

The use of Artificial Intelligence in nursing education: opportunities, challenges and solutions

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ABSTRACT

Artificial Intelligence (AI) has the potential to transform nursing education by enhancing instructional quality and better preparing students for future healthcare demands. This traditional review examines opportunities, challenges, and strategies for AI integration into nursing education, drawing on full-text studies indexed in Web of Science, Scopus, and Google Scholar. AI supports professional competence and reduces educators' workload through virtual patient simulations, instant feedback, personalized learning, improved accessibility, time efficiency, and the promotion of analytical and critical thinking. However, unresolved ethical and legal issues, misinformation risks, academic misconduct, resistance to technology, financial constraints, and limited infrastructure hinder effective implementation. Conscious, ethical, and sustainable integration of AI can yield substantial benefits, yet adoption in developing countries remains insufficient. This review offers a practical roadmap for educators, policymakers, and researchers to leverage AI effectively in nursing education.

Keywords: Artificial Intelligence, nursing education, opportunities, challenges, solutions

INTRODUCTION

Artificial Intelligence (AI) technologies (e.g., big data and analytics, chatbots, robotics, and virtual and augmented reality), which are defined as the development of computer systems that can perform tasks that require human intelligence, have developed rapidly in recent years and have radically affected many fields, especially the health sector and nursing practices (Castonguay et al., 2023; Lifshits & Rosenberg, 2024). The potential of AI in healthcare to improve patient care and enhance clinical outcomes has accelerated its integration into nursing education and practice (Korkmaz, 2024). However, effective integration of AI into the nursing curriculum is a complex process that requires careful planning and implementation. Incorporating AI into educational settings brings significant opportunities and challenges and inflames debates in this field (De Gagne et al., 2024; Schneidereith & Thibault, 2023).

Nurse educators are working to ensure that nursing students can deliver safe, high-quality care in an increasingly complex and technology-integrated health system. At this point, it is essential to adapt to these new technologies that can support student learning and nursing education (Castonguay et al., 2023). Integrating AI, a relatively new technology, into nursing education provides many benefits. For example, algorithms used in simulation-based learning allow students to develop practical skills in clinical settings, while tools such as ChatGPT

offer innovative educational methods to nursing students (Alderden et al., 2018; Shorey et al., 2020). The potential benefits of AI in nursing education include supporting students in developing medical knowledge and professional skills, creating safe clinical education environments, and increasing student success (Lifshits & Rosenberg, 2024). However, while using AI in nursing education provides many benefits, it also brings various challenges. Nursing educators' and students' low level of knowledge and competence about AI applications, ethical concerns, economic limitations, and confidentiality problems can be counted among the difficulties experienced (De Gagne et al., 2024; Sun & Hoelscher, 2023).

Although there has been a significant increase in studies on the use of AI in nursing as of 2017, there are significant gaps in the literature on how to use AI in nursing education (Korkmaz, 2024). Moreover, a standard and comprehensive roadmap for integrating AI into the nursing education curriculum and effectively using these technologies has not been established (Castonguay et al., 2023). It is stated that it is necessary for educators to fully understand the potential benefits, limitations, and ethical dimensions of AI in order to fill the existing gap and ensure the successful integration of AI into nursing education (Schneidereith & Thibault, 2023; Sun & Hoelscher, 2023). Accordingly, this review study aims to provide a road map for nursing educators with the

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opportunities offered by using AI in nursing education, the difficulties that may be encountered in this process, and solutions for the effective use of AI in nursing education. This study will provide a fundamental reference point for the effective integration of AI into nursing education and guide future research.

OPPORTUNITIES OFFERED BY THE USE OF AI IN NURSING EDUCATION

AI is a powerful tool that enriches learning experiences in nursing education, reduces the workload of educators, and makes education more efficient, practical, and accessible. With various applications ranging from simulations to individualized learning experiences, AI has great potential for transformation in nursing education (Korkmaz, 2024; Sun & Hoelscher, 2023). The opportunities offered by using AI in nursing education are explained below.

Simulations and Virtual Patients

AI-supported simulations and virtual patients enable students to improve their clinical decision-making, patient assessment, and communication skills. By providing realistic and immersive learning environments, these technologies equip nursing students with practical knowledge and critical thinking skills and increase their motivation to learn (Gonzalez, 2024; Kouka et al., 2025; Lifshits & Rosenberg, 2024; Son et al., 2023; Topaz et al., 2025). Moreover, the capacity of AI to generate various simulation cases, such as patient interviews or job interviews, saves educators time and enhances students' interactive learning experiences (Couper, 2025; De Gagne, 2023).

Individualized and Interactive Learning

By providing interactive education platforms, AI tracks students' performance and provides content to strengthen their weaknesses. AI algorithms create personalized education plans by analyzing each student's learning speed and deficiencies. This technology increases efficiency in education by providing personalized and interactive learning experiences in nurse education and areas such as remote patient monitoring. One study observed that students' knowledge, attention levels, and autonomous learning skills increased significantly after using an AI-based teaching methodology (Archibald & Clark, 2023; Rodriguez-Abad et al., 2023).

Creating Lesson Materials

AI can be used to create lesson plans and course materials. This can help educators facilitate lesson preparation and improve students' oral presentation skills, comprehension, and organizational abilities (Castonguay et al., 2023).

Analytical/Critical Thinking

Analytical and critical thinking is an important challenge at all stages of nursing studies. The main goal of clinical instructors is to enable nursing students to integrate theoretical knowledge into clinical practice effectively. Nursing students need to develop a structured thinking process to achieve this goal. This process starts with assessing the patient's condition, identifying key problems, and considering all possible interventions. AI can significantly contribute to this thinking process by providing advanced tools that help students select

appropriate nursing interventions (Choi et al., 2023; Lifshits & Rosenberg, 2024).

Instant Feedback

AI accelerates learning by showing students their mistakes in real-time. This feedback lets students quickly correct their misconceptions by identifying errors and suggesting correct approaches (Castonguay et al., 2023). It also supports students to improve their weaknesses with individualized suggestions (Lifshits & Rosenberg, 2024).

Research Support

AI provides excellent convenience for nursing educators and researchers in task organization, summarization, and simplification tasks. It also supports research processes by accelerating data analysis and interpretation. For example, AI tools can analyze large data sets, highlight important findings, and provide recommendations, thus saving researchers time (Castonguay et al., 2023).

Access in Education

AI reduces language and cultural barriers by providing translation and language support and offers globally accessible educational materials. Digital education tools can increase access to quality education for students in geographically disadvantaged areas. By offering course materials in different languages, AI-enabled platforms provide students with equal opportunities and can customize the learning experience (Castonguay et al., 2023; Couper, 2025). Thus, even peripheral students can access educational resources on a global level (Lifshits & Rosenberg, 2024).

Grading and Documentation

AI automates routine tasks such as grading and documentation, allowing instructors to focus more on teaching and guidance (Rony et al., 2024). It also supports nursing educators in preparing exam questions and guidelines (Castonguay et al., 2023). These tools improve teaching quality while alleviating educators' workload (Lifshits & Rosenberg, 2024).

Time-Saving

AI provides students quick answers on various topics, making information quickly accessible. Thanks to its big data processing capacity, students can get immediate answers to their questions and be directed to relevant resources. This feature allows students to work more efficiently and accelerates learning (De Gagne, 2023). On the other hand, AI saves instructors considerable time by automating routine tasks such as grading, attendance tracking, and student progress monitoring. In this way, instructors can focus on complex teaching tasks and guidance so that AI can improve student and instructor experience (Castonguay et al., 2023).

CHALLENGES OF USING AI IN NURSING EDUCATION

While integrating AI into nursing education offers significant opportunities, such as improved learning outcomes and increased efficiency, it also brings privacy and security concerns, ethical issues, and resistance to adoption (De Gagne, 2023). The New York Department of Education's ban on access to some AI-based programs due to concerns about academic integrity violations has brought the negative impacts

of these technologies on education back to the agenda (Korn & Kelly, 2023). However, reports of increased cheating cases in exams and academic studies have intensified the debate on the possible adverse effects of tools such as ChatGPT on the education system (Sun & Hoelscher, 2023). The challenges of using AI in nursing education, which are at the center of the debates, are discussed comprehensively in this section.

Ethical and Legal Issues

Integrating AI into nursing education brings fundamental ethical challenges, such as student and patient confidentiality. Since AI systems require access to personal data, ensuring data privacy and security is very important (Abdulai & Hung, 2023; Katznelson & Gerke, 2021). Moreover, the inherent complexity of some AI models can lead to various ethical and legal issues (Couper, 2025; O'Connor et al., 2023; Topaz et al., 2025). In addition, algorithmic biases can cause serious fairness issues in AI systems. This can lead to unfair decisions by reflecting the biases in the data sets used in the results (De Gagne et al., 2024; Rony et al., 2024).

The rapid spread of AI technologies also reveals the lack of legal and regulatory frameworks for using these technologies. The insufficient development of national and international regulations on the use of AI in education creates uncertainties about responsibility and limits of use. The lack of legal regulations and uncertainties about who is responsible and the limits of use can lead to various legal problems for educational institutions and students (Vincent-Lancrin & Vlies, 2020). In particular, the lack of data privacy and ethical use of AI-based systems can increase the risk of misuse of students' data. Moreover, the lack of international standards creates significant differences in implementing AI in education in different countries, leading to global inequality (De Gagne, 2023; Zhang & Aslan, 2021).

Access to Misinformation

Although AI applications can produce compelling and user-friendly content, they have significant limitations in accuracy and reliability. AI-generated information can often be false or completely fabricated (Chen et al., 2024). AI's tendency to generate and disseminate false information can undermine users' trust in information and lead to erroneous decisions. This becomes a concern in environments where academic integrity and credibility are important (Thorne, 2024; Topaz et al., 2025). Furthermore, if AI-generated texts are rephrased or altered, the systems may not even recognize the information they generate (Topaz et al., 2025).

AI models are limited in providing, summarizing, and synthesizing up-to-date information depending on the frequency with which knowledge bases are updated. In rapidly evolving fields such as nursing and health care, AI responses may not incorporate the latest developments, resulting in the dissemination of incomplete or outdated information. Although language models are constantly updated and improved, they depend on educational data and cannot fully meet human cognition's knowledge, skill performance, and assessment requirements. As such, AI cannot generate original ideas, such as new theoretical models (Castonguay et al., 2023).

Errors in Research

AI's ability to generate content can, in some cases, produce incomplete, inaccurate or misleading information.

Misinformation can lead to erroneous conclusions in academic research and applied sciences, leading to larger-scale problems (Archibald & Clark, 2023; Chen et al., 2024). Especially in academic research, the limitations of AI in generating references pose a significant problem. In some cases, references are misrepresented or not based on actual sources. This poses significant risks to academic integrity. Leading scientific journals have expressed opposition to using AI tools as an "author" for various ethical and methodological reasons (Thorne, 2024).

Threat to Examination Security and Critical Thinking

The development of AI technologies in recent years has led to significant concerns in examinations for measuring critical thinking and diagnostic reasoning skills in nursing education (Abujaber et al., 2023; Archibald & Clark, 2023). The high success of AI-based tools such as ChatGPT in undergraduate exams increases the debate on integrating these technologies into educational processes (Huang, 2023). Especially in distance education programs, students' easy access to such tools threatens the effectiveness of existing exam security systems (Abujaber et al., 2023).

Academic Misconduct

While AI is gaining attention as a valuable learning tool in education, the potential for students to use this technology in unethical ways raises concerns. In particular, the ability of tools such as ChatGPT to generate summaries or content raises the issue of academic misconduct, which can result in students using the generated summaries, presenting them as their own, and ignoring the actual labor involved in the process (Abujaber et al., 2023).

Technological Barriers

The lack of necessary technical infrastructure (internet access, hardware) poses a serious problem when using AI technologies, especially in developing and remote regions. Technological requirements such as a strong internet connection, modern hardware, and computers with high processing capacity are often not accessible in these regions. Using online AI tools is almost impossible, especially in regions with limited internet access (Chisom et al., 2024). Advanced AI applications' high software and hardware costs can make accessing these technologies complex for many educational institutions (Lifshits & Rosenberg, 2024). Building and deploying AI infrastructure, acquiring AI software, and integrating it into existing health systems require significant financial investment. This can be particularly challenging for universities operating on tight budgets (Rony et al., 2024).

The Need for Continuous Updating

Since AI is rapidly developing, the systems used must be updated regularly and keep up with innovations. This necessity increases the challenges teaching staff and educational institutions may face in digital transformation processes. Moreover, due to the rapid advancement of AI, old technologies may quickly become obsolete, further complicating the cost and adaptation processes. Educational institutions may not always be able to quickly change their curricula with these technologies (Alkhaqani, 2023; Hwang et al., 2022).

Limited Human Characteristics

Since nursing education is a human-oriented profession, excessive use of AI technologies may make developing human skills (communication, empathy) challenging. AI-supported simulations and virtual patient applications may not fully provide the experience students gain from real patient interaction in practice (Buchanan et al., 2021).

Resistance

Educators and students may face cultural and educational barriers to using AI in education (Chen & Lee, 2024). In order to be able to use AI tools effectively, educators must first be informed and trained. However, this process requires significant time and cost, and some educators may be concerned that AI will increase their workload or threaten their role (De Gagne, 2023). Furthermore, resistance to adopting AI is a challenge for educators and students that needs to be addressed. Nurses nursing students and educators may be apprehensive about integrating AI into their workflow and fear that it may change or diminish the value of their role. Resistance to technologies can make the adoption of AI in education difficult and hinder the effective use of the innovations AI offers (Rony et al., 2024).

SUGGESTIONS FOR EFFECTIVE USE OF AI IN NURSING EDUCATION

In the last part of this review, various solution suggestions are given to cope with the difficulties brought by the use of AI in nursing education and maximize the benefit of technology. AI-related developments require a review of assessment methods in nursing education and a reconsideration within an ethical framework. Educators should take more careful and strategic steps to balance the opportunities and threats that AI technologies will create in educational processes (Gonzalez, 2024; Sun & Hoelscher, 2023).

Ethical and Legal Steps

Using AI technologies in nursing education necessitates setting ethical standards and making these standards applicable. In particular, the adoption of advanced security technologies such as encryption and anonymization is necessary to ensure the security of student and patient data. Such practices aim to reduce AI's potential risks to data privacy (Dunlap & Michalowski, 2024). Furthermore, algorithms that make the decision-making processes of AI transparent and explainable should be developed. However, at this point, data bias and the risk of reinforcing existing inequalities through AI systems is another critical issue that needs to be carefully addressed (Seibert et al., 2020). Ethical concerns during the integration of AI into nursing education require solutions not only at the individual but also at the systemic level (Abdulai & Hung, 2023).

Educators and students should be trained to understand AI's limitations, possible inaccuracies, and biases. In this context, appropriate policies and guidelines should be established. This can ensure a balanced approach that enriches the learning experience and preserves academic integrity (Alkhaqani, 2023; De Gagne, 2023). Robust privacy and security measures ensure that the full potential of AI in education is realized while maintaining ethical values. While AI can be a handy tool, students and lecturers must recognize its limitations and cautiously approach its use (De Gagne, 2023). A combination

of ethical guidance, comprehensive educational programs, and strong safety protocols are imperative for the effective use of AI in nursing education. National and international laws regulating the integration of AI into education should be established and developed. Licensing and approval mechanisms should be established to ensure that AI tools used in education are reliable and effective.

Strengthening Technology and Infrastructure

Infrastructure investments can be provided through state-supported funds or private-sector partnerships to enable educational institutions to procure the necessary hardware and software. Developing low-cost AI tools and open-source systems in developing countries can support this process. Integrating AI-based tools into nursing curricula involves significant costs due to elements such as software, hardware, and staff training and requires investments in technology and infrastructure (Ahmad & Jenkins, 2022; Couper, 2025). However, these concerns can be effectively addressed by engaging instructional design experts and nurse educators in developing technology-enhanced curricula with appropriate training and technical support (Abujaber et al., 2023; Cary et al., 2024). One way to do this is by reallocating resources from existing budgets, seeking grant support, or collaborating with sector partners. To address these challenges, governments and educational institutions should create long-term strategic plans prioritizing technological investments (Abujaber et al., 2023).

Training and Awareness Studies

Training programs that include pedagogical aspects, applications, and use of AI technologies and train-the-trainer training should be planned to increase the knowledge and skills of trainers. To convey the potential and limitations of AI to students, it should be integrated into the curriculum, and seminars, workshops, and courses should be organized regularly (Topaz et al., 2025). Higher education institutions should recognize the need for professional development of faculty members to learn and understand AI technologies such as ChatGPT so that it can be used as a meaningful learning tool. Academic administrators should prioritize time and funding to support faculty members in developing their competence in using and understanding AI functionality and capabilities (Castonguay et al., 2023). It is also necessary to increase awareness by including an educational framework that includes the effects and use of AI in the nursing education curriculum (Abdulai & Hung, 2023; Archibald & Clark, 2023; Castonguay et al., 2023).

Steps Towards Skill Development

It is of great importance for educators to use AI-based tools and techniques in a way that supports human interaction, critical thinking, and creativity. Nurse educators can contribute to developing skilled and professional nurses through their critical role in developing these essential skills. Collaboration between AI researchers and nurse educators can promote a holistic approach to nursing education that takes advantage of technology while maintaining the value of human interaction (Jung, 2023).

Furthermore, nurse educators should play an important role in designing AI-enabled tools in alignment with the goals of nursing education and the profession's core values, ensuring that these tools support clinical judgment and patient-

centered care. This requires educators to continue to explore, innovate, and adapt their teaching methods to provide the best possible education to nursing students (De Gagne, 2023; Jung, 2023; Reid, 2024; Schneidereith & Thibault, 2023).

In order to develop students' critical thinking, problem-solving, creativity, and self-directed learning skills, it is recommended to use a variety of teaching methods, such as written assignments, as well as oral presentations and exams that keep multiple-choice formats to a minimum and focus on skills such as visual interpretation, open-ended responses to patient scenarios or problem-solving. However, assignments that support oral expression skills, synchronous presentations, live discussions, or debates will further reduce students' reliance on AI (Castonguay et al., 2023; O'Connor et al., 2023; Reid, 2024; Sun & Hoelscher, 2023). Such assignments have the potential to limit student dependency due to AI's inability to process non-textual inputs (Topaz et al., 2025).

Dealing with Resistance

Instructors and students should be actively involved in AI training and processes to reduce or overcome possible resistance to new technologies. It is important to emphasize that AI technology supports and enhances the teaching and learning process when used correctly to reduce resistance. Creating an ethical framework that aligns with nursing values is an essential preparation step for students to understand and adopt AI. Students are encouraged to evaluate AI's potential benefits and ethical responsibilities through value clarification exercises (De Gagne, 2023). In order to reduce resistance to AI, AI applications should be integrated with methods that develop students' human skills, such as empathy, communication, and ethical decision-making. AI-based learning systems should be balanced with face-to-face education and actual clinical experiences using Blended Learning Models (Topaz et al., 2025). Studies on the explainability of AI can help students and educators find technology more reliable. It is recommended that educators provide clear and understandable explanations to increase students' confidence in technology (Weitz, 2021).

Continuous Updates and Standardization

For AI systems to adapt to rapidly developing technology, updates should be created continuously and regularly. National and international standards for using AI in nursing education should be developed to ensure consistency between institutions. In addition, an international guide, directive, or policy should be created to use AI tools (Abdulai & Hung, 2023; Castonguay et al., 2023; Sun and Hoelscher, 2023). It should be determined and transparent about the consequences of plagiarism or other academic integrity violations. As AI tools and technologies rapidly evolve, the quality and effectiveness of AI-supported educational resources may change. Establishing standards and best practices for AI integration in nursing education is crucial to ensuring consistency and quality. This includes developing guidelines for using AI in educational environments, evaluating the effectiveness of AI tools, and sharing best practices across institutions (Couper, 2025).

Interdisciplinary Collaboration

Effective use of AI in education can be achieved through teamwork by collaborating with experts from disciplines such as nursing, informatics, ethics, and law. In particular,

academic and industry collaboration can contribute to developing innovative approaches for integrating AI into education, research, and development (De Gagne, 2023; Weitz, 2021).

Ensuring Access and Equality

For everyone to benefit from the advantages of AI, these technologies need to be made accessible and affordable. In this context, strategies are suggested to support language and cultural diversity by adapting AI tools to different languages and cultures (Son et al., 2023). For example, the CILS (Cross-Cultural Intelligent Language Learning System) system offers personalized learning experiences that can be adapted to individuals' linguistic and cultural needs using artificial intelligence technologies. This approach facilitates global interactions by increasing language and cultural understanding levels (Xia et al., 2024). Similarly, studies on how AI can support diversity, equity, and inclusion in education emphasize that technologies should be designed and evaluated relatively. It has been stated that such systems should be developed from a social and technical perspective, especially considering the needs of historically disadvantaged groups (Viberg et al., 2024). In addition, studies on language education with AI have discussed how these technologies can provide a solution to overcome language and cultural barriers along with their pedagogical benefits. Studies show that AI tools can be practical in different geographies by encouraging the continuous participation of learners (Xu & Li, 2024).

CONCLUSION

AI stands out as a significant technological advancement with the potential to revolutionize nursing education. Its advantages, such as providing interactive learning experiences, rapid access to information, and enhancing student learning, make this technology a valuable tool in education. However, the potential risks of AI on academic integrity, ethical violations, data privacy, and independent thinking necessitate a careful and informed approach to its use. In particular, integrating AI chatbots, such as ChatGPT, into nursing education has great potential to improve students' learning experiences and prepare them for a rapidly changing healthcare environment. However, incorrect or excessive use of these tools can decrease students' original thinking and critical reasoning skills. Therefore, nursing educators must establish clear guidelines for ethical use, provide students with the ability to critically evaluate AI resources, and develop methods that encourage independent learning. Although the application of AI in nursing is still in its early stages, it is expected to provide important scientific insights in the future. In this process, ongoing research is important to explore best practices of AI in education and understand its impact on student learning while addressing ethical and legal concerns. As Nobel Peace Prize winner Christian Lous Lange said, "Technology is a useful servant but a dangerous master." Accordingly, AI's responsible and conscious use can help avoid potential pitfalls in nursing education and maximize its benefits. AI opens the door to an innovative transformation in nursing education. Nursing educators who adopt an ethical, responsible, and critical approach can effectively integrate this technology into education, prepare their students for the requirements of the rapidly changing technological environment in health care, and contribute to the advancement of the profession. Strengthening the technological infrastructure, ensuring

equality, establishing interdisciplinary collaboration, and establishing a standard model in education can be listed among the basic recommendations for the effective use of AI in nursing education. As a result, integrating AI into nursing education can provide an innovative restructuring of education by moving technology beyond being a mere tool. Using AI tools to complement human interactions can help students develop essential skills such as complex problem-solving, critical thinking, and collaboration. However, it should be noted that AI technologies cannot replace professional nursing skills but can support them.

ETHICAL DECLARATIONS

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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