

Empowering Future Nurses: Integrating Artificial Intelligence into Nursing Education

Zhang Nan

*International School of Nursing, Hainan Vocational University of Science and Technology, Haikou,
571137, China
380762555@qq.com*

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Abstract: Artificial intelligence (AI) is increasingly transforming healthcare and creating new competency requirements for future nurses. This narrative review examines the applications, benefits, challenges, and curriculum implications of integrating AI into nursing education. Current evidence shows that AI can support personalised learning, intelligent tutoring, automated feedback, teaching preparation, virtual patients, and simulation-based training. These applications may improve students' knowledge acquisition, engagement, communication, clinical reasoning, decision-making, and readiness for practice. However, AI integration also raises concerns about inaccurate or fabricated information, algorithmic bias, patient privacy, data security, academic integrity, accountability, and excessive dependence on automated tools. Differences in faculty readiness, institutional resources, and access to technology may further limit effective and equitable implementation. Preparing future nurses for AI-enabled healthcare therefore requires more than technical skills. Nursing students need AI literacy, critical evaluation skills, information verification ability, ethical awareness, data protection knowledge, and strong clinical judgement. AI content should be progressively integrated into nursing informatics, ethics, research, clinical, and simulation courses, supported by faculty development, clear institutional policies, and assessment methods that evaluate students' reasoning processes. Future research should use longitudinal, experimental, and multicentre designs to examine the long-term effects of AI on clinical competence, patient safety, and professional practice. AI should ultimately enhance rather than replace nurses' clinical judgement, ethical responsibility, communication, and compassionate care.

1. Introduction

Artificial intelligence (AI) is increasingly used in healthcare for clinical decision support, patient monitoring, data analysis, documentation, and disease prediction [1,3,7]. These developments are reshaping nursing practice and creating new competency requirements for future nurses. In addition to clinical knowledge and practical skills, nursing students need to understand how AI systems operate, assess the reliability of AI-generated information, protect patient data, and use AI ethically [2,3,18].

AI also offers new opportunities for nursing education. Adaptive learning systems can provide personalised content and immediate feedback, while virtual patients, chatbots, and AI-supported simulations can help students practise clinical reasoning, communication, and decision-making in safe environments [5,6,9,10,12]. Generative AI tools may also support literature reviews, case analysis, care-plan development, and examination preparation. For educators, AI can assist with lesson planning, the development of learning materials, formative assessment, and student support [5,10,12,15].

However, integrating AI into nursing education also involves important risks. AI systems may produce inaccurate, biased, or fabricated information. The use of patient data may raise concerns about privacy, confidentiality, and professional accountability [1,7,16,20]. Excessive dependence on AI may also weaken students' independent thinking, clinical judgement, and problem-solving abilities. Therefore, AI should support rather than replace human judgement, empathy, communication, and professional responsibility.

Academic integrity is another major concern. Students may use generative AI to complete assignments or clinical case reports without fully understanding the content. This makes it difficult to determine whether their work reflects genuine knowledge and competence. Nursing programmes therefore need clear policies on acceptable AI use, disclosure, information verification, and assessment [13–15,18,20]. Greater attention should be given to authentic tasks, oral explanations, reflective writing, and clinical reasoning processes.

Although interest in AI-supported nursing education is growing, current research remains fragmented. Many studies focus on students' attitudes or short-term learning experiences, while evidence concerning long-term learning, clinical competence, faculty readiness, and patient safety remains limited [3,6,8,10,20]. Although general and nursing-specific AI literacy frameworks have begun to emerge, there is still limited agreement on how these competencies should be taught and assessed across nursing curricula [17–19].

Therefore, this paper examines the applications, benefits, and challenges of integrating AI into nursing education. It argues that effective integration requires a structured and human-centred approach that develops AI literacy, strengthens clinical judgement, protects patient safety, and preserves the ethical and compassionate foundations of nursing.

2. Applications and Benefits of AI in Nursing Education

2.1 AI-Supported Teaching and Learning

AI supports nursing education by making learning more personalised, interactive, and accessible. Intelligent learning systems can analyse students' performance, identify knowledge gaps, and provide learning materials suited to their individual needs. Unlike traditional teaching, which usually provides the same content to all students, AI can adjust task difficulty and feedback according to students' progress. This approach may help students review difficult concepts, learn at their own pace, and receive support outside regular class hours. Existing reviews indicate that AI-supported education can improve knowledge acquisition, learning efficiency, and student engagement, although its effectiveness varies across technologies and educational settings [6,10,12,20].

ChatGPT and other AI-powered chatbots are among the most widely discussed tools in nursing education. They can answer course-related questions, explain complex nursing concepts, summarise learning materials, generate practice questions, and support case analysis. Chatbots can also act as virtual tutors by providing immediate responses and guiding students through clinical problems. A scoping review of 14 studies found that chatbots were used to support learning, skill development, simulation, tutoring, assessment, and feedback. Their use was associated with improved knowledge retention, engagement, and skill development [9]. Similarly, Gunawan et al. identified academic

writing, healthcare simulation, data modelling, and personal development as major areas of ChatGPT use in nursing education [5].

Generative AI can also support teaching preparation. Nurse educators may use it to develop lesson plans, clinical cases, discussion questions, quizzes, assessment rubrics, and supplementary learning materials. It may reduce the time required to prepare routine materials and allow teachers to focus more on student guidance and classroom interaction. AI-assisted assessment systems can provide immediate formative feedback, identify common errors, and help teachers monitor student progress [9,10,12,15]. However, AI-generated materials and feedback must be reviewed by educators because they may contain inaccurate, incomplete, or inappropriate information. AI should therefore be used as a teaching assistant rather than an independent source of nursing knowledge.

2.2 Simulation and Clinical Competency Development

Simulation is another important area of AI application in nursing education. AI-supported virtual patients and simulation systems can create realistic clinical situations in which students collect patient information, assess symptoms, select nursing interventions, and evaluate outcomes. These systems allow students to practise repeatedly without placing real patients at risk. They can also present uncommon, complex, or emergency situations that students may not encounter during limited clinical placements. Virtual simulation more broadly has been associated with improvements in knowledge, clinical reasoning, skills, confidence, and learner satisfaction [11], while recent nursing reviews indicate growing use of AI within simulation-based learning [4,12].

AI can make simulation more responsive by allowing virtual patients to react to students' questions and decisions. For example, students may practise interviewing patients, assessing symptoms, providing health education, or responding to changes in a patient's condition. This interaction can strengthen clinical reasoning because students must interpret information, set priorities, and justify their decisions. AI-generated patient responses may also support communication training by exposing students to different patient needs, emotional reactions, and communication scenarios. Such practice can help students develop confidence before communicating with real patients [4,9,12].

AI may be applied throughout the simulation process. During prebriefing, chatbots can introduce the case, explain learning objectives, and test students' preparation. During simulation, virtual environments can present changing patient conditions and require students to make clinical decisions. During debriefing, AI can analyse students' actions and provide individualised feedback. However, Chan et al. found that most existing studies focused on the simulation stage, while AI applications in prebriefing and debriefing remained limited. Their review included 14 studies, of which 11 examined virtual environments, two examined chatbots in prebriefing, and only one focused on AI-supported feedback during debriefing [4].

AI-supported simulation may also increase student engagement because students can practise in a flexible and less threatening environment. Students who are anxious about making mistakes in front of teachers, patients, or classmates may feel more comfortable practising with virtual patients. Immediate feedback and repeated practice can help them recognise errors and improve their performance before entering clinical settings. Nevertheless, virtual interactions cannot fully reproduce the uncertainty, emotional complexity, physical contact, and human relationships involved in real nursing care. AI simulation should therefore complement rather than replace laboratory practice, teacher-led simulation, and clinical placement [4,11,12,20].

3. Challenges of AI Integration

3.1 Ethical, Academic, and Safety Concerns

AI-generated information may be inaccurate, outdated, biased, or fabricated. In nursing education, students who accept such information without verification may develop incorrect clinical knowledge, potentially affecting patient safety. Algorithmic bias is another concern because AI systems trained on unrepresentative data may provide less reliable information for certain populations. Therefore, AI outputs should always be evaluated against current clinical evidence and professional guidelines [1,7,16,20].

The use of AI also raises concerns about patient privacy, data security, and accountability. Entering identifiable patient information into public AI platforms may violate confidentiality, while unclear responsibility makes it difficult to determine who is accountable for AI-related errors. In addition, students may use generative AI to produce assignments, care plans, or case reports without disclosure, weakening academic integrity and making it difficult to assess their actual competence. Nursing institutions therefore need clear policies on data protection, AI disclosure, information verification, and responsible use [1,7,13–16,20].

3.2 Dependence, Inequality, and Implementation Barriers

Excessive dependence on AI may reduce students' willingness to search for evidence, solve problems independently, and reflect on clinical decisions. Although AI can support learning, it should not replace the reasoning processes required to develop clinical judgement. Educators should design activities that require students to evaluate AI responses, explain their decisions, and identify errors rather than simply accept generated answers [15,16,18,20].

Implementation is also limited by differences in faculty readiness and institutional resources. Some nursing educators lack sufficient AI knowledge or training to integrate these tools effectively. Differences in internet access, software, funding, and technical support may further widen the digital divide between students and institutions. Successful integration therefore requires faculty development, equitable access to technology, institutional guidance, and continuing evaluation of educational outcomes [8,10,12,20].

4. Preparing Future Nurses for an AI-Enabled Healthcare System

4.1 AI Literacy and Professional Competency

Future nurses need more than the ability to operate AI tools. They should understand basic AI concepts, data sources, common applications, and technological limitations. They must also be able to evaluate AI-generated information, identify possible errors or bias, and verify outputs against reliable evidence and clinical guidelines [17–19]. AI literacy should therefore combine technical knowledge with critical thinking and information evaluation.

Professional competency also requires nurses to decide when AI use is appropriate and when human judgement should take priority. Students should understand data privacy, informed consent, accountability, and the ethical use of patient information. They must remain responsible for clinical decisions even when these decisions are supported by AI. Therefore, AI competence should be developed together with clinical judgement, communication, empathy, and professional responsibility [1,7,18,20].

4.2 Curriculum Integration and Future Research

AI education should be integrated progressively across nursing curricula rather than taught only as a separate topic. Basic AI concepts can be introduced in nursing informatics, research methods, ethics, and evidence-based practice courses. More advanced applications can then be included in clinical and simulation courses through virtual patients, AI-supported case analysis, and the critical evaluation of AI-generated care plans [18,19]. This gradual approach can connect AI knowledge with clinical practice.

Faculty development is also essential. Nurse educators need training in AI tools, ethical issues, assessment methods, and information verification. Assessment should focus not only on final answers but also on students' reasoning processes. Oral presentations, reflective reports, case discussions, and AI-use disclosure can help teachers evaluate students' actual knowledge and clinical judgement. Institutions should also establish clear rules for acceptable AI use, data protection, academic integrity, and accountability [8,10,12,20].

Current research on AI in nursing education remains limited by small samples, short-term interventions, self-reported outcomes, and differences in technologies and assessment methods. Future studies should use longitudinal, experimental, and multicentre designs to examine clinical competence, critical thinking, patient safety, and long-term professional practice. More research is also needed on validated AI competency frameworks, faculty readiness, curriculum effectiveness, and AI education in resource-limited settings [6,8,10,20].

5. Conclusion

AI offers important opportunities to improve personalised learning, simulation, feedback, clinical reasoning, and teaching efficiency in nursing education. However, inaccurate information, algorithmic bias, privacy risks, academic misconduct, overdependence, and unequal access may reduce its educational value. Effective integration therefore requires AI literacy, teacher preparation, curriculum reform, clear institutional policies, and continuous evaluation. Most importantly, AI should enhance rather than replace nurses' clinical judgement, ethical responsibility, communication, and compassionate care [1,7,20].

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