the study at any time without consequence. These measures align with institutional review board (IRB) guidelines and uphold the highest standards of research integrity and participant privacy.

Data analysis

The collected data were analyzed via the Statistical Package for Social Sciences (SPSS) Version (27). Data analysis of descriptive and inferential statistics was conducted. With respect to descriptive statistics, frequencies, percentages, mean scores and standard deviations (SDs) were used to describe the study variables. With respect to inferential statistics, independent *t* tests and one-way ANOVA were conducted. For inferential analyses, independent *t*-tests were performed to compare differences between two groups, while one-way ANOVA was used to examine variations across multiple groups. A significance threshold of $p < 0.05$ was applied to determine statistical significance in all tests. This threshold was used to assess whether observed differences between groups were unlikely to have occurred by chance. All data were double-checked for outliers and errors before analysis to ensure the accuracy and reliability of the results.

Results

Demographic characteristics

Seventy-eight percent of the participants were females. The greatest age group (73.7%) was 19–22 years old. The lower percentages in the other age groups indicated that traditional-aged college students made up the majority of the sample. Villages accounted for the majority of the participants (57.6%), with cities being the second most common (36.8%). The last 5.6% of the population was from camps for refugees. The distribution of fourth-year students (41.4%) was greater than that of students at other university levels. There were also many first-year students (23.4%). Modern University College (40.5%) and

Al-Quds University (18.1%) received the highest percentages of responders. The other universities' distribution was more widespread, with each accounting for 4.3% to 13.8% of the total responses. Additional information is provided in Table 1.

Artificial intelligence (AI) knowledge

An overview of the participants' AI knowledge is given in Table 2. A total of 84.5% of the participants knew what AI was. A total of 15.4% of the respondents were unclear or did not know what AI was. Although slightly more than half (52.6%) of the participants were aware of machine learning and deep learning, a notable percentage (47.4%) were either uncertain or did not know. While somewhat more than half of the respondents (53.3%) were aware of AI's uses in the medical field, a percentage (46.7%) did not. Fewer than half of the students (41.8%) said they had learned about AI in college, and nearly half (49.7%) said they had not. A majority (72.4%) expressed optimism about the potential application of AI in education by believing that it can enhance the learning process. Even still, approximately 28% expressed uncertainty, suggesting that although AI's potential was understood.

Knowledge of ChatGPT

Table 3 explores the students' knowledge of ChatGPT, their background knowledge or education in the area,

Table 1 Demographic data ($n = 304$)

Variable		N	%
Gender	Male	89	29.3
	Female	215	70.7
Age	Below 19	36	11.8
	19–22 years	224	73.7
	23–27 years	31	10.2
	28 and more	13	4.3
Living Place	City	112	36.8
	Village	175	57.6
	Refugee Camp	17	5.6
University level	First year	71	23.4
	Second year	43	14.1
	Third year	64	21.1
	Fourth year	126	41.4
University	Al Quds University	55	18.1
	Arab American University	42	13.8
	Modern University College	123	40.5
	An-Najah University	19	6.3
	Palestine Ahliya University	17	5.6
	AL- Rawda College	20	6.6
	Polytechnic University	15	4.9
	Nablus University	13	4.3

Table 2 Level of knowledge of AI ($n = 304$)

	Yes		No		I don't know	
	N	%	N	%	N	%
Do you know what AI is?	257	84.5	32	10.5	15	4.9
Do you know about machine learning and deep learning?	160	52.6	106	34.9	38	12.5
Do you know about any application of AI in medical field?	162	53.3	109	35.9	33	10.9
Have you ever been taught about AI in the college?	127	41.8	151	49.7	26	8.6
Do you think that AI can support the educational process?	220	72.4	52	17.1	32	10.5

Table 3 Level of knowledge of ChatGPT ($n = 304$)

		N	%
How familiar are you with ChatGPT?	Very familiar	84	27.6
	Somewhat familiar	149	49.0
	Not at all familiar	71	23.4
Have you received any training or education related to ChatGPT?	Yes	93	30.6
	No	211	69.4
How do you think ChatGPT can be used in patient care? (select all that apply)	Answering patient questions	109	35.9
	Providing medication reminders	74	24.3
	Offering emotional support	46	15.1
	Conducting initial assessments	66	21.7
	Other	79	26

and their opinions on its potential applications in patient care. A total of 49% of the students reported knowing anything about ChatGPT, with 27.6% indicating that they knew it very well. However, almost a quarter (23.4%) had no idea what ChatGPT was. Sixty-nine percent of the students reported having no formal education or training related to ChatGPT. Merely 30.6% had acquired any kind of instruction or training. Answering patient questions was the most widely acknowledged potential use of ChatGPT in patient care (35.9%). Other notable applications included sending medication reminders (24.3%) and carrying out initial assessments (21.7%). These findings demonstrate that ChatGPT can be useful for routine patient management tasks. Fewer respondents (15.1%) recognized providing emotional assistance. According to the other group (26%), students might have known more specific applications or had other suggestions.

Level of AI attitude

The attitudes of the students toward AI in the health care profession, together with their worries and views of the obstacles to AI adoption in Palestine, are displayed in Table 4. The majority of the students (82.9%) felt that AI was crucial to the medical field. The small minority (13.8%) of them who disagreed may be worried about the potential impact of AI on healthcare. The majority

of the students (79%) were in favor of AI being included in nursing and specialized training programs. It is possible that worries regarding the viability or applicability of AI in the current training programs accounted for 16.7% of the disagreement. The majority (72.3%) agreed that AI helps with disease severity assessment and early diagnosis. A total of 21.4% disagreed, perhaps because they had doubts about AI reliability or accuracy for these important activities. AI might replace healthcare providers, according to 51.7% of respondents, but 43% disagreed. The majority (75.4%) thought that AI had to be included in hospitals and health centers; 19.1% disagreed, which may be a result of implementation, cost, or potential effects on healthcare quality issues. With respect to whether AI would be a burden, the students were largely divided, with 48.3% agreeing and 40.5% disagreeing. The majority of students—who were confident in the potential advantages of AI—thought that hospitals should set aside money for AI. It is possible that the 19.7% of people who disagreed were worried about the expected return on investment in AI investments or their financial priorities. Concerns concerning AI reliability and the possible hazards of integrating AI into medical procedures were highlighted by the majority (62.2%), who felt that AI could increase diagnostic errors. Nevertheless, 28.6% disagreed, probably because they saw AI as a tool to lessen

Table 4 Level of attitudes toward AI ($n = 304$)

	Agreement		No opinion		Disagreement	
	N	%	N	%	N	%
Do you believe AI is essential in medical field?	252	82.9	10	3.3	42	13.8
Do you think AI should be included in curriculum in nursing school as well as specialist training?	240	79	13	4.3	51	16.7
Do you think that AI aids practitioner in early diagnosis and assessment of severity of disease?*	220	72.3	19	6.3	65	21.4
Do you believe that AI will replace health care providers in future?	157	51.7	16	5.3	131	43
Do you think the introduction of artificial intelligence is necessary in hospitals and health centers?	229	75.4	17	5.6	58	19.1
Do you believe AI would be a burden for practitioner?	147	48.3	34	11.2	123	40.5
Do you believe budget should be allocated for AI to be used in hospitals and health centers?	228	75	16	5.3	60	19.7
Do you believe AI would increase the percentage of errors in diagnosis?	189	62.2	28	9.2	87	28.6
						N
						%
According to you what might be the reason for reduced practice of AI in Palestine?	Lack of interest				160	52.6
	Lack of awareness				159	52.3
	Lack of curriculum				140	46
	Lack of proper training				171	56.2
	Lack of financial resources				137	45
	Lack of technological advancement				80	26.3

human error rather than create new mistakes. A lack of appropriate training (56.2%) and a lack of interest (52.6%) were the main factors contributing to the decrease in AI practices in Palestine, suggesting that education and awareness are significant obstacles. A lack of curriculum (46%) and financial constraints (45%) both had a major impact, highlighting the necessity of structural adjustments to enable AI integration. The perception of technological advancement (26.3%) was considered less significant than other criteria, indicating that infrastructure and education were more important.

Attitude toward ChatGPT

The use of ChatGPT, particularly its potential to enhance patient outcomes, patient receptiveness, and healthcare providers' views toward integrating it into their practice, was evaluated by the respondents (Table 5). With respect

to whether ChatGPT can improve patient outcomes, the students were divided almost evenly, with a majority (50.7%) expressing doubt. Most respondents (57.9%) said that patients would not be open to communicating via the ChatGPT. While 42.1% would be receptive to interacting with ChatGPT. A total of 47.7% of them, or nearly half, were uncertain about using the ChatGPT in their practice. Only 19.1% of the students were excited, whereas 23% were anxious.

Practice of AI

Table 6 summarizes how students have used AI and technology in their coursework. The majority (58.6%) had used AI, whereas 16.4% and 25% had never used it. While more than half (54.3%) considered AI simple to use, 24.7% found it difficult, possibly as a result of difficulties with comprehension or application. While just

Table 5 Attitudes toward ChatGPT ($n = 304$)

		N	%
Do you believe that ChatGPT can improve patient outcomes?	Yes	150	49.3
	No	154	50.7
Do you think that patients would be receptive to interacting with ChatGPT?	Yes	128	42.1
	No	176	57.9
How do you feel about incorporating ChatGPT into your practice?	Excited	58	19.1
	Neutral	145	47.7
	Anxious	70	23.0
	Others	31	10.2

Table 6 AI practices ($n = 304$)

	Yes		No		Never Applied	
	N	%	N	%	N	%
Have you ever applied AI technology in any field?	178	58.6	76	25.0	50	16.4
Was it easy for you to apply AI?	165	54.3	75	24.7	64	21.1
Did AI make your task easy?	178	58.6	69	22.7	57	18.8
Previous experience					Yes	No
Have you had any previous experience with AI technology?					N (%)	N (%)
					211 (69.4)	93 (30.6)
Frequency of technology Use					N	%
How often do you use technology in your academic studies?		Daily			108	35.5
		Several times a week			96	31.6
		Once a week			49	16.1
		Rarely			43	14.1
		Never			8	2.6
Comfort Level with technology						
How comfortable are you with using technology?		Very comfortable			69	22.7
		Comfortable			138	45.4
		Neutral			88	28.9
		Uncomfortable			7	2.3
		Very uncomfortable			2	0.7
Access to Technology						
Do you have access to technological resources (e.g., computers, internet) for your academic studies?		Yes, always			165	54.3
		Yes, sometimes			107	35.2
		No, rarely			24	7.9
		No, never			8	2.6
Language Proficiency						
What is your proficiency in English?		Fluent			46	15.1
		Proficient			94	30.9
		Intermediate			142	46.7
		Beginner			18	5.9
		None			4	1.3

30.6% lacked prior AI experience, a majority (69.4%) did. According to academic studies, 35.5% of participants utilized technology daily, and 31.6% used it several times per week. The majority of the students (68.1%) reported feeling either extremely comfortable or comfortable using technology. Although 10.5% of the people had access to technology only sometimes or never, 54.3% of the people had constant access. Although a tiny number had limited proficiency, which could limit their use of AI, most people had intermediate or greater English ability, which is essential for interacting with AI technologies.

Practice of the ChatGPT

Table 7 displays the results of 304 participants' responses regarding the use of ChatGPT by nurses in their practice. Among the students, 62.8% did not feel comfortable using ChatGPT for patient care, whereas 37.2% did. Among the nurses practicing, 33.9% had used ChatGPT, and 66.1% had not. Ultimately, 304 replies were classified, indicating a variety of experiences with ChatGPT in nursing practice. Of those, 75 were classified. Good

Occurrences ($n = 39$): ChatGPT is "very good," "very successful," and useful for learning nursing interventions, presentations, and care plans; however, tests and quizzes work less well. Negative Experiences ($n = 7$): A few people mentioned accuracy problems, called it "bad" or "a failed experiment," and said it gave wrong answers in the nursing field. Mixed Responses ($n = 13$): Although users found it easy to use, they were dubious about the accuracy of the information, which made them double-check or only partially trust it. No Experience ($n = 8$): Despite hearing about ChatGPT from peers, some had not utilized it. Neutral/General Responses ($n = 8$): ChatGPT is thought to be helpful for certain activities, such as reviewing protocols or looking up diseases and medications, but its applicability is sometimes considered to be limited.

Knowledge, attitudes and practices related to AI on the basis of demographic characteristics

Knowledge of AI

With respect to artificial intelligence and its applications in the medical field, there were significant differences

Table 7 Practice of ChatGPT (n = 304)

	Yes		No	
	N	%	N	%
Do you feel comfortable using ChatGPT in your patient care?	113	37.2	191	62.8
Have you ever used ChatGPT in your practice as a nurse?	103	33.9	201	66.1
Have you ever used ChatGPT in your practice as a nurse? If yes, please describe your experience using ChatGPT				
Category	Example Responses		N	
Positive Experience	"Very successful," "Very good, and make my study easy," "Help me learn nursing interventions for patients," "It was an excellent experience," "Good for presentation tips and to take ideas for care plan but bad for quizzes and tests," "It was easy to reach the information that I wanted, since the program answers your exact question," "Very useful when you want ideas for how to do your assignments."		39	
Negative Experience	"Don't give a correct answer in nursing," "Bad," "For cheating, and it's bad," "Very bad," "I failed because of it" It is only somewhat useful because it does not solve the questions correctly. "A failed experiment."		7	
Mixed Feedback	"In terms of usability, it was good and easy, but in terms of information, some of it was not accurate," "I did some search on data sheets and care plans to verify some information," "It's easy to use and makes it easy to find information, but I don't fully trust it for nursing."		13	
No Experience	"I don't use it," "I do not have any experience, but my friend told me about it," "I heard about it but never used it," "I never used it."		8	
Neutral/General	"Answer me about ask practice," "Reviewing the procedures we take for the patient in the event of a specific illness," "Look for information about certain diseases or certain medications," "Sometimes it's tricky, you can use it for general information."		8	
Total			75	

between males and females in terms of female sex ($p < 0.05$). However, there were no significant differences in terms of their overall knowledge. Details are provided in Table 8. The results of an ANOVA revealed that third-year students aged 23–27 years had high levels of AI knowledge, but there were no significant differences in terms of where they attended university and lived. Table 10 presents the p values obtained via ANOVA.

AI attitudes

Table 9 shows that there was no statistically significant difference in attitudes between males and females ($p > 0.05$). Table 10 shows that there was no significant difference in attitudes across the age groups ($p = 0.144$). There is no significant change in attitude depending on where you live ($p = 0.486$). The attitudes toward AI varied significantly across university levels ($p = 0.022$). First-year students scored the lowest ($M = 27.25$), and fourth-year students scored the highest ($M = 29.99$) in terms of attitudes. There was no significant difference in attitudes according to university ($p = 0.178$).

Practice of AI

There was no statistically significant difference ($p > 0.05$) in the difference in AI practices between males and females, as indicated by a p value of 0.108. Age did, however, significantly differ in AI practice ($p = 0.000$), with the 23–27 age group exhibiting the lowest levels of practice. There was no significant variation in AI usage across residences ($p = 0.203$). There was a significant difference between university levels ($p = 0.000$), with fourth-year students exhibiting the least amount of practice ($M = 4.25$). With respect to university, there was no significant difference in AI practices ($p = 0.694$). The practice questionnaire was notable for having a scale with 1 denoting yes and 2 denoting no.

Knowledge, attitudes and practices of the ChatGPT on the basis of demographic characteristics

Knowledge of ChatGPT

There was no significant difference in the level of familiarity with ChatGPT between males and females, as indicated by the gender p value of 0.882. The age-related p

Table 8 Knowledge of AI based on gender ($n = 304$)

		Gender		P
		Male	Female	
Do you know what artificial intelligence is?	Yes	69	188	0.032
	No	14	18	
	I don't know	6	9	
Do you know about machine learning and deep learning (subtypes of AI)?	Yes	43	117	0.649
	No	38	68	
	I don't know	8	30	
Do you know about any application of AI in medical field?	Yes	39	123	0.027
	No	37	72	
	I don't know	13	20	
Have you ever been taught about Artificial intelligence in the college?	Yes	35	92	0.961
	No	47	104	
	I don't know	7	19	
Do you think that artificial intelligence can support the educational process?	Yes	62	158	0.518
	No	17	35	
	I don't know	10	22	
Sum of knowledge of AI* Gender				0.065

P values based on Chi Square

Table 9 Attitudes toward and practices of AI by gender ($n = 304$)

		Attitude of AI				Practice of AI			
		M	SD	T	P	M	SD	T	P
Gender	Male	29.33	6.928	0.422	0.674	4.56	1.895	-1.617	0.108
	Female	28.98	5.577			4.97	2.205		

P values based on Independent t test

Table 10 Knowledge, attitudes and practices related to AI on the basis of demographic characteristics ($n = 304$)

Variable		Knowledge				Attitude				Practice			
		M	SD	F	P	M	SD	F	P	M	SD	F	P
Age	Below 19	8.944	1.999	8.784	0.000	27.20	5.590	1.817	0.144	5.81	2.068	7.369	0.000
	19–22 years	7.330	2.081			29.24	5.873			4.89	2.150		
	23–27 years	6.581	1.361			29.23	6.376			3.45	0.995		
	28 and more	6.921	2.842			31.23	7.574			4.92	2.290		
Living Place	City	7.455	2.213	0.129	0.879	28.70	6.676	0.724	0.486	5.03	2.236	1.602	0.203
	Village	7.389	2.109			29.42	5.486			4.81	2.097		
	Refugee Camp	7.647	1.766			28.12	6.382			4.06	1.435		
University level	First year	8.437	1.962	8.564	0.000	27.25	5.676	3.261	0.022	5.86	2.313	9.885	0.000
	Second year	7.628	1.720			29.16	5.810			5.14	2.221		
	Third year	6.984	1.714			29.25	5.735			4.72	1.964		
	Fourth year	7.016	2.315			29.99	6.196			4.25	1.832		
University	Al Quds University	6.909	2.296	1.205	0.300	30.69	5.891	1.470	0.178	4.42	1.912	0.675	0.694
	Arab American University	7.405	2.348			30.24	6.227			4.71	2.156		
	Modern University College	7.577	1.912			28.59	5.568			4.99	2.121		
	An-Najah University	7.947	2.549			27.26	6.814			5.32	2.562		
	Palestine Ahliya University	6.941	1.713			27.53	5.702			4.59	1.906		
	AL- Rawda College	7.250	1.970			29.45	6.203			5.15	2.301		
	Polytechnic University	8.267	2.404			27.67	7.355			4.73	2.086		
	Nablus University	7.462	2.145			28.92	6.006			5.08	2.431		

M Mean, SD Standard Deviation, P values based on ANOVA Test

value was 0.066, indicating that there was no significant difference in ChatGPT knowledge according to age. There was no significant variation in ChatGPT knowledge based on living place, as indicated by the p value of 0.056 for living place. The university-level p value is 0.000, indicating significant variation in ChatGPT knowledge across year levels, with fourth-year students being more familiar. A statistically significant variation in the level of acquaintance with ChatGPT among institutions is indicated by the p value of 0.005 for university affiliation. In support of Al Quds University, Modern University College, and Arab American University, in that order. (See Table 11).

Attitude of ChatGPT

The p value was 0.042, indicating a significant difference between males and females, with males being more likely to believe that ChatGPT can improve patient outcomes. The p value (0.015) was significantly different, with younger participants (19–22 years) being more likely to believe that ChatGPT can improve patient outcomes. The p value (0.022) indicates a significant difference in living place, with those from villages being more likely to believe that ChatGPT can improve patient outcomes. The p value (0.000) was highly significantly different, with fourth-year students being most likely to believe that ChatGPT can improve outcomes. The p value (0.010)

indicates a significant difference in responses based on university affiliation in favor of Modern University College, Al-Quds University and Arab American University. In the case of patient receptivity, the results revealed significant differences at the university level ($p = 0.000$), with fourth-year students being most optimistic about patient receptivity and university affiliation ($p = 0.018$) in favor of Modern University College, Al-Quds University and Arab American University, respectively, but not in terms of gender, age, or living place. The p value (0.022) was significantly different, with those from villages being more likely to feel anxious or neutral about incorporating ChatGPT. The p value is 0.000, indicating a significant difference across university levels, with fourth-year students being more excited about incorporating ChatGPT. The p value is 0.029, indicating a significant difference in excited attitudes toward incorporating ChatGPT into practice on the basis of university affiliation in favor of Modern University College, Al-Quds University and Arab American University. (See Table 12).

Practice of the ChatGPT

In practice, there were significant differences in ChatGPT usage according to university level ($p = 0.028$), with fourth-year students using it more frequently. There were no significant differences observed in other characteristics, including sex, age, place of residence, and university

Table 11 Knowledge of ChatGPT ($n = 304$)

		How familiar are you with ChatGPT?			P
		Very familiar	Somewhat familiar	Not at all familiar	
Gender	Male	23	44	22	0.882
	Female	61	105	49	
Age	Below 19	4	21	11	0.066
	19–22 years	66	106	52	
	23–27 years	13	14	4	
	28 and more	1	8	4	
Living Place	City	33	56	23	0.056
	Village	49	87	39	
	Refugee Camp	2	6	9	
University level	First year	7	38	26	0.000
	Second year	6	24	13	
	Third year	18	34	12	
	Fourth year	53	53	20	
University	Al Quds University	26	18	11	0.005
	Arab American University	15	22	5	
	Modern University College	17	68	38	
	An-Najah University	6	9	4	
	Palestine Ahliya University	3	9	5	
	AL- Rawda College	7	10	3	
	Polytechnic University	4	8	3	
	Nablus University	6	5	2	

P values based on Chi Square

affiliation. Gender ($p = 0.007$), age ($p = 0.006$), and university level ($p = 0.006$) significantly impacted how comfortable participants felt in using ChatGPT for patient care; men, older participants, and fourth-year students felt more at ease. Residence and university associations did not significantly differ. See Table 13.

Discussion

Insights into the knowledge, attitudes, and practices of Palestinian nursing students toward AI

The findings of this study offer valuable perspectives on the knowledge, attitudes, and practices (KAPs) of nursing students in Palestinian universities regarding artificial intelligence (AI), with a particular focus on ChatGPT. The integration of AI into medical education is rapidly advancing on a global scale, with institutions worldwide exploring its potential to enhance learning, improve clinical decision-making, and address healthcare workforce shortages [4, 9]. In countries with well-established AI infrastructure, such as the United States, Canada, and parts of Europe, AI-driven education is increasingly prevalent. These regions incorporate machine learning, virtual standardized patients, and AI-assisted diagnostics into medical curricula [11]. These advancements have significantly transformed learning experiences,

enhancing diagnostic accuracy, streamlining clinical training, and influencing students' career outlooks [15].

Despite this global progress, AI adoption in medical education remains a challenge in the Middle East, including Palestine. Unlike Western counterparts, many universities in the region face limitations in AI-focused curricula, insufficient training opportunities, and infrastructural barriers that hinder large-scale implementation [7]. While some advancements have been made in Jordan, Lebanon, and the Gulf region, disparities persist due to variations in resources, faculty expertise, and institutional policies [6, 13].

Discussion

Bridging global trends with the Palestinian context

This study reveals that Palestinian nursing students demonstrate a high level of AI awareness (84.5%) and acknowledge its significance in medical education. However, structured AI education remains scarce, with 69.9% of students reporting no formal exposure to AI training. This knowledge gap aligns with broader trends in the Middle East, where AI remains underutilized due to economic, infrastructural, and educational barriers. In contrast, students in AI-integrated healthcare systems, such as those in the United States and Germany, benefit from

Table 12 Attitude of ChatGPT ($n = 304$)

		Do you believe that ChatGPT can improve patient outcomes?		P	Do you think that patients would be receptive to interacting with ChatGPT?		P	How do you feel about incorporating ChatGPT into your practice?				P
		Yes	No		Yes	No		Excited	Neutral	Anxious	Others	
Gender	Male	52	37	0.042	41	48	0.370	18	45	14	12	0.603
	Female	98	117		87	128		40	100	56	19	
Age	< 19	9	27	0.015	9	27	0.071	5	15	9	7	0.672
	19–22	120	104		103	121		44	106	53	21	
	23–27	14	17		10	21		6	16	7	2	
	≥ 28	7	6		6	7		3	8	1	1	
Living Place	City	50	62	0.022	42	70	0.082	20	50	24	18	0.022
	Village	96	79		82	93		33	92	40	10	
	Refugee Camp	4	13		4	13		5	3	6	3	
University level	First	16	55	0.000	16	55	0.000	9	22	23	17	0.000
	Second	20	23		12	31		7	21	8	7	
	Third	35	29		28	36		12	29	20	3	
	Fourth	79	47		72	54		30	73	19	4	
University	Al Quds	32	23	0.010	28	27	0.018	11	32	12	0	0.029
	Arab American	28	14		24	18		9	26	6	1	
	Modern University College	44	79		37	86		18	48	32	25	
	An-Najah	11	8		10	9		5	6	6	2	
	Palestine Ahliya	7	10		6	11		5	8	3	1	
	AL- Rawda College	11	9		12	8		4	10	5	1	
	Polytechnic	9	6		6	9		3	8	3	1	
	Nablus	8	5		5	8		3	7	3	0	

P values based on Chi Square

structured exposure to AI tools, including ChatGPT-based simulations and clinical decision-support systems, which fosters greater confidence in AI applications [10]. The absence of AI-focused curricula in Palestinian universities mirrors findings from other Middle Eastern institutions, where students express strong optimism about AI (79%) but struggle with its practical implementation. In comparison, countries that invest in AI-driven medical education report higher student engagement, improved diagnostic capabilities, and shifts in career perspectives as AI competencies become increasingly essential in modern healthcare roles [16].

Impact on career choices

A key global concern is whether AI will replace or complement healthcare professionals. This debate is particularly relevant in Palestine, where students, despite limited exposure to AI in clinical training, express a willingness to adopt it. Findings indicate that 51.7% of students believe AI could replace healthcare providers, while 43%

disagree, reflecting a level of uncertainty similar to that observed in international studies [15].

In regions with strong AI infrastructure, students tend to view AI as a collaborative tool that enhances decision-making rather than a threat to employment. For example, medical students in South Korea and Germany report that AI enhances diagnostic efficiency, reduces physician workload, and improves patient outcomes without diminishing the human role in healthcare [16]. However, Palestinian students expressed concerns about AI's potential for diagnostic errors (62.2%) and its impact on future job security.

To address these concerns, integrating AI-focused training into Palestinian nursing education—following successful models from AI-integrated curricula elsewhere—could help bridge the knowledge-to-practice gap. This approach would enable students to develop confidence in AI applications while addressing concerns regarding AI's reliability, accessibility, and practical implementation in healthcare.

Table 13 Practice of ChatGPT ($n = 304$)

		Have you ever used ChatGPT in your practice as a nurse?			P	Do you feel comfortable using ChatGPT in your patient care?			P
		Yes	No	Never Applied		Yes	No	Others	
Gender	Male	31	58		0.461	43	46		0.007
	Female	72	143			70	145		
Age	< 19	8	28		0.318	6	30		0.006
	19–22	80	144			85	139		
	23–27	12	19			13	18		
	≥ 28	3	10			9	4		
Living Place	City	37	75		0.596	39	73		0.330
	Village	62	113			70	105		
	Refugee Camp	4	13			4	13		
University level	First	14	57		0.028	11	60		0.000
	Second	14	29			15	28		
	Third	26	38			25	39		
	Fourth	49	77			62	64		
University	Al Quds	18	37		0.055	24	31		0.077
	Arab American	22	20			21	21		
	Modern University College	32	91			32	91		
	An-Najah	10	9			7	12		
	Palestine Ahliya	4	13			7	10		
	AL- Rawda College	7	13			8	12		
	Polytechnic	5	10			7	8		
	Nablus	5	8			7	6		

P values based on Chi Square

Knowledge of AI and ChatGPT

The study identified a significant knowledge gap, with 46.7% of respondents unfamiliar with AI's applications in the medical field. This finding aligns with [7], which reported limited AI curriculum integration in Lebanese medical schools. Moreover, only 41.8% of students had received any formal AI instruction, reinforcing existing literature that calls for stronger curricular support for AI in medical training [6].

Similarly, knowledge of ChatGPT followed the same pattern, with 69% of students reporting no formal education on its use. Despite growing awareness of AI, these findings highlight the need for structured educational programs that focus on AI's practical applications in healthcare settings.

Attitudes toward AI and ChatGPT

Overall, students held positive attitudes toward AI, with 82.9% considering it crucial for the medical field and 79% supporting its inclusion in nursing curricula. These findings are consistent with [11], which reported similar enthusiasm among nursing students toward incorporating AI into practice.

However, concerns about AI reliability were notable, with 62.2% of students believing AI could increase diagnostic errors. This apprehension aligns with [16], which found that medical students feared AI might lead to misdiagnoses or replace human decision-making. These concerns underscore the importance of equipping students with the skills necessary to critically engage with AI, ensuring its ethical and safe integration into healthcare.

Regarding ChatGPT, students' confidence in using the tool for patient care was divided. While 37.2% felt comfortable utilizing ChatGPT in practice, a majority (62.8%) expressed concerns about accuracy and trust. These findings mirror those of [12], where students demonstrated high behavioral engagement with AI tools like ChatGPT but raised usability and accuracy concerns.

Practices in AI and ChatGPT use

In terms of practical application, 58.6% of students had used AI, with over half finding it easy to apply in their academic or professional tasks. This aligns with findings from [4], which emphasized AI's role in personalizing educational experiences for healthcare professionals.

Despite this engagement with AI, only 33.9% of students had used ChatGPT in their nursing practice. This

limited adoption suggests a need for increased practical exposure and training, as ChatGPT has the potential to streamline administrative tasks, provide real-time support in patient management, and foster critical thinking, as outlined by [13, 21].

Limitation of the study

Despite the valuable insights provided by this study on the knowledge, attitudes, and practices of Palestinian nursing students regarding AI and ChatGPT, several limitations must be acknowledged. The study employed a cross-sectional design, which captures data at a single point in time. While this approach effectively provides a snapshot of students' perceptions and experiences, it limits the ability to establish causal relationships between AI awareness, attitudes, and actual usage trends. A longitudinal study would be more effective in tracking changes over time, providing a deeper understanding of how exposure to AI in education influences students' knowledge, attitudes, and practices in the long run.

Additionally, the study utilized a convenience sampling technique, which, while practical, introduces selection bias and limits the generalizability of the findings. The sample may not fully represent all nursing students across Palestine, particularly those from universities that were not included in the study. This sampling method may also overlook the perspectives of students who have had different levels of exposure to AI, leading to potential gaps in the data. Future studies should consider employing randomized or stratified sampling techniques to enhance the representativeness of the sample.

Another limitation stems from the reliance on self-reported data collected through an online questionnaire. While self-reporting is an efficient means of gathering large-scale data, it is prone to social desirability bias, where participants may overestimate their AI knowledge or engagement due to perceived expectations. Additionally, recall bias may affect responses, particularly regarding past AI training or experiences. This reliance on subjective data highlights the need for complementary qualitative methods, such as interviews or focus groups, to gain deeper insights into students' actual interactions with AI technologies.

The study also underscores the limited integration of AI within nursing curricula, making it difficult to assess the direct impact of structured AI training on students' competencies. While the findings suggest a strong interest in AI education, there is little institutional support for formal AI courses in nursing programs. This gap calls for further research into the effects of AI-specific training on students' preparedness and skill acquisition. Future studies could evaluate the impact of AI-focused coursework through experimental research or intervention-based

studies that assess learning outcomes before and after AI training.

Moreover, institutional and technological constraints present another challenge to AI adoption. The findings indicate that financial limitations, inadequate training programs, and a lack of AI infrastructure hinder the widespread integration of AI tools in nursing education. However, this study does not extensively explore the institutional policies, administrative support, or infrastructural challenges that influence AI adoption in Palestinian universities. Further research is needed to examine these factors in detail, particularly through qualitative investigations that engage faculty members, policymakers, and students in discussions about the practical barriers to AI integration.

Lastly, while the study assesses students' familiarity with AI and ChatGPT, it does not extensively analyze how AI tools are currently integrated into clinical practice or their direct impact on patient care. Future research should explore practical AI applications in greater depth, incorporating case studies or AI-driven simulations that provide real-world insights into the effectiveness of AI in nursing education and practice.

Future research

Future research should focus on addressing the limitations identified in this study by adopting a longitudinal approach to track changes in students' AI knowledge, attitudes, and practices over time. Experimental and intervention-based studies could assess the impact of AI-focused training programs on nursing students' competency and preparedness for AI integration in healthcare. Additionally, qualitative research involving faculty members, policymakers, and students could provide deeper insights into the institutional and infrastructural barriers to AI adoption in nursing education. Comparative studies across different regions would also be valuable in understanding how economic, cultural, and policy differences influence AI implementation in medical training. Furthermore, exploring practical applications of AI in clinical settings through simulations, case studies, and hands-on training could provide empirical evidence on AI's effectiveness in improving patient care and decision-making. Integrating mixed-methods research would offer a more comprehensive perspective on the role of AI in nursing education and support evidence-based policy recommendations for its sustainable implementation.

Practical implications

The findings suggest several implications for the integration of AI into nursing education in Palestine and similar contexts. First, positive attitudes toward AI and the willingness to engage with tools such as ChatGPT indicate

readiness among students for more comprehensive AI-focused curricula. This is supported by global trends calling for curricular reforms in medical education, as noted by [6] and [7]. However, the concerns raised around AI reliability and diagnostic accuracy highlight the need for training programs that emphasize critical use and ethical considerations of AI in clinical practice.

To bridge the gap between knowledge and practice, it is crucial to develop structured learning experiences that not only introduce AI concepts but also offer hands-on experiences with tools such as ChatGPT. As suggested by [14], experiential learning in AI can significantly increase students' confidence and competence, ensuring that future healthcare professionals are well prepared to navigate the evolving landscape of AI in healthcare. Moreover, addressing infrastructural and financial challenges, as indicated by 45% of the students citing financial constraints, will be essential for facilitating broader AI integration in medical training programs across Palestine.

Conclusion

This study highlights the varying levels of AI knowledge, attitudes, and practices among nursing students in Palestine. While most students are familiar with AI concepts, formal education on the subject remains limited. Optimism about AI's potential to improve healthcare is predominant, although concerns about reliability and integration persist. ChatGPT, while familiar for its potential in patient care, faces mixed responses regarding its use, with some students uncertain about its effectiveness. In practice, many students have not yet fully integrated AI tools like ChatGPT into their clinical routines, with some expressing hesitance due to accuracy concerns. Barriers to AI adoption include inadequate training, lack of curriculum, and financial constraints, highlighting the need for structural reforms to fully integrate AI into healthcare education and practice.

Abbreviations

AI Artificial Intelligence
KAP Knowledge, Attitudes, and Practices

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12912-025-02913-4>.

Supplementary Material 1.

Acknowledgements

The authors would like to thank all students who participated in the study.

Authors' contributions

CRedit authorship contribution statement Nisreen Salama: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. Rebhi Bsharat:

Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. Abdallah Alwawi: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. Zuheir N. Khlaif: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing.

Funding

This writing received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Scientific and Ethical Research Committee at the Palestinian Universities. Participants were informed that their involvement was voluntary, and data collection commenced only after ethical approval was granted. All procedures adhered strictly to relevant standards and regulations, including the Declaration of Helsinki. Informed consent was obtained from all participants, and data was collected using a self-reported online questionnaire.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Faculty of Nursing, Arab American University, Jenin, Palestine. ²Nursing College, Ramallah, Palestine. ³Nursing Department, Al-Quds University, Jerusalem, Palestine. ⁴Faculty of Humanities and Educational Sciences, A Najah National University, Nablus, Palestine.

Received: 7 November 2024 Accepted: 1 March 2025

Published online: 11 March 2025

References

- Kolachalama VB, Garg PS. Machine learning and medical education. *NPJ Digit Med*. 2018;1(1):54.
- Londhe VY, Bhasin B. Artificial intelligence and its potential in oncology. *Drug Discov Today*. 2019;24(1):228–32.
- Gunawan J. Exploring the future of nursing: Insights from the ChatGPT model. *Belitung Nurs J*. 2023;9(1):1–5.
- Randhawa GK, Jackson M. The role of artificial intelligence in learning and professional development for healthcare professionals. *Healthc Manage Forum*. 2020;33(1):19–24. <https://doi.org/10.1177/0840470419869032>.
- Maicher KR, Zimmerman L, Wilcox B, Liston B, Cronau H, Macerollo A, et al. Using virtual standardized patients to accurately assess information gathering skills in medical students. *Med Teach*. 2019;41(9):1053–9.
- Al Saad MM, Shehadeh A, Alanazi S, Alenezi M, Eid H, Alfaouri MS, Alenezi R. Medical students' knowledge and attitude towards artificial intelligence: an online survey. *Open Public Health J*. 2022;15(1).
- Doumat G, Daher D, Ghanem N-N, Khater B. Knowledge and attitudes of medical students in Lebanon toward artificial intelligence: a national survey study. *Front Artif Intell*. 2022;5:1015418.
- Omar A, Shaqour AZ, Khlaif ZN. Attitudes of faculty members in Palestinian universities toward employing artificial intelligence applications in higher education: opportunities and challenges. *Front Educ*. 2024;9:1414606.

9. Demaidi MN. Artificial intelligence national strategy in a developing country. *AI & SOCIETY*. 2023;1–13.
10. Khumrin P, Ryan A, Judd T, Verspoor K. Diagnostic Machine Learning Models for Acute Abdominal Pain: Towards an e-Learning Tool for Medical Students. *Stud Health Technol Inform*. 2017;245:447–51.
11. Barghot M, Abusakran MN, Hamad MH, Sourani AIEL. The Role of Scientific Research in Developing Educational Policies for Higher Education Institutions. *An-Najah Univ J Res - B (Humanities)*. 2024;38(6):1259–88.
12. Khlof M. Impact of employing artificial intelligence on media institutions in Palestine from the viewpoint of those in charge of communication. *An-Najah Univ J Res - B (Humanities)*. 2024;38(6):1093–120.
13. Ahmed Z, Bhinder KK, Tariq A, Tahir MJ, Mehmood Q, Tabassum MS, et al. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Pakistan: A cross-sectional online survey. *Ann Med Surg*. 2022;76:103493.
14. Labrague LJ, Aguilar-Rosales R, Yboa BC, Sabio JB, de Los Santos JA. Student nurses' attitudes, perceived utilization, and intention to adopt artificial intelligence (AI) technology in nursing practice: a cross-sectional study. *Nurse Educ Pract*. 2023;73:103815.
15. Ajlouni AO, Wahba FAA, Almahaireh AS. Students' Attitudes Towards Using ChatGPT as a Learning Tool: The Case of the University of Jordan. *Int J Interact Mob Technol*. 2023;17(18).
16. Khlaif ZN, Alkhouk WA, Salama N, Abu EB. Redesigning Assessments for AI-Enhanced Learning: A Framework for Educators in the Generative AI Era. *Educ Sci*. 2025;15(2):174.
17. Irwin P, Jones D, Fealy S. What is ChatGPT and what do we do with it? Implications of the age of AI for nursing and midwifery practice and education: An editorial. *Nurse Educ Today*. 2023;127:105835.
18. Abujaber AA, Abd-Alrazaq A, Al-Qudimat AR, Nashwan AJ. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of ChatGPT Integration in Nursing Education: A Narrative Review. *Cureus*. 2023;15(11):e48643.
19. Park SH, Choi J, Byeon J-S. Key principles of clinical validation, device approval, and insurance coverage decisions of artificial intelligence. *Korean J Radiol*. 2021;22(3):442.
20. PintodosSantos D, Giese D, Brodehl S, Chon SH, Staab W, Kleinert R, et al. Medical students' attitude towards artificial intelligence: a multicentre survey. *Eur Radiol*. 2019;29:1640–6.
21. Awadallah Alkhouk W, Khlaif ZN. AI-resistant assessments in higher education: practical insights from faculty training workshops. *Front Educ*. 2024;9:1499495.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.