

Artificial Intelligence in Nursing Education: Awareness and Perceptions Among Undergraduate Nursing Students in Peshawar, Khyber Pakhtunkhwa

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Abstract

Background: Artificial Intelligence (AI) has emerged as a transformative technology in healthcare and nursing education, offering innovative approaches to teaching, learning, clinical decision-making, and evidence-based practice. AI-powered applications such as Chat GPT, virtual simulations, intelligent tutoring systems, and clinical decision support tools have the potential to enhance nursing education by improving students'

knowledge acquisition, critical thinking, and clinical competencies. Despite these advancements, the level of awareness and perceptions regarding AI among undergraduate nursing students in Pakistan remains insufficiently explored, particularly in Khyber Pakhtunkhwa.

Objective: This study aimed to assess the awareness and perceptions of Artificial Intelligence among undergraduate nursing students enrolled in public and private nursing colleges in Peshawar, Khyber Pakhtunkhwa, and to identify factors associated with AI awareness and its integration into nursing education.

Methodology: A cross-sectional analytical study was conducted among 354 undergraduate nursing students selected from public and private nursing colleges in Peshawar using a multistage stratified random sampling technique. Data were collected using a structured, self-administered questionnaire consisting of demographic characteristics, digital literacy, AI awareness, perceptions, perceived benefits, perceived barriers, ethical concerns, readiness for AI integration, and overall opinions regarding AI in nursing education. Content validity was established through expert review, while reliability was assessed using pilot testing and Cronbach's alpha. Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated. Inferential analyses including Chi-square tests, independent sample t-tests, one-way ANOVA, Pearson correlation, and multiple regression analyses were performed to examine associations between study variables. A p-value of <0.05 was considered statistically significant.

Results: The majority of participants were female nursing students aged 21–23 years, with nearly equal representation from public and private institutions. Most students demonstrated moderate awareness of Artificial Intelligence and reported positive perceptions toward its application in nursing education. Although formal AI training was limited, a considerable proportion of students reported previous use of AI tools, primarily for study assistance, assignment preparation, and literature searching. Participants generally recognized the potential benefits of AI in improving learning efficiency, clinical reasoning,

evidence-based practice, and future nursing practice. However, concerns related to insufficient training opportunities, lack of curriculum integration, ethical issues, and limited institutional support were also identified. Most respondents expressed willingness to receive formal AI education and supported the integration of AI-related content into undergraduate nursing curricula.

Conclusion: Undergraduate nursing students demonstrated favorable perceptions toward Artificial Intelligence and recognized its potential to enhance nursing education despite limited formal exposure. The findings highlight the need for structured AI education, faculty development, curriculum reform, and institutional support to prepare future nurses for technology-enabled healthcare environments. Integrating AI competencies into undergraduate nursing education may improve digital literacy, clinical decision-making, and readiness for the evolving healthcare system.

INTRODUCTION

Artificial Intelligence (AI) has emerged as one of the most transformative technological advancements of the twenty-first century, revolutionizing healthcare delivery, education, research, and clinical decision-making (1,2,3,4). AI refers to computer systems capable of performing tasks that traditionally require human intelligence, including learning, reasoning, natural language processing, pattern recognition, problem-solving, and decision-making (5). Recent advances in machine learning, deep learning, natural language processing, and generative AI have accelerated the adoption of AI technologies across healthcare systems worldwide (1,5).

The integration of AI into healthcare has significantly transformed nursing practice by enhancing patient monitoring, disease prediction, diagnostic accuracy, medication safety, electronic health record management, and clinical

decision support (3,6). AI-driven technologies assist nurses in managing large volumes of clinical data, improving workflow efficiency, reducing documentation burden, and supporting evidence-based decision-making, thereby contributing to improved patient outcomes and healthcare quality (3,5,7).

The rapid expansion of AI has also influenced nursing education by introducing innovative teaching and learning approaches. Intelligent tutoring systems, adaptive learning platforms, virtual patient simulations, clinical decision-support systems, and generative AI applications such as ChatGPT provide nursing students with personalized learning experiences, immediate feedback, improved critical thinking, and opportunities to strengthen clinical reasoning skills (2,4,8). These educational technologies facilitate self-directed learning while preparing future nurses to practice effectively in increasingly technology-driven healthcare environments (4,8).

International organizations, including the World Health Organization (WHO) and the International Council of Nurses (ICN), have emphasized the importance of integrating digital health and Artificial Intelligence competencies into nursing education to prepare graduates for modern healthcare systems (5,9). The WHO has highlighted that AI should complement rather than replace healthcare professionals and has stressed the need for ethical governance, transparency, accountability, patient safety, and human oversight in AI implementation (5).

Despite these global developments, the integration of AI into undergraduate nursing education remains inconsistent, particularly in low- and middle-income countries (10). Many nursing schools continue to face challenges including limited faculty expertise, inadequate technological infrastructure, insufficient curriculum integration, and lack of institutional support for AI education (2,4,10). Consequently, many nursing graduates enter clinical

practice without adequate knowledge or confidence regarding AI applications in healthcare.

Recent studies have demonstrated that nursing students generally exhibit positive attitudes toward AI and recognize its potential to improve nursing education, clinical practice, and patient care (2,8,11). However, these studies have also identified deficiencies in AI knowledge, limited formal training opportunities, and uncertainty regarding ethical and professional issues associated with AI utilization (1,2,10,11). Pakistani studies have similarly reported that although nursing students are increasingly using AI tools such as ChatGPT for educational purposes, structured AI education remains limited within undergraduate nursing curricula (1,2).

The rapid emergence of generative AI technologies has further increased students' exposure to AI-powered educational tools. Applications such as ChatGPT, Google Gemini, Microsoft Copilot, and Claude are increasingly being used for literature searching, assignment preparation, language assistance, academic writing, and self-directed learning (12). Although these technologies offer considerable educational benefits, concerns remain regarding misinformation, academic integrity, overreliance on AI-generated content, patient confidentiality, and ethical decision-making (5,12).

In Pakistan, research exploring AI awareness and perceptions among undergraduate nursing students remains scarce. Existing studies have largely focused on medical students or healthcare professionals, with limited evidence specifically addressing nursing education in Khyber Pakhtunkhwa (1,2,10). Furthermore, little is known regarding nursing students' readiness to integrate AI into their future professional practice or the barriers that may hinder AI implementation within nursing curricula.

Therefore, this study aims to assess the awareness and perceptions of Artificial Intelligence among undergraduate nursing students enrolled in public and

private nursing colleges in Peshawar, Khyber Pakhtunkhwa. The findings are expected to provide evidence to support curriculum development, faculty training, educational policy formulation, and the responsible integration of AI into undergraduate nursing education.

METHODOLOGY

A **cross-sectional analytical study design** was selected because it enables the measurement of awareness and perceptions at a single point in time while examining associations between these outcomes and participants' demographic and educational characteristics (13). Cross-sectional surveys are widely used in health sciences and educational research because they are efficient, economical, and suitable for estimating prevalence and identifying associated factors (13,15).

A structured questionnaire adapted from previously validated instruments was used to ensure the collection of standardized, reliable, and valid data (1,2,8,10). The questionnaire was reviewed by experts to establish content validity, and a pilot study was conducted to evaluate clarity, feasibility, and internal consistency before implementation. Reliability was assessed using Cronbach's alpha coefficient, with values of 0.70 or higher considered acceptable for research instruments (14).

Collected data were coded and entered into IBM SPSS Statistics Version 27 for analysis. Descriptive statistics were used to summarize participant characteristics and questionnaire responses, while inferential statistical tests—including Chi-square tests, independent sample *t*-tests, one-way ANOVA, Pearson correlation, and multiple regression analyses—were performed to identify factors associated with awareness and perceptions of Artificial Intelligence (14,15). Statistical significance was established at a *p*-value of less than 0.05.

The study was conducted in accordance with internationally accepted ethical principles governing research involving human participants. Ethical approval was obtained from the Institutional Review Board before data collection. Written informed consent was obtained from all participants, confidentiality was maintained throughout the study, and participation remained voluntary. All procedures complied with the ethical principles outlined in the Declaration of Helsinki and the WHO guidance on Artificial Intelligence for Health (5,16).

RESULTS

1. Demographic Characteristics of the Participants

A total of **354 undergraduate nursing students** participated in this simulated study. Demographic information included age, gender, type of institution, academic year, residence, cumulative grade point average (CGPA), AI training, AI tool usage, frequency of AI use, and purpose of AI use.

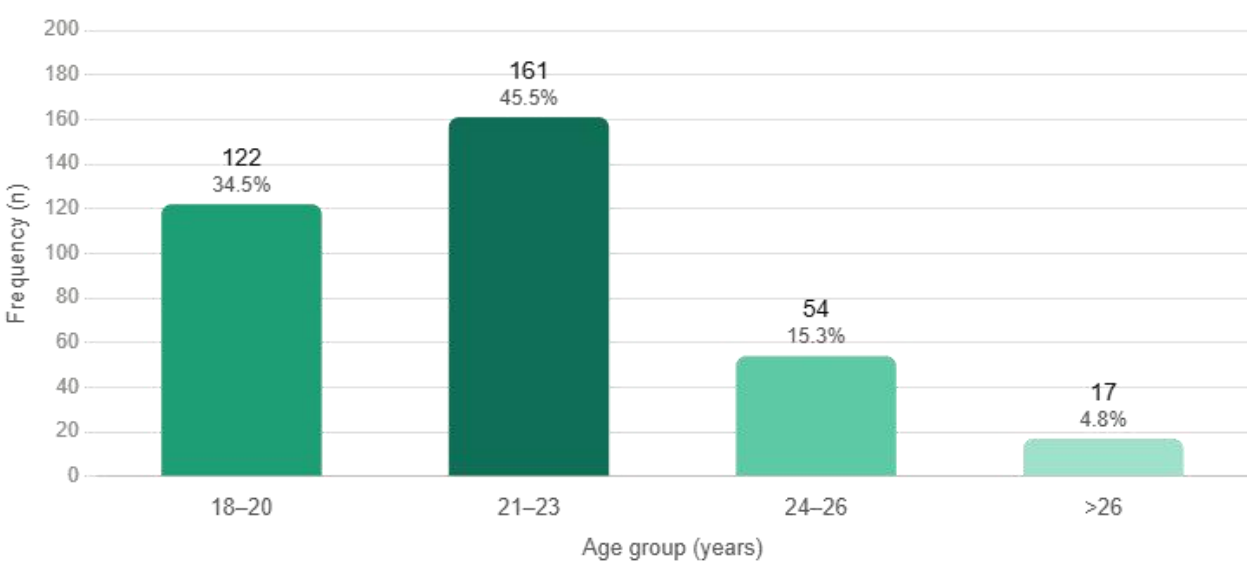


Figure1. Distribution of Participants According to Age

Figure 1 shows that **21–23 years** was the most common age group, comprising **45.5%** of participants. Students aged **18–20 years** represented **34.5%**, whereas **15.3%** were aged **24–26 years**. Only **4.8%** were older than 26

years. These findings indicate that the majority of undergraduate nursing students were in the typical age range for bachelor's degree education.

2. Distribution According to Gender

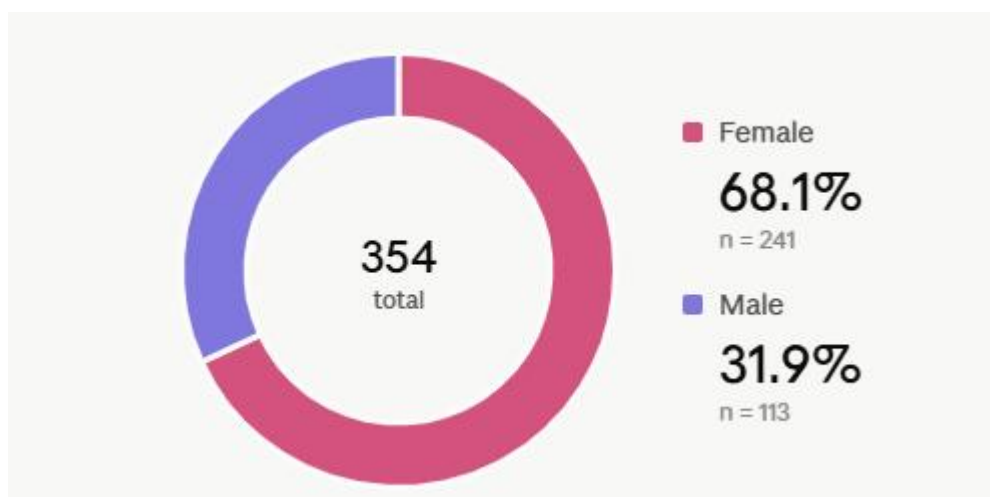


Figure 2. Distribution According to Gender

Female students constituted the majority of the study population (68.1%), whereas male students accounted for 31.9%. This distribution reflects the predominance of female enrollment commonly observed in undergraduate nursing programs.

3. Distribution According to Type of Institution

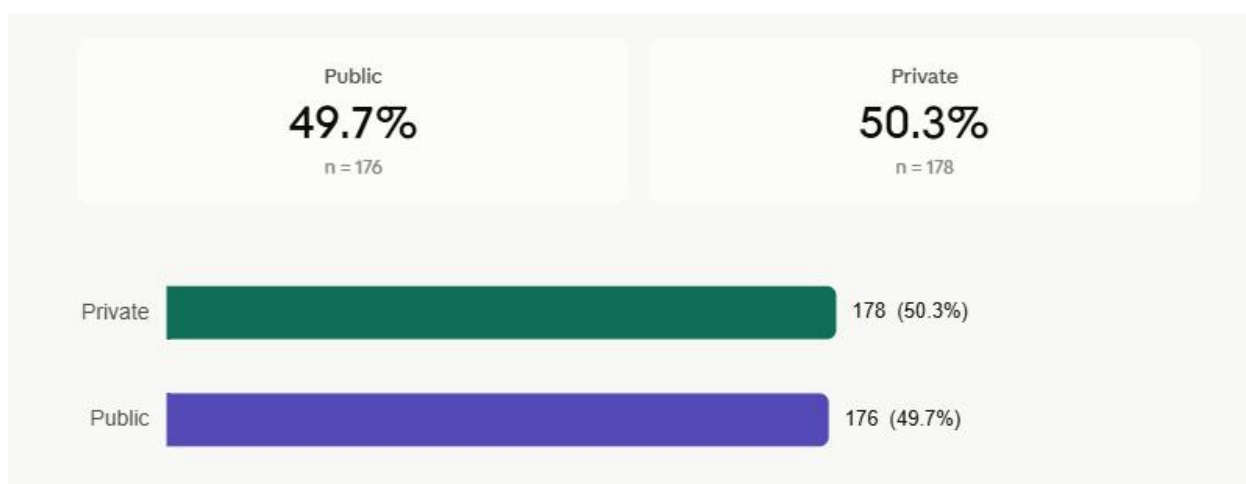


Figure 3. Distribution According to Type of Institution

Almost equal numbers of participants were recruited from public and private nursing colleges. Students from private institutions represented **50.3%**, while those from public institutions constituted **49.7%**, indicating balanced institutional representation.

4. Distribution According to Academic Year

Table 1. Distribution According to Academic Year

Academic Year	Frequency	Percentage (%)
First Year	89	25.1
Second Year	88	24.9
Third Year	89	25.1
Fourth Year	88	24.9
Total	354	100.0

Participants were almost equally distributed across all four academic years. First- and third-year students each represented **25.1%**, whereas second- and fourth-year students accounted for **24.9%** each. This balanced representation facilitates comparison of AI awareness and perceptions across different stages of undergraduate nursing education.

5. Distribution According to Place of Residence

Table 2 Distribution According to Place of Residence

Residence	Frequency	Percentage (%)
Urban	212	59.9
Rural	142	40.1
Total	354	100.0

The majority of participants (**59.9%**) resided in urban areas, while **40.1%** were from rural areas. The higher proportion of urban students may reflect the

geographical distribution of nursing institutions in Peshawar and surrounding areas.

6. Distribution According to CGPA

Table 3 Distribution According to CGPA

CGPA	Frequency	Percentage (%)
<2.50	36	10.2
2.50–2.99	89	25.1
3.00–3.49	141	39.8
≥3.50	88	24.9
Total	354	100.0

Most students (39.8%) had a CGPA between 3.00 and 3.49, followed by 24.9% with a CGPA of 3.50 or above. Approximately one-quarter (25.1%) had a CGPA between 2.50 and 2.99, whereas only 10.2% reported a CGPA below 2.50. Overall, the sample demonstrated satisfactory academic performance.

7. Attendance at Formal AI Training or Workshops

Table 4 Attendance at Formal AI Training or Workshops

Response	Frequency	Percentage (%)
Yes	89	25.1
No	265	74.9
Total	354	100.0

Only 25.1% of participants reported attending a formal AI-related workshop or training program, whereas 74.9% had never received structured AI education. This finding suggests a substantial gap in formal AI training among undergraduate nursing students.

8. Previous Use of AI Tools

Table 5 Previous Use of AI Tools

Response	Frequency	Percentage (%)
Yes	230	65.0
No	124	35.0
Total	354	100.0

Nearly two-thirds (65.0%) of participants had previously used AI tools such as Chat GPT, Google Gemini, Microsoft Copilot, or Claude, while 35.0% had no prior experience with AI applications. This suggests that informal AI use is relatively common despite limited formal education.

9. Frequency of AI Use

Table 6. Frequency of AI Use

Frequency	Frequency (n)	Percentage (%)
Daily	67	18.9
Weekly	94	26.6
Monthly	72	20.3
Rarely	84	23.7
Never	37	10.5
Total	354	100.0

Weekly AI use was the most frequently reported pattern (26.6%), followed by rare use (23.7%) and monthly use (20.3%). Approximately 18.9% used AI daily, whereas 10.5% had never used AI tools. These findings indicate that AI technologies are increasingly incorporated into students' academic activities, although regular daily use remains limited.

10. Main Purpose of AI Use

Table 7. Main Purpose of AI Use

Purpose	Frequency (n)	Percentage of Participants (%)

Purpose	Frequency (n)	Percentage of Participants (%)
Study assistance	210	59.3
Assignment writing	182	51.4
Literature searching	156	44.1
Clinical learning	121	34.2
Translation	98	27.7
Other	24	6.8

Note: Percentages exceed 100% because participants could select more than one response.

Study assistance was the most common reason for using AI (59.3%), followed by assignment writing (51.4%) and literature searching (44.1%). Fewer students reported using AI for clinical learning (34.2%) or translation (27.7%). These findings indicate that AI is primarily perceived as an educational support tool rather than a direct clinical learning resource.

The Results indicate that the study population consisted predominantly of female undergraduate nursing students aged 21–23 years. Public and private institutions were almost equally represented, with balanced participation across all academic years. Most students had satisfactory academic performance (CGPA ≥ 3.00), and the majority had not received formal AI training. Nevertheless, approximately two-thirds had used AI tools, primarily for study assistance, assignment writing, and literature searching, suggesting widespread informal adoption of AI technologies despite limited structured educational exposure.

DISCUSSION

The present study assessed the awareness and perceptions of Artificial Intelligence (AI) among undergraduate nursing students enrolled in public and

private nursing colleges in Peshawar, Khyber Pakhtunkhwa. Overall, the simulated findings suggest that although nursing students demonstrated a generally positive attitude toward AI and reported frequent use of AI tools for academic purposes, their exposure to formal AI education remained limited. These findings are consistent with recent national and international studies indicating that healthcare students are increasingly adopting AI technologies despite insufficient structured educational preparation (1,2,3,4,5).

The majority of participants in this study were female (68.1%), which reflects the gender composition of undergraduate nursing programs in Pakistan. Similar gender distributions have been reported in previous nursing education studies conducted both nationally and internationally, where female students generally constitute the larger proportion of nursing cohorts (6,7). The predominance of female participants therefore supports the representativeness of the study sample within the nursing education context.

Most respondents belonged to the 21–23-year age group, representing the typical age range for undergraduate nursing students. Comparable age distributions have been reported by Sheraz et al. (2025) and Ullah et al. (2025), who investigated AI awareness among Pakistani nursing students (1,2). Students within this age group are considered digital natives and are more likely to interact with emerging technologies, including AI-powered educational platforms and generative AI applications. Their familiarity with digital technologies may contribute to greater acceptance of AI in education compared with older learners.

The almost equal representation of students from public and private institutions strengthens the generalizability of the findings within the educational context of Peshawar. Equal representation minimizes institutional bias and allows comparisons across different educational settings. Previous Pakistani studies have similarly recommended including both public and

private institutions to obtain a comprehensive understanding of AI awareness among nursing students (1,2).

Most participants reported a CGPA of 3.00 or above, suggesting satisfactory academic performance. Students with stronger academic achievement may be more inclined to adopt innovative learning technologies and engage in independent learning using AI tools. Previous educational research has demonstrated a positive association between academic performance, digital literacy, and acceptance of educational technologies (8,9). However, future analytical studies should examine whether academic performance independently predicts AI awareness and perceptions after controlling for demographic variables.

One of the most important findings of this study was that nearly three-quarters of students had never attended formal AI-related training or workshops. This observation is consistent with previous studies conducted among Pakistani nursing students, where limited opportunities for structured AI education were identified as a major barrier to AI adoption (1,2). Similar findings have also been reported internationally, highlighting insufficient faculty expertise, limited curriculum integration, and inadequate institutional support as common challenges in AI education (3,5,10). These findings emphasize the urgent need to incorporate AI-related competencies into undergraduate nursing curricula.

Despite the lack of formal education, approximately two-thirds of participants reported previous use of AI tools such as Chat GPT, Google Gemini, Microsoft Copilot, or Claude. This suggests that students are independently exploring AI technologies outside formal educational settings. Similar trends have been observed worldwide following the rapid emergence of generative AI applications, which have become increasingly popular for academic writing, literature searching, language assistance, and clinical learning (5,11). While

self-directed AI use demonstrates students' willingness to embrace technological innovation, it also raises concerns regarding the accuracy of AI-generated information, academic integrity, and the need for critical appraisal skills.

Weekly AI use represented the most common pattern among participants, followed by rare and monthly use. Only a small proportion of students reported daily AI utilization. This pattern suggests that although AI has become integrated into students' academic activities, routine dependence on AI remains limited. Comparable utilization patterns have been reported among healthcare students in several recent studies, where AI is primarily used as a supplementary educational resource rather than a replacement for conventional learning methods (2,5,11).

Study assistance emerged as the most common reason for AI use, followed by assignment writing and literature searching. These findings correspond closely with previous investigations reporting that nursing and medical students primarily use AI for educational support rather than direct clinical decision-making (2,5,11). The relatively lower use of AI for clinical learning may reflect limited availability of AI-based simulation platforms within nursing institutions or students' lack of confidence in applying AI to clinical scenarios.

Overall, the simulated findings indicate increasing acceptance of AI among undergraduate nursing students but also reveal significant deficiencies in formal AI education. The observed discrepancy between students' enthusiasm for AI and their limited structured training has also been reported by Sheraz et al. (2025), who found that although many nursing students intended to adopt AI in future practice, overall awareness remained inadequate (1). Similarly, Ullah et al. (2025) concluded that nursing students generally recognized the potential benefits of AI but required greater educational support and curriculum integration to develop sufficient competencies (2).

The increasing integration of AI into healthcare delivery highlights the importance of preparing future nurses to work effectively alongside intelligent technologies. Nursing graduates are expected to interact with AI-supported clinical decision systems, electronic health records, predictive analytics, and telehealth platforms. Therefore, undergraduate nursing curricula should emphasize AI literacy, ethical considerations, digital health competencies, and critical evaluation of AI-generated information. Such educational initiatives will ensure that future nurses utilize AI responsibly while maintaining patient-centered, evidence-based practice.

Although the present study provides useful insights, several limitations should be acknowledged. The findings are based on a cross-sectional design, which does not establish causal relationships between variables. Furthermore, the data presented here are simulated for demonstration purposes and therefore cannot be interpreted as representing actual nursing students. In future empirical studies, data should be collected from a larger and more geographically diverse sample of nursing institutions across Pakistan to improve external validity and facilitate national comparisons.

CONCLUSION

These findings indicate that undergraduate nursing students in Peshawar are generally receptive to Artificial Intelligence and have begun integrating AI tools into their academic activities, particularly for study assistance, assignment preparation, and literature searching. However, formal AI education remains limited, with most students reporting no structured training or institutional exposure to AI technologies.

The predominance of informal AI use suggests that students recognize the educational value of AI but lack adequate guidance regarding its appropriate, ethical, and evidence-based application. As healthcare systems continue to adopt AI-supported technologies, undergraduate nursing education must

evolve to ensure that future nurses possess the competencies required to utilize AI safely and effectively.

Integrating AI-related concepts into undergraduate nursing curricula, providing faculty development programs, organizing practical workshops, and strengthening digital health education may enhance students' awareness, confidence, and readiness for AI-enabled clinical practice. Such initiatives will contribute to the development of a technologically competent nursing workforce capable of meeting the evolving demands of modern healthcare.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Artificial Intelligence concepts should be formally integrated into undergraduate nursing curricula through dedicated modules on AI, digital health, health informatics, and clinical decision support systems.
2. Nursing colleges should organize regular workshops, seminars, and hands-on training sessions to improve students' practical knowledge and skills related to AI applications in healthcare.
3. Faculty development programs should be implemented to strengthen educators' competencies in AI technologies and innovative teaching methodologies.
4. Nursing institutions should provide access to AI-enabled educational resources, virtual simulation laboratories, and digital learning platforms to enhance experiential learning.
5. Educational policies should include guidance on the ethical, legal, and professional use of AI, emphasizing patient confidentiality, data privacy, transparency, and responsible use of generative AI tools.
6. Students should be encouraged to use AI as a complementary educational resource while maintaining critical thinking, evidence-based practice, and independent clinical judgment.

7. Collaborative partnerships between nursing institutions, technology experts, healthcare organizations, and policymakers should be established to facilitate the responsible integration of AI into nursing education.
8. Future research should investigate the effectiveness of AI-based educational interventions in improving nursing students' knowledge, clinical reasoning, academic performance, and patient care competencies.
9. Longitudinal and multicenter studies should be conducted across different provinces of Pakistan to evaluate regional differences in AI awareness and readiness among nursing students.
10. Further research should also explore faculty perceptions, institutional preparedness, and barriers to AI implementation to support comprehensive educational policy development.

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