

Navigating Challenges: Educational Interventions To Improve Nursing Students' Understanding and Acceptance of Artificial Intelligence

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Abstract:

Background: The integration of Artificial Intelligence (AI) into healthcare education and practice marks a significant advancement. This study aimed to evaluate the effect of educational guidelines on nursing students' knowledge, attitudes, and barriers related to AI. **Methods:** A quasi-experimental design was utilized, involving a convenience sample of 600 undergraduate nursing students at Sohag University. Data was collected using three questionnaires: knowledge regarding AI, attitudes toward AI, and barriers hindering AI utilization. Pre- and post-intervention assessments were conducted. **Results:** The intervention resulted in a statistically significant improvement in knowledge (pre-test mean: 7.02 ± 0.78 ; post-test mean: 12.22 ± 1.56 , $p < 0.001$) and attitudes (pre-test mean: 30.65 ± 2.04 ; post-test mean: 43.08 ± 1.78 , $p < 0.001$). Barriers to AI use decreased from a mean of 7.03 ± 0.55 to 4.52 ± 1.43 ($p < 0.001$). A strong positive correlation was found between knowledge and attitudes ($r = 0.657$, $p < 0.01$). **Conclusion:** This study concluded that the educational guidelines had a significant effect on improving the studied undergraduate Nursing Students' knowledge, attitudes, and barriers hindering the use of artificial intelligence. **Recommendations:** The educational guidelines significantly enhanced nursing students' knowledge and attitudes towards AI while reducing perceived barriers. These findings underscore the necessity of incorporating AI training into nursing curricula to prepare future healthcare professionals for the evolving landscape of digital health.

Keywords: Artificial Intelligence; Attitude; Knowledge; Nursing students; Nursing Education & Barriers

Introduction

Artificial Intelligence (AI) is a broad term that refers to technologies that allow computer hardware and software to replicate intelligent human behavior and achieve performance comparable to that of humans ¹. AI-driven technologies have been adopted across various fields, including law, finance, computer science, and industrial manufacturing ². This swift growth and advancement of AI have led to its application in the medical sector. For example, AI has been utilized in oncology for cancer diagnosis and grading ³, as well as in gastroenterology through endoscopes for identifying and diagnosing pathological lesions. Additionally, AI has been integrated into the education and training of nursing students. A notable example is the development of a computer-aided learning system designed to enhance diagnostic skills in health professions students by training a machine learning model on numerous clinical cases. Furthermore, Virtual Patients have emerged as an effective virtual counseling tool for undergraduate nursing students, helping them to build communication skills before interacting with actual patients and healthcare professionals during their clinical placements ⁴.

Three types of artificial intelligence are utilized in hospitals: natural language processing, which is the most recent and involves the fusion of linguistics and artificial intelligence and includes intelligent analysis of written language; deep learning, which is a machine learning approach and neural network extension; and machine learning, which is a statistical technique set for problem-solving ⁵. Egypt has become a safer place to live and do business and to achieve Egypt's Vision 2030, the country has begun to adopt AI and technology in various sectors. The government is becoming more intrusive in sparking the growth of AI through initiatives aimed at boosting research and development within its borders. Regarding an Egyptian society powered by AI and robotics, the government has set a general target of 7.7% of Egypt's Gross Domestic Product to be derived from AI and robotics by 2030 ⁶.

Artificial intelligence has the potential to revolutionize the nursing industry and have a significant impact on healthcare delivery. By leveraging AI technology, nursing professionals can improve patient care, optimize workflows, improve decision-making, and transform the way healthcare is delivered ⁷. AI is expected to help provide proactive patient care and reduce future risks for patients, nurses, and the entire profession. As a result, research into the use of AI technology in healthcare settings is increasing. Nurses have varying attitudes and feelings about adopting AI technology ⁸. The way that nursing students view their work affects how they help patients through their challenges. The goal of the nursing process is to provide comprehensive care, and the skills and traits of certain medical health nurses can influence the standard of care and help them comprehend patients and resolve challenges. Solving problems is the ability to find suitable and workable answers to problems that come up in daily life. By employing problem-solving techniques, a person or group can improve their concentration and abilities ⁹.

These days, the main AI applications used in nursing practice are speech recognition, data mining, and physical deterioration prediction. Future advancements in AI technology, however, will enable nurses to provide individualized, evidence-based treatment by integrating relevant data ¹⁰. Because nurses collaborate closely with patients and ensure that diagnosis and treatment plans are successful, they play a crucial role in the delivery of healthcare. Nurses perform a variety of daily responsibilities, such as updating patient charts, recording and monitoring vital signs, assisting with physical examinations, and facilitating communication among patients, nursing staff, and administrative personnel. According to Liu et al. (2022) ¹¹, AI-driven medical information processing has the potential to improve nursing care management.

Expert systems, heuristic problem-solving, natural language processing, and vision are the four main gears of AI. Expert systems monitor the situation as an expert and provide performance. Heuristic problem-

solving is intended to evaluate a small range of solutions and may involve some guesswork to find near-optimal solutions. Natural language processing facilitates human-machine communication. Vision is the capacity to recognize shapes and features automatically ¹². As a key to student success in higher education, student knowledge and attitudes regarding artificial intelligence have received much attention over the past decade from administrators, practitioners, and researchers ¹³. Thus, in prevailing times, attitude is expressed as a "psychological tendency, expressed by the evaluation of a certain entity with some degree of favor or disfavor." It consists of three complementary components: the emotional component means constructive–undesirable emotional relationships or moods that a person experiences towards a thing or action; the cognitive component represents the satisfaction of our thoughts, such as our beliefs about what founds a fact, while the behavioral component shows the action patterns to which we must respond while performing an object in a particular way ¹⁴.

The growing use of AI in nursing presents both advantages and challenges. While AI has the potential to cause harm to patients, nurses, and their careers, it also offers significant benefits to the profession. As a powerful tool, AI can enhance the quality of care, improve patient outcomes, increase efficiency, and lower healthcare costs. By analyzing large volumes of data, AI can assist nurses in making informed decisions and create personalized care plans for patients. A key advantage of AI in nursing is its ability to evaluate patient data, detect potential health risks, and notify nurses of issues before they escalate, thereby reducing the likelihood of medical errors and malpractice ¹⁵⁻¹⁷. Additionally, AI can support and enhance the tasks of nurses, who possess essential emotional and interpersonal skills critical for delivering comprehensive healthcare. Nurses are tasked with assessing patients' overall health, deciding on suitable actions, and helping patients and their families manage health-related and emotional challenges. In essence, AI can enable nurses to carry out their responsibilities more efficiently and accurately while ensuring that the vital role of providing compassionate healthcare remains intact ^{18,19}.

The uses of AI-based technologies in nursing practice have elevated fears and public debate, with many fearing that this technology can substitute nurses. While, other major worries focused on the ethical use of these technologies, such as management data bias and the necessity to grow new perspectives on technology implementation and identifying barriers in technology approval between nurses are equally as important today. Some of these fears could be relieved by offering sufficient information about AI for users, comprehending the existing research on these technologies, and providing information regarding the ethics of AI in nursing ²⁰.

Significance of the Study:

Artificial intelligence technology will become more widely used and valuable in the healthcare industry because of factors including cost, quality, nursing results, and assistance in efficiently analyzing vast volumes of data. Few studies, nevertheless, have investigated artificial intelligence-related teaching interventions for nurses ²¹. Nursing students can remotely monitor patients' conditions in the clinical area via AI-enabled wearable devices, ensuring that these programs help AI-powered chatbots and virtual assistants communicate with patients and provide information and support, enhancing patient engagement and education. Overall, AI offers valuable tools for continuous learning and improvement in the learning field. As AI continues to evolve, its integration into education and practice is expected to become increasingly vital for the delivery of efficient and effective teaching processes ²². Although these systems have proven their effectiveness, the role of the computer has evolved from that of the teacher to that of the learning agent. Regardless of the educational model used, students used AI to learn something; they rarely learned about the AI itself. In addition, the need to develop study programs on AI so that young students can acquire knowledge on the subject is beginning to emerge ²³. Therefore, the aim of the current study was to evaluate the effect of educational guidelines on Nursing Student knowledge, attitude, and barriers hindering the use of artificial intelligence.

Hypotheses:

H1: The mean score of knowledge and attitude of nursing students regarding artificial intelligence expected to improve after educational guidelines intervention than pre-intervention

H2: The barriers hindering nursing students' use of artificial intelligence have decreased following the implementation of educational guidelines compared to pre-intervention levels.

Design & sample size

A quasi-experimental research design using one group pre/post-test was utilized to fulfill the aim of the study. The study was conducted on a convenience sample including 600 nursing students at Faculty of nursing, Sohag University enrolled in the fourth academic year (2023-2024).

Instruments & questionnaire

Three tools were utilized to collect data as follows: Tool I: Nursing Students' Knowledge Regarding Artificial Intelligence Questionnaire. This questionnaire was developed by researchers after reviewing relevant literature^{24,25} to assess nursing students' understanding of artificial intelligence. It consists of two parts: Part I: Gathers demographic information from participants, including age, gender, residence, prior training in artificial intelligence, and sources of information about AI. Part II: Evaluates the knowledge levels of nursing students regarding artificial intelligence both before and after the educational guidelines' intervention. This section includes seven items designed to assess knowledge about definition of AI, importance, how it works, types, advantages and disadvantages. Responses are scored as follows: "two marks" for complete and accurate answers, "one mark" for partially correct responses, and "zero" for incorrect answers. A score of 60% or higher indicates satisfactory knowledge of artificial intelligence, while a score below 60% reflects unsatisfactory understanding.

Tool II: Undergraduate Nursing Students' Attitudes Toward Artificial Intelligence. This tool includes an attitude-assessing section with 10 items, created by the researcher after reviewing pertinent literature²⁶⁻²⁸. The scoring for both attitude domains is based on a 5-point Likert scale, where responses range from 'strongly disagree' (1 point) to 'strongly agree' (5 points) for attitudes, and from 'never' (1 point) to 'all the time' (5 points), with a maximum possible score of 50. Attitudes are classified as negative if the score is 60% or lower, and positive if the score is 61% or higher.

Tool III: Barriers Hindering the Use of Artificial Intelligence Questionnaire. This tool was developed by the researcher after reviewing relevant literature^{29,30}. It contains eight items focusing on barriers to the use of AI. The questionnaire lists seven potential obstacles that may prevent students from integrating AI into their everyday lives, along with a "none" option for participants who do not identify any barriers. The identified barriers include insufficient knowledge about AI, lack of necessary technical tools or access, concerns about ethics and privacy, time constraints due to academic responsibilities, the perception that AI is overly complex, lack of exposure to AI in the curriculum, and limited opportunities to practice and learn AI skills.

Tools Validity and Reliability:

The researchers translated each tool from Arabic into English and back again. To evaluate the tools' face and content validity, a panel of five experts, two from the field of artificial intelligence, one in pediatric nursing, one in Medical-Surgical Nursing, and one in community health nursing tested the tools. For substance, clarity, simplicity, relevance, completeness, and applicability, the experts revised the tools. In response to their criticism, no modifications were made. Experts deemed the instruments to be legitimate. The tools' dependability was demonstrated by their strong Cronbach's alpha value (internal consistency) of 0.899 for the nursing students' knowledge 0.876 for their attitude, and 0.877 for tool three.

Pilot study:

A total of 60 undergraduate nursing students, representing 10% of the overall study sample, participated in the pilot study. The primary aim was to assess the feasibility and clarity of the study's instruments. Notably, the nursing students who participated in this pilot study were subsequently included in the main study sample, ensuring that the feedback gathered contributed to refining the tools used for the larger research effort. This preliminary phase helped enhance the reliability and relevance of the instruments, ultimately benefiting the overall study outcomes.

Administrative and Ethical Considerations:

This study received approval from the Research Ethics Committee of Sohag University's Faculty of Nursing. An official request for permission to conduct the study was sent to the director of Sohag University Hospital by the dean of the nursing faculty. Nursing students who agreed to participate provided written consent, confirming that their involvement was voluntary. It was clearly communicated to the participants that they could withdraw from the study at any time without needing to provide a reason. Additionally, measures were taken to ensure confidentiality through anonymity protection, reinforcing the ethical commitment to safeguarding participants' privacy throughout the research process. These steps helped create a trustworthy environment for the nursing students involved in the trial.

Fieldwork:

Following the acquisition of official approvals, the fieldwork commenced in early October 2023 and continued until November 2024. The researchers engaged with nursing students to explain the study's purpose, distributing the data collection tools to each participant individually. Data was collected three days a week over a span of 10 to 15 sheets, ensuring thorough documentation. Afterward, the completed tools were gathered and reviewed for accuracy and completeness. The fieldwork consisted of four distinct phases:

Assessment Phase: Once permission was granted to proceed, the researchers began recruiting nursing students from the university hospitals. They introduced themselves to each participant, provided an overview of the study's objectives and procedures, and invited them to participate. Each item on the study tools was read and explained to the nursing students, with their responses recorded. Completing the questionnaire took approximately 30 to 40 minutes, during which the researchers conducted interviews to gather baseline demographic data, as well as information for the knowledge questionnaire, attitude scale, and barriers questionnaire. Data collected during this phase informed the development of the intervention sessions. Participants were assured that all information collected would remain confidential and would only be used for research purposes.

Planning Phase: The researchers gained a comprehensive understanding of artificial intelligence by reviewing relevant literature. Based on the results from the assessment phase and the characteristics of the study sample, the content for the intervention sessions was developed. Additionally, a booklet containing verified information and illustrations was created as a self-learning resource for the nursing students involved in the study. A pamphlet summarizing key points was distributed to participants at the end of each educational session.

Creation of Educational Guidelines: The educational guidelines for artificial intelligence were structured around specific objectives:

General Objective: To enhance nursing students' knowledge and attitudes regarding artificial intelligence.

Specific Objectives: Following the educational intervention, nursing students should be able to:

- Define artificial intelligence and its characteristics within the nursing field.
- Explain the significance of artificial intelligence.
- Describe the operational mechanisms of artificial intelligence.
- Identify the advantages and strategies associated with artificial intelligence.
- Recognize barriers to the implementation of artificial intelligence.
- Enumerate the disadvantages of artificial intelligence.
- Discuss the four types of artificial intelligence.
- Explain the components involved in artificial intelligence.
- Explore applications of artificial intelligence in healthcare.
- Identify key issues related to artificial intelligence and propose solutions.
- Discuss principles governing artificial intelligence.
- Demonstrate the challenges and solutions pertaining to artificial intelligence in nursing.
- Suggest ways to enhance nurses' perceptions of artificial intelligence.

Implementation: The educational guidelines intervention was carried out for all nursing students using a question-and-response strategy to effectively convey key points. Researchers implemented the intervention in designated settings, with the goals and topics for each session tailored to the students' understanding, available time, and content requirements. All nursing students received the same materials, and a variety of instructional methods were employed, including role models, lectures, small-group discussions, and the distribution of brochure booklets. During the sessions, all computer users interacted with four videos presented on a laptop, accompanied by a PowerPoint presentation that outlined the intervention. This was followed by group discussions about the video content. Additionally, researchers facilitated feedback sessions to enhance learning. Booklets featuring engaging visuals and straightforward language were provided on CDs to assist students in grasping the material post-intervention. Each session began with a review of the previous session's content and an explanation of the current session's objectives, presented in accessible language to match the nursing students' comprehension levels. Reinforcement strategies, such as praise, were utilized to promote active engagement and enhance learning outcomes.

The sessions were structured as follows:

1. **First Session:** Researchers provided an overview of the educational guideline's intervention, outlining objectives, the number of sessions, duration, meeting locations, and schedules. A pre-test was conducted using data-gathering instruments.
2. **Second Session:** This session introduced the concept of artificial intelligence, including its definition and significance. Researchers explained how artificial intelligence underpins the development and implementation of algorithms that mimic human cognitive processes. Key characteristics of artificial intelligence and its applications in healthcare were also discussed.
3. **Third Session:** Beginning with a recap of the previous session, this discussion focused on the applications of artificial intelligence in nursing care and its mechanisms. The use of AI in analyzing complex medical data, medication discovery, treatment protocols, and patient monitoring was highlighted. Researchers emphasized how AI can handle vast amounts of data, revealing patterns that may be beyond human capability. The potential of AI to streamline tasks for patients, nurses, doctors, and hospital managers was also covered, showcasing its ability to enhance remote monitoring and improve diagnostic speed and accuracy.
4. **Fourth Session:** Participants engaged in group discussions about the benefits of artificial intelligence, such as minimizing human errors, providing 24/7 availability, assisting with repetitive tasks, and making faster decisions. Strategies for integrating artificial intelligence into healthcare were also discussed.
5. **Fifth Session:** After a review of the previous session, the challenges associated with artificial intelligence were addressed, including fears, cultural barriers, talent shortages, and the absence of a

strategic approach to adoption. Potential solutions, such as enhancing computing power and addressing data privacy concerns, were also discussed.

6. **Sixth Session:** This session included a recap and presentation of videos showcasing various forms of artificial intelligence. The researchers covered the key components of AI, including expert systems, robotics, computer vision, natural language processing, and machine learning, highlighting how these elements enable machines to learn and interact with their environment in unprecedented ways.
7. **Seventh Session:** Following a recap, the focus shifted to educating nursing students about the diverse applications of artificial intelligence and how these can benefit their practice. Examples of AI in nursing were provided, along with discussions on the challenges AI faces in healthcare and its guiding principles.
8. **Eighth Session:** This session facilitated group discussions about the challenges and opportunities AI presents in nursing, alongside strategies to enhance the positive perception of artificial intelligence.
9. **Ninth Session:** Participants engaged in discussions about AI's potential to improve nursing practice and patient outcomes, with each session lasting approximately 15 minutes.
10. **Tenth Session:** Researchers summarized the benefits of the educational guidelines' intervention and reviewed discussions from all prior sessions. This final meeting also provided a platform for nursing students to ask questions and express gratitude for their participation, establishing channels for future communication between researchers and participants.

Evaluation Phase: To assess the impact of the educational guidelines on nursing students' knowledge, attitudes, and barriers to using artificial intelligence, the same pre-test tools were administered again two months after the implementation of the educational guidelines. This comparison aimed to measure the effectiveness of the intervention in enhancing students' understanding and attitudes toward artificial intelligence.

Statistical analysis

All statistical analysis was conducted using SPSS for Windows version 20.0 (SPSS, Chicago, IL). Continuous data were assessed for normal distribution and presented as mean $\pm$ standard deviation ($\pm$ SD). Categorical data were reported in terms of frequencies and percentages. To compare variables with categorical data, the chi-square test (or Fisher's exact test, when appropriate) was utilized. The reliability (internal consistency) of the questionnaires employed in the study was also evaluated. A p-value of less than 0.05 was considered statistically significant.

Results:

Table 1 indicates demographic characteristics of nursing students. The sample consisted of 600 nursing students, 67% of the undergraduate nursing students studied were female, with 75% being over the age of 20. Additionally, 77% resided in rural areas.

Figure 1 indicates that a vast majority (92%) of nursing students had no prior training in artificial intelligence.

Figure 2 shows sources of knowledge regarding artificial intelligence. It is clear that the primary source of knowledge about AI for most students was the Internet (80%), followed by TV (12%) and doctors (8%).

Table 2 Mean scores of nursing students' knowledge, attitude, and barriers hindering AI Use. There is a statistically significant improvement in knowledge (from 7.02 to 12.22) and attitude scores (from 30.65 to 43.08) post-intervention, alongside a reduction in barriers (from 7.03 to 4.52), indicate the effectiveness of the educational guidelines ($p < 0.001$).

Figure 3 illustrates that before the educational intervention, only 12% of nursing students had a satisfactory level of knowledge regarding artificial intelligence; however, this percentage rose to 92% after the intervention.

Figure 4 indicates that the proportion of students with a positive attitude was 28% before the educational intervention, which increased to 88% afterward.

Table 3 reveals the strong positive correlation ($r = 0.657$, $p < 0.01$) between total AI knowledge and attitudes suggests that increased knowledge directly influences positive attitudes.

Table 4 illustrates that the age, sex, and residence of nursing students significantly predicted their total knowledge of artificial intelligence ($p = <0.01$).

Table 5 shows that the age, sex, and residence of the nursing students also had highly significant positive effects on their attitudes toward artificial intelligence ($p = <0.01$).

Table (1): Demographic data of the undergraduate Nursing Students

Variables	n (600)	%
Age (years)		
< 20	250	25.0
> 20	450	75.0
Mean $\pm$ SD	20.6 $\pm$ 1.6	
Gender		
Male	198	33.0
Female	402	67.0
Residence		
Rural	462	77.0
Urban	138	23.0

Figure (1): Nursing students previous training in artificial intelligence

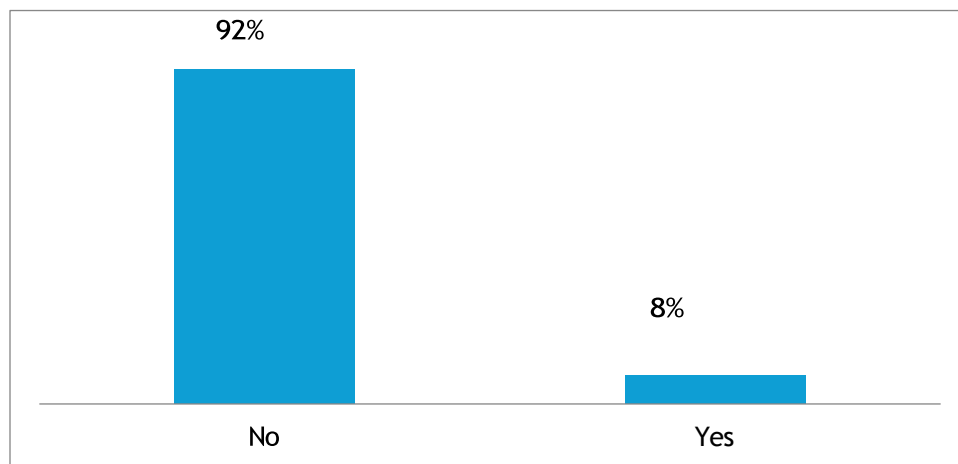


Figure (2): Nursing students Sources of knowledge regarding artificial intelligence

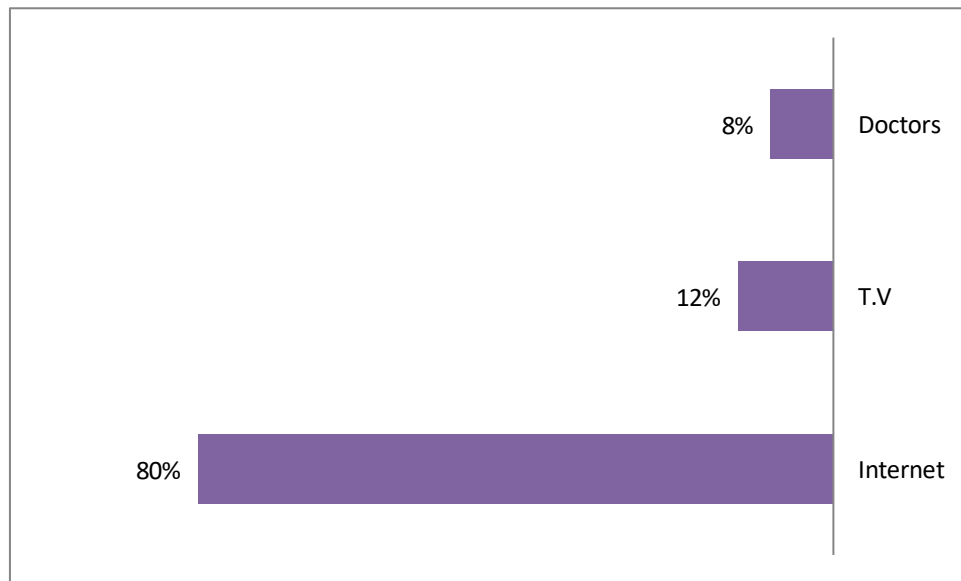


Table 2. Mean score of nursing students' knowledge, attitude and barriers hindering AI use

Items	Pre-test	Post-test	t-test	P-value
Knowledge Mean scores	7.02±0.78	12.22 ±1.56	141.33	<0.001**
Attitude Mean scores	30.65 ±2.04	43.08±1.78	65.210	<0.001**
Barriers hindering the use of AI mean scores	7.03±0.55	4.52 ±1.43	141.33	<0.001**

Figure (3): Total Knowledge Level regarding AI among nursing students pre- and post-educational guidelines intervention

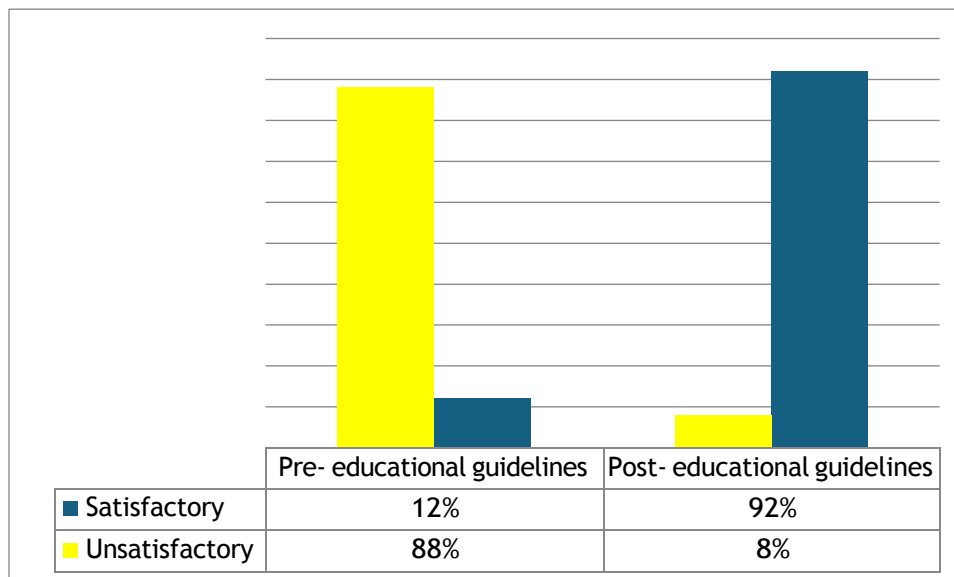


Figure (4): Total attitude Level regarding AI among nursing students pre- and post-educational guidelines intervention

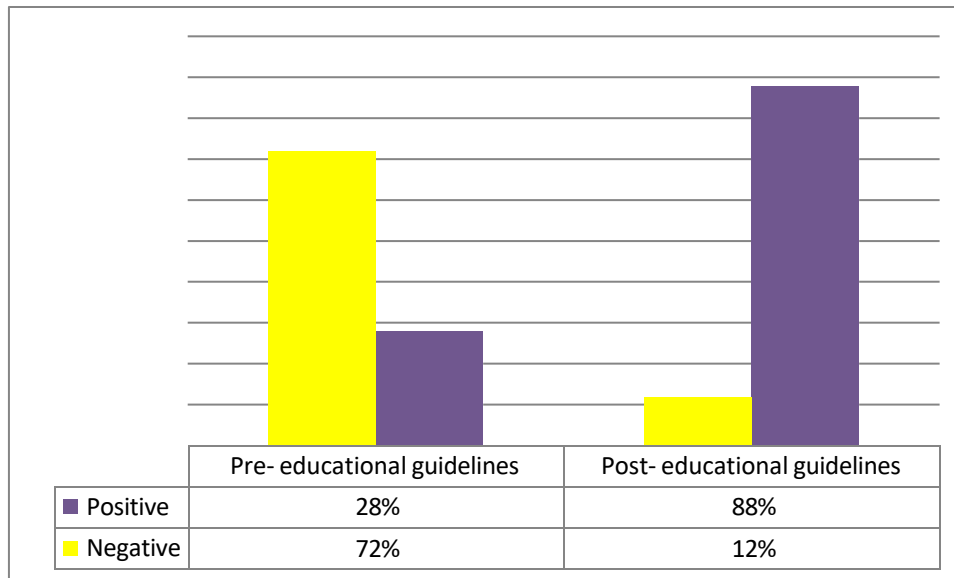


Table (3): Correlation between nursing students' total knowledge and their total attitude toward AI

Variable	Total AI knowledge
Total AI attitude	$r = 0.657 - P = 0.000^{**}$

r = correlation coefficient test. P = p-value ** highly significant at $p < 0.01$.

Table (4) Best-fitting multiple linear regression for nursing students' total AI knowledge

Items	Unstandardized Coefficients		Standardized Coefficients	t-test	P value
	B	SE	Beta		
(Constant)					
Age	0.234	0.095	0.458	4.075	<0.001*
Sex	6.035	1.713		5.213	<0.001*
Residence	0.246	0.072	0.317	3.786	<0.001*

r -square = 0.538 $f = 12.234$ P value <0.001*

Table (5) Best-fitting multiple linear regression for nursing students' total AI attitudes

Items	Unstandardized Coefficients		Standardized Coefficients	t-test	P value
	B	SE	Beta		
(Constant)					
Age	4.812	.248	0.458	4.876	.000**
Sex	3.016	.449	.334	8.921	.000**

Residence	.543	.187	0.317	9.039	.000**
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r-square = 0.538 f= 12.234 P value <0.001*

Discussion:

Nowadays AI is emerging as an innovation and getting popular due to its ability to analyze clinical data and patient details with greater amounts of research evidence for decision-making and enhance new knowledge ³¹. Because of these capacities, AI can renovate different aspects of healthcare systems in the forthcoming decades. These innovations of AI in nursing require training to transform the nursing education and practice aspects. Nurses need skills and knowledge to integrate AI knowledge into clinical practice ³². Due to rapid advances in technology, law, and patient expectations, healthcare organizations must implement AI, which can help proactively treat patients, reduce future risks, and streamline business operations. As a result of these challenges, healthcare organizations have become essential to the success and prosperity of the healthcare system by reducing organizational costs and providing high-quality services ³³. So, this study aimed to determine the effect of educational guidelines on nursing students' knowledge, attitude, and barriers hindering the use of artificial intelligence.

The present study revealed that more than two-thirds of the studied nursing students were females, and three-quarters of them their age were more than 20 years old. Additionally, more than three-quarters of them live in rural areas. These findings might be due to the profession of nursing encourages engagement. As well, previously the nursing profession used to accept only females. These results are consistent with those of an Egyptian study done by Mohamed et al. (2023) ³⁴, who found that nearly all undergraduate nursing students were female. The present study revealed that most of the undergraduate nursing students studied didn't attend previous training in artificial intelligence. From the researcher's point of view, it confirmed the need to implement this study and to update undergraduate nursing students. This confirmed that the undergraduate nursing students in the study need to adhere to the latest artificial intelligence training standards, the researchers said. This finding may be explained by the fact that most undergraduate nursing students reported that they had never taken any artificial intelligence training classes before and that the nursing curriculum did not address the concepts of AI. Few of them in the study reported having studied artificial intelligence in courses, therefore they had no prior knowledge of the topic. Furthermore, the absence of this training session is due to the failure to hold them accountable.

The present study revealed that the main source of knowledge among most nursing students about artificial intelligence was the Internet. This might be because the Internet is an invaluable resource for knowledge and learning. Its vastness, accessibility, timeliness, diversity of perspectives, and ability to connect with others make it a valuable tool for anyone seeking to expand their knowledge and understanding of the world around them. These findings are supported by those of Robinson (2020) ³⁵, in Nigeria, who mentioned that the internet has been the main source. Everybody who wants to learn more about the world they live in can benefit greatly from it because of its scope, immediacy, accessibility, diversity of perspectives, and interpersonal connectivity. These findings align with those of Robinson (2020) ³⁵, who reported that 893.2% of Nigerian sources came from the Internet. These results contrast with those of Abuzaid et al (2022) ³⁶ in Sharjah, Sharjah, USA, who found that more than half of the respondents stated their knowledge of AI was obtained through self-taught measures for most of the participants, while one-fifth of them gained it through various courses.

In the present study, findings confirmed the research hypothesis, which stated that knowledge mean scores among undergraduate nursing students improved after the educational guideline intervention in all domains. This demonstrated that the post-educational guidelines intervention phase had the highest mean scores compared to the pre-intervention. This suggests that following the educational guidelines intervention,

undergraduate nursing students' level of knowledge increased across the board. This showed that, in comparison to the pre-intervention phase, the post-educational guidelines intervention phase had the highest mean scores. According to the researchers, it demonstrated how well the orientation training had worked to increase the undergraduate nursing students' understanding of artificial intelligence. According to these findings, Sommer et al. (2024)³⁷ found that participants in a study generally lacked sufficient expertise in AI. Conversely, the findings of Mohamed et al. (2023)³⁴, found that only a small portion of head nurses had sufficient knowledge of artificial intelligence before the deployment of their study's orientation program, differed from this one.

The current study results revealed that a pre-educational guidelines intervention minority of undergraduate nursing students had unsatisfactory knowledge regarding AI. However, after educational intervention, there were statistically significant differences among all domains scores of undergraduate nursing students' knowledge of artificial intelligence between pre- and post-intervention. This indicates that the overall knowledge level of undergraduate nursing students improved after the educational guideline intervention was implemented. This increase in nurses' satisfaction toward AI, might be explained by nurses understanding the advantages and uses of AI and the value of artificial intelligence in nursing through the AI educational intervention, observe their environment, recognize objects, assist in decision-making, resolve conflicts, plan actions, learn new things, solve complex problems. In addition, it might be due to the success of the program in improving all domains of AI knowledge.

According to this, nurses' general level of knowledge increased very away after Swan (2021)¹² also investigated the attitudes and knowledge of nursing staff regarding artificial intelligence in US healthcare settings. They found that most nurses were either ignorant of or did not comprehend the use of AI in clinical practice. These results run counter to those of Sheela (2022)³⁸, who found that more than half of the participants had adequate knowledge of AI. These findings also concurred with those of Abuzaid et al. (2022)³⁶, who discovered a lack of awareness regarding AI in Sharjah, USA. Seventy-five percent of respondents believed that some fundamental knowledge of AI should be taught in nursing curricula. These outcomes were consistent with a very recent study by Mohamed et al. (2023)³⁴, which found that head nurses' mean difference scores before and after intervention and between pre-intervention and follow-up varied significantly. According to the researchers, it demonstrated the beneficial outcomes of the orientation program intervention.

The current study results revealed that the total level of knowledge concerning artificial intelligence was satisfactory among most nursing students post post-educational guidelines intervention. From the researcher's point of view, it reflected the positive effects of educational guidelines intervention. This outcome is consistent with the findings of Abuzaid et al. (2022)³⁶, who investigated the lack of technical knowledge and comprehension of AI principles in the nursing profession and came to the conclusion that healthcare organizations and higher education institutions need to develop and implement suitable AI educational and educational guidelines intervention for nursing staff to increase their competency in fostering the safe integration and application of AI into nursing practice.

The current study results revealed that there were highly statistically significant differences that were detected among all attitudes items in the two phases of intervention among undergraduate nursing students pre- and post-educational guidelines intervention. These previous results were convenient with those of Abdullah & Fakieh (2020)³⁹, aimed at identifying attitudes toward and perceptions of AI implementation in the healthcare sector among employees. The study was conducted in 4 hospitals in Riyadh, Saudi Arabia, which identified that 3.11 out of 4 respondents fear that AI will replace employees and have a general lack of knowledge regarding AI in prior intervention. In addition, most of the respondents were not aware of the most common benefits and challenges of AI applications in the health sector.

The results of the current study indicated that the total level of attitude was positive among most nursing students at post-educational guidelines intervention. From the researchers' point of view, it reflected the success of educational guidelines intervention which met the study objectives. Similarly, a study conducted by Kumari & Hemalatha (2021)⁴⁰ on "Human Resources Management Practices and Attitude of Artificial Intelligence: With Particular Reference to Chennai IT Companies" showed that workers have a positive opinion of the technology and do not see AI systems as a threat.

These outcomes were consistent with those of a very recent study conducted by Mohamed et al. (2023)³⁴, which found that the mean difference scores of head nurses were significantly different before and after intervention (25.196) and between pre-intervention and follow-up (25.033). These findings were consistent with those of Zhou (2022)⁴¹, who conducted a study to examine the application of AI in clinical nursing among Chinese nursing staff. The study's findings were excellent, and it helped advance the use of AI technology in clinical nursing. Zhou also suggested that effective application measures be developed in conjunction with the actual work content. Additionally, the study discovered that head nurses' opinions regarding AI technologies varied significantly between pre- and post-intervention.

The findings of the current study were corroborated by Elsayed and Sleem's (2021)⁴² study, "Attitudes and Perceptions of Nurse Managers about The Use of AI in Healthcare Settings," which found that over three-quarters of the sample had a moderate opinion of the use of AI in nursing settings. The minority of nurses, however, had a favorable opinion. Additionally, the study "Perceptions of Artificial Intelligence Applications by Healthcare Workers: A Survey Study" by Abdullah & Fakieh (2020)³⁹ showed that healthcare workers' general attitudes regarding AI were moderate. This could be explained, according to the researchers, by the fact that COVID-19 is giving nurses the chance to understand the advantages of using AI in nursing settings. The present study indicated that the barriers hindering the use of artificial intelligence mean scores among undergraduate nursing students decreased after the educational guideline intervention in all domains. This demonstrated that the post-educational guidelines intervention phase had the lowest mean scores compared to the pre-intervention.

Prior research has looked at barriers to the acceptance and adoption of AI by healthcare professionals but hasn't focused much on these barriers in health professions students⁴³. The barriers found in this study collectively highlight the need for comprehensive strategies to bridge the AI knowledge gap and facilitate the effective incorporation of AI. The main obstacles to the smooth integration of AI into the educational journey of health professions students in Jordan were a lack of knowledge and expertise, coupled with limited access to necessary technical equipment. Other notable challenges included concerns about the time demands of academic studies, the perceived complexity of AI technology, and its limited integration within the curriculum into medical education. Similarly, Chan & Zary, (2019)⁴⁴ reported the same results.

Furthermore, according to Sabra et al. (2023)¹⁶, less than half of nurses concurred that AI is rigid and challenging to use because of controversial issues. Elsayed & Sleem (2021)⁴² found that nurse managers' views of the advantages of implementing AI aligned with this result, with the implementation of AI in healthcare obtaining the highest mean score. In contrast, Abdullah & Fakieh (2020)³⁹ stated that the best score was related to issues pertaining to artificial intelligence applications in healthcare followed by the advantage of using artificial intelligence among healthcare employees. From the researchers' opinion, this may be due to the widespread of artificial intelligence technology applications in every aspect of society in response to Egypt's Vision 2030 which focuses on using artificial intelligence in a variety of work settings including the health care sector.

The results of the current study showed that there was a highly significant positive correlation between undergraduate nursing students' total knowledge and their total attitudes toward artificial intelligence.

According to the researchers, this outcome might be the consequence of the undergraduate nursing student's exposure to contextual cues and information that shape their perspectives about artificial intelligence. The second query, which inquired about the nurses' attitudes toward AI applications, is addressed by this finding.

Conclusion & Recommendations

The study demonstrated that educational guidelines significantly enhance nursing students' knowledge and attitudes regarding artificial intelligence (AI) while simultaneously reducing barriers to its use. Post-intervention results indicated a marked improvement in both knowledge and attitudes, suggesting that structured educational interventions can effectively prepare nursing students to integrate AI into their practice. The findings underscore the importance of incorporating AI training into nursing education to ensure that future healthcare professionals are equipped with the necessary skills to leverage technology in improving patient care. The researchers recommended the following: nursing curricula should include comprehensive training on artificial intelligence, focusing on its applications in healthcare, benefits, and ethical considerations. Encourage collaborative learning environments where nursing students can engage with AI technologies through practical experiences and simulations. Advocate for institutional policies that support the incorporation of AI education into nursing programs, thereby enhancing the overall quality of nursing education. Promote further research into the effective integration of AI in nursing and healthcare to identify best practices and overcome existing barriers.

Conflict of interest

The researchers declare that there is no conflict of interest

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Declaration of the use of AI in scientific writing

Nothing to declare

Guarantor

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