**Elsaid Nassef and, Israa Abou Zeid**

# ARTIFICIAL INTELLIGENCE IN NURSING EDUCATION:
## A descriptive literature review of the evidence

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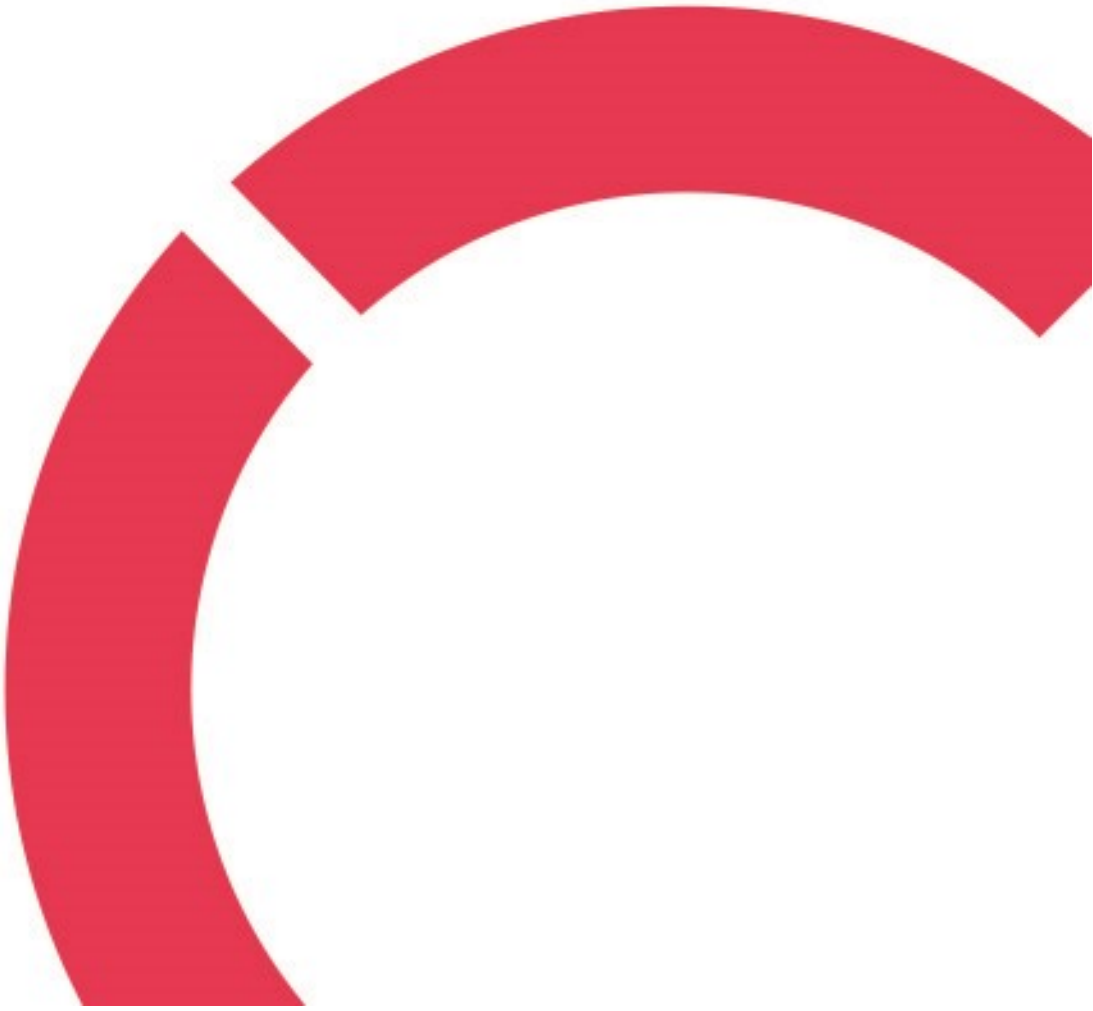

**ABSTRACT**

| Centria University of Applied Sciences | Date<br>May 2024 | Authors<br>Elsaid Nassef and, Israa Abou Zeid |
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| **Degree programme**<br>Bachelor of Health Care, Nursing | | |
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In the evolving landscape of nursing education, the integration of artificial Intelligence (AI) stands as a transformative force, yet literature addressing its implications, particularly in the Finnish context, remains limited. This thesis endeavors to fill this gap by conducting a descriptive literature review aimed at elucidating the role of AI in nursing education, examining its implications, and informing strategies for effective integration into curricula.The purpose of the thesis is to explore innovative ideas using artificial intelligence in nursing education. The aim of the study intends to further the conversation on artificial intelligence in nursing education while also benefit Centria University of Applied Science's nursing programs, instructors, and students.

Using a descriptive literature review technique, this study investigate the body of research on artificial intelligence's use in nursing education using a descriptive literature review, which examines previously published research data, was used to complete this thesis. In data collection, four databases were used: CINAHL, SCIENCE DIRECT, PUBMED, and MEDLINE. 13 articles were selected for content analysis from these databases. In order to gather data, extensive searches were performed using terms like artificial intelligence, virtual reality, nursing, nursing education, and AI technologies across global databases. Relevant research articles that meet the requirements for inclusion criteria were reviewed, analyzed and summarized to find utilization patterns of AI in nursing education, advantages and gaps in the literature.

Findings indicate that artificial Intelligence (AI) technology, such as virtual assistants, extended reality, chatbots, and virtual reality simulations provide a potential path to improve nursing education outcomes, such as students' enhanced performance, improve clinical competency for complex nursing procedures, and enhance critical thinking abilities. Despite the possible advantages, ethical issues including privacy concerns and academic integrity demand that AI be carefully integrated and supervised in educational contexts. The study also emphasizes the need for continued investigation into the efficacy and significance of AI in nursing education, with a focus on closing implementation gaps and guaranteeing ethical norms. Investing in nursing educator training, and creating extensive instructional programs that strike a balance between traditional educational methods and AI technology innovations with alignment to the best practices in pedagogy. In summary, incorporating AI into nursing education has the potential to significantly alter the way that learning occurs and better equip future nurses to meet the demands of modern healthcare settings. However, to optimize AI's advantages while reducing its possible drawbacks, close attention to educational, practical, and ethical issues is essential.



Key words: Artificial intelligence, nursing, nursing education, virtual reality.

**CONCEPT DEFINITIONS:**

AI: Artificial intelligence.

AIHT: Artificial Intelligence healthcare technology

AR: Augmented reality

CDM: Clinical decision making

ICN: International Council of nursing

VR: Virtual Reality

XR: extended reality

**CONTENTS**

# 1 INTRODUCTION

In the contemporary landscape of healthcare, artificial intelligence (AI) looms large as a transformative force. However, despite its significance, literature addressing the implications of AI in nursing education, particularly in the Finnish context, is notably scant. Compounding this scarcity, within clinical environments, nursing leaders and educators often confront formidable obstacles in understanding the integration of AI into nursing education. This highlights a critical imperative: the urgent necessity for nursing students to understand the ramifications of AI. Such comprehension is indispensable for preparing them to adeptly navigate the ever-evolving technological landscape of nursing education. Thus, this study aims to undertake a descriptive literature review to elucidate the existing evidence regarding AI's role in nursing education, shedding light on its implications and informing strategies for effective integration into curricula.

AI is in the continuous revolution improvement stage, and more investigations and research are needed in Finland to provide up-to-date statistical data that will help understand the extent of AI usage and its benefits to nursing and healthcare in Finland (Lyijynen, & Jänis, 2020). Meanwhile, nursing students do not have a clear picture of machine learning and natural language processing and it is not included in the existing nursing undergraduate or postgraduate curriculum (O'Connor, Yan, Thilo, Felzmann, Dowding & Lee 2022). For instance, registered nurse in Finland should demonstrate competencies of using digital, innovative healthcare technology needed in nursing, used in providing holistic patient and family centred care and guidance based on the up to date evidence based practices, additionally, the graduated nurse should demonstrate the ability to improve the nursing quality and development of innovative ideas using research knowledge to support the nursing care and clinical decision making (Korhonen 2020).

Faculties of nursing and midwifery need to invest as well in educators to be aware and gain the knowledge and skills needed to teach Artificial intelligence-based technologies in nursing education, at the meantime research needed to evaluate the efficiency of artificial intelligence based technologies in nursing and midwifery education (O'Connor et al. 2022).

# 2 THEORETICAL BACKGROUND

Within scholarly discourse, diverse definitions of "nursing" have been articulated through literature. One notable perspective, dating back to the 19th century, is Florence Nightingale's characterization of nursing as the endeavor to optimize the patient's condition in the best way to facilitate natural healing processes (Nightingale 1860, 133).

The international council of nursing defined nursing as it encompasses health promotion, illness prevention, care provision for diverse populations including the sick, disabled, and dying, advocacy, environmental safety promotion, research, health policy shaping, patient and health systems management, and the profound privilege of empathetic engagement in individuals' lives, facilitating informed decision-making regarding health, birth, and death while providing steadfast support throughout their journeys (ICN 2002). As nursing education evolves quickly, it's crucial to approach the integration of AI into the curriculum with careful planning and mindful execution. The introduction of Generation AI into educational settings has stirred up discussions about the potential upsides and challenges it brings (De Gagne 2023, 1). In the following subchapters, the authorss will discuss the theoretical background including artificial intelligence, technology enhanced learning, utilization of AI technology applications, ChatGPT, AI-based Clinical Decision Support (CDS) tools, Virtual reality (VR), extended reality (XR), and its utilization on nursing education.

## 2.1 Artificial Intelligence

The definition of AI has evolved since its inception, with the core concept being that machines can emulate human-like performance (O'Connor 2023). Artificial Intelligence is an umbrella and all-encompassing term that aims to enable computers to replicate human-like cognitive processes and mimic human actions (Robert 2019). AI Systems include both software and hardware created by humans and aim to achieve complex goals by operating in either the physical or digital domain. These systems are involved in making sense of their surroundings by acquiring data, analysing the collected data, whether structured or unstructured, and applying reasoning to the knowledge derived from this information (AI HLEG 2019, 6).

Artificial intelligence (AI) includes a wide range of technologies used to teach computers how to replicate human-like behaviors, including analysis, communication, teaching, and decision-making

(Van Bulck, Couturier & Moons 2023). The goal of AI is to solve problems efficiently and quickly, surpassing human capabilities in the process (Robert 2019). Artificial Intelligence (AI) is driving radical changes across societies, organizations, work environments, and educational settings, becoming an integral part of daily life. The integration of artificial intelligence (AI) in nursing and academia is recognized as a force for change, as AI systems augment human capabilities rather than replace them. Unique human elements such as empathy and interpersonal skills continue to be important in nursing and education. (De Gagne 2023, 2). Our next chapter will discuss the technology enhanced learning.

## 2.2 Technology-Enhanced Learning

Technology-enhanced learning, including AI applications, has been shown to enhance nursing students' performance, competence, and overall educational outcomes. It can contribute to the future advancement of nursing education, research, and curriculum development (O'Connor et al. 2022). Using AI technology in nursing education has contributed to the success in learning and teaching for both students and educators (O'Connor 2021). In addition, Technology enhanced learning resulted in improving the students' performance, nursing competencies, and outcomes that support the faculty future improvement, research and curriculum of nursing and midwifery education (O'Connor, Kennedy, Wang, Ali, Cooke, & Booth 2022).

A recent study suggests that artificial intelligence is seen as an opportunity to improve nursing skills and promote open communication; artificial intelligence holds promise for providing personalized learning experiences and promoting inclusive education. This potential for change requires a reshaping of the roles of nursing and academia, making it urgent to prepare for an AI-integrated future. (De Gagne 2023.)

Over the years, AI has become increasingly complex, cross-disciplinary, and multipurpose, driven by advances in technology. AI's intelligent capabilities have expanded to industries such as healthcare, logistics, and manufacturing, as well as in the development of robotics, Chabot's, and face recognition technology (O'Connor 2023.)

## 2.3 Utilization of AI technological applications

One important recent finding indicates that the utilization of AI technological applications, chatbots, and virtual assistants in nursing education in Finland has yielded noteworthy outcomes. These technologies have been effectively employed to aid nursing students in tasks such as patient screening, monitoring, and data analysis. The incorporation of AI technology into nursing education is poised to enhance the efficiency of nurses within the contemporary healthcare work environment (Zhang 2019). The application of ChatGPT and Metaverse technologies in nursing education enhances skills and confidence by offering immersive, personalized learning experiences for remote patient monitoring. This integration equips nurses with essential skills, contributing to improved patient outcomes and elevating the overall quality of nursing practice. (Sharma & Sharma 2023.)

Nevertheless, the potential misuse of AI in education, particularly in the context of nursing assessments, raises concerns regarding academic integrity and the erosion of critical thinking skills. While AI chatbots can play a role in preventing plagiarism by guiding students on proper citation practices, their irresponsible use may inadvertently lead to academic misconduct. As the Nursing profession emphasizes critical thinking and creativity, the uncritical reliance on AI software for assessments may compromise the quality and accountability of nursing education programs, necessitating careful consideration of ethical implications and the development of safeguards. OpenAI, a leading research institute, underlines the importance of advancing AI research responsibly for the benefit of humanity (O'Connor 2023.)

## 2.4 Utilization of ChatGPT on nursing education

A recent study discussed the effects of ChatGPT on nurse education, the authors highlight the potential challenges and benefits of Integrating artificial intelligence language models, nurse educators can strategically leverage ChatGPT to enhance critical thinking in nursing students through assignments like care plan development. Its use in discussions enriches perspectives, and educators reviewing conversation logs can identify learning gaps. While technological advances predict increased integration, it is crucial for ChatGPT to complement, not replace, human interaction in nursing education. (Choi, Lee, Ho, Kwok, & Lok 2023, 2-3.) One important recent finding indicates that artificial Intelligence (AI) in education; particularly AI Chabot’s, offers personalized learning but raises concerns in nursing assessments. While AI can prevent plagiarism, its misuse may compromise

critical thinking. Balancing innovation with ethical considerations is crucial to safeguarding academic integrity in nursing education. (O'Connor 2023.)

In addition, iinnovative technologies such as ChatGPT and Metaverse have brought about a significant transformation in the field of nursing education. These technologies offer customized and immersive learning opportunities that improve students' skills, self-assurance, and proficiency in making decisions. While ChatGPT aids in accessing updated research and guidelines, the Metaverse offers secure practical training, fostering collaboration and skill development. Although ongoing research indicates promise, Addressing ethical concerns is crucial, yet the potential integration of these technologies holds promise for a comprehensive, personalized approach to nursing education, contributing to better-prepared professionals and improved patient outcomes (Sharma & Sharma 2023.).

Despite its potential, ChatGPT poses challenges to nursing education. careful consideration needs to be taken as there is still under investigations more roles are not clear regarding clinical judgement and context specific responses. Ethical concerns, including privacy issues related to reviewing conversation logs, must be addressed. Empirical research is essential to assess the impact of ChatGPT on critical thinking, clinical reasoning, and teaching practices. While AI technology is a valuable tool, it should complement, not replace, human interaction in nursing education. Awareness of these drawbacks is crucial to maintaining a balanced and effective approach to Integrating AI in nurse education. (Choi et al. 2023, 2-3.)

### 2.5 Utilization of AI-based Clinical Decision Support (CDS) tools on nursing education

The implementation and use of AI-based Clinical Decision Support (CDS) systems in the healthcare industry is being investigated. Despite their recognized potential in enhancing healthcare delivery and improving patient outcomes, the slow adoption necessitates understanding key factors and nursing education aiming to identify implementation gaps and serve as a foundational resource for future research contributing to their effective use in diverse healthcare settings (Bajgain, Lorenzetti, Lee & Sauro 2023). This advancement is expected to contribute to improved healthcare outcomes by providing valuable support in clinical decision-making, guiding patient monitoring processes, facilitating data analysis, reducing costs, and addressing nursing shortages effectively. The integration

of AI in nursing education in Finland reflects a strategic and progressive approach to preparing nurses for the evolving demands of the healthcare sector (Zhang 2019).

### 2.6 Utilization of Virtual reality (VR) on nursing education

Virtual reality (VR) denotes an immersive digital technology, originally conceived in the 20th century, where computer devices and hardware enable engagement within an artificially created sensory environment. VR technology possesses the Capability to construct a standardized, secure, and adaptable virtual setting, delivering instantaneous, strategic, and goal-directed feedback. (Hu, Yuan, Ye, Chang, Hu, Zhang, & Li 2023). The potential efficacy of Immersive visual reality (VR) simulations in nursing education, emphasizing positive student attitudes. The VR Simulation demonstrated satisfactory usability, suggesting the need for further enhancements. Findings affirm the importance of authentic replication of nursing care, particularly in communication, participation, and technical aspects. Technical support is crucial when integrating new educational technologies, and VR Simulation should complement traditional methods. The study's outcomes guide educators in selecting user-friendly teaching approaches, emphasizing the significance in nursing education (Mäkinen, Haavisto, Havola, & Koivisto 2023, 3217.)

Recent research on virtual Simulation and serious gaming in critical thinking, clinical reasoning, clinical judgment, and critical decision making indicates generally positive outcomes in Enhancing Cognitive skills among undergraduate Nursing students. Considering the increasing complexity of decision-making in nursing, particularly in Critical Decision Making (CDM), there's a growing imperative for innovative teaching methods like VR to bolster and refine these skills. However, the literature emphasizes the necessity for more rigorous research to ascertain the effectiveness of 3 dimension Immersive virtual reality in advancing clinical decision-making skills among undergraduate nursing students. (Jans, Bogossian, Andersen &Levett-Jones 2023.) Moreover, another study highlights the effecticiency of 3D Simulation videos using VR in improving knowledge, self-confidence, and Satisfaction among nursing students for safe blood transfusion practice, suggesting the significance of virtual reality as an essential pedagogical option in nursing learning (Lee, Tsang, Chan, O'Connor, Lokmic-Tomkins, Ye, & Ho 2023, 7).

## 2.7 Utilization of extended reality (XR) on nursing education

Furthermore, a recent study about the experiences of instructors using extended reality (XR) in nursing practice education demonstrated that XR use in nursing education improved learners' competencies by enabling them to experience the full patient care process and by strengthening their critical thinking and clinical judgment abilities. However, limitations were noted, such as decreased immersion and concentration over time, emphasizing the importance of a blended learning approach that combines XR education with traditional methods. The study suggests that Addressing instructors' lack of experience with XR, providing technical support, and enhancing the systems can improve the application of extended reality in nursing practice learning environment, potentially contributing to improved learning outcome. Additionally, the results highlight the need for further research to develop comprehensive reality nursing education programs and establish supportive policies for collaboration among experts in the field (Kim & Jeong 2023, 8.). In addition, the application of XR in educating nurses, exemplified by Collaborative efforts at an Australian university, enriches simulated learning by providing Immersive 3D experiences, enhancing students' psychomotor, affective, and Cognitive skill acquisition (Fealy, Irwin, Tacgin, See, & Jones 2023, 227).

In regards to higher education for future nurses, the application of smart glasses in learning activities holds promise as a technology-enhanced learning tool, potentially preparing students for technologically influenced clinical practices and enhancing motivation and engagement; however, careful consideration of drawbacks, such as the necessity for a well-functioning infrastructure and technical support, is crucial for effective implementation. (Romare & Skär 2023, 6) Moreover, A recent study highlights the transformative effect of 14-week online course on competency-based writing, incorporating AI-powered assessment tools, on on the writing performance and self-efficacy of nursing students, addressing gaps in educating nurses and advocating for the application of mandatory scholarly writing courses, and AI-powered automated essay scoring to enhance communication skills and improve critical thinking skills essential for safe practicing of nursing (Wolf & Wolf 2023).

# 3 PURPOSE, OBJECTIVES AND RESEARCH QUESTIONS

The purpose of the thesis is to explore innovative ideas using artificial intelligence in nursing education. The objectives, this thesis aimed to explore the scientific literature on the implications of artificial intelligence technologies in nursing education, which will be beneficial for Centria University of Applied Science nursing undergraduate and postgraduate programs, research and development, nursing educators and the nursing students in universities of applied science, using the following questions.

1. How is artificial intelligence being applied in nursing education?
2. What are the benefits of using artificial intelligence technologies in nursing education?

# 4 METHODOLOGY

This section provides an overview of the descriptive literature review method utilized in this thesis. Additionally, the research process is outlined, including criteria for database selection, the search process, and subsequent analysis. Finally, a table summarizing the 13 selected articles for analysis is presented at the conclusion of this chapter.

Research methodology is used to identify, analyse, evaluate the problem, answer the research question, and determine the nature of the topic, the descriptive literature review approach is used to revise, inspect, evaluate, explore, and understand a phenomenon (Wood & Haber 2017, 105.). Literature reviews encompass various approaches, including descriptive, systematic, and meta-analysis methodologies (Polite &Beck 2003, 24). In this chapter the authors will discuss thesis implementation process which includes operational environment, method of research, how the data will be collected and analysed.

## 4.1 Operational environment

This thesis was conducted at Centria University of Applied Sciences and aimed to benefit nursing students, nursing educators, the nursing program, and research and development in nursing education amid the era of artificial intelligence.

## 4.2 Research method

Literature review means an in-depth comprehensive evaluation and review of the existing knowledge to answer the research question, it requires the researcher to identify weaknesses and strengths in prior research and understand the research questions and the significance of the study. In addition, it has essential functions to identify the problem of the research, orientate about what is already known and what is still vague and needs more investigations and research, identify research gaps, develop new evidence, implications, refine clinical intervention, and provide a guide for us and recommendations for the development of evidence-based practices and quality improvement projects (Polite &Beck 2003, 23- 88.). In the descriptive literature review, current research studies and publications are

comprehensively summarized, and synthesized by an intensive approach to identify the trends of the phenomenon and the currently available state of knowledge (Wood & Haber 2017, 108).

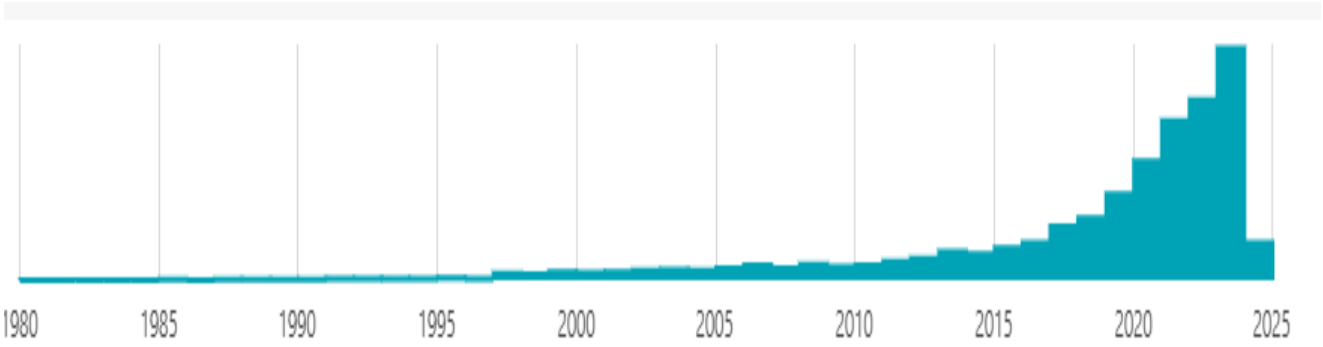
### 4.3 Data collection

A comprehensive descriptive literature review and investigation of the current body of knowledge is the data collection method. Centria University of Applied Science provides access to the local and international databases for nursing students. In this study, after determining the clinical question, identifying key concepts and variables, and defining inclusion and exclusion criteria (Table 1), electronic research was conducted for the current body of knowledge and publications to review the publications and exclude irrelevant resources, bibliographic and abstract electronic database including CINAHL, SCIENCE DIRECT, MEDLINE, and PUBMED. Searching in database using keywords, research title, and research question, relevant sources then retrieved and stored, preliminary reading conducted to eliminate irrelevant abstracts then critically reading all the available publications that focus on the thesis topic, summarize it, and synthesize critical summaries of the literature (Wood & Haber 2017, 69;70.). Keywords used during the search in electronic databases are artificial intelligence, nursing, nursing education, virtual reality and AI technology. Table 1 below lists the inclusion and exclusion criteria chosen for this thesis; their rationales are subsequently discussed.

TABLE1. Inclusion and exclusion criteria for the study

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| ▪ **Study materials focused on artificial intelligence, AI technology in nursing, and nursing education** | ▪ **Irrelevant Study material that doesn't focus on on artificial intelligence, AI technology in nursing, and nursing education** |
| ▪ **Full text is available** | ▪ **Full text is not available** |
| ▪ **Peer reviewed publications** | ▪ **Study that has not peer reviewed** |
| ▪ **Scientific publications that originate from the database** | ▪ **Authorss opinions, unknown publications, and editorials.** |
| ▪ **Publications between years 2019-2024** | ▪ **Publications before 2019** |
| ▪ **Original scientific publications from the**<br>▪ **databases** | ▪ **Opinion pieces, editorials, and publica-tions not from the databases** |
| ▪ **Studies that are published in English** | ▪ **Other languages** |

This thesis research explores studies articles spanning the years 2019 to 2024, sourced from the Centria-Finna database. Notably, the landscape of Artificial Intelligence (AI) in nursing education research has witnessed a remarkable surge during this period. Concurrently, AI has undergone revolutionary transformations in healthcare, necessitating the imperative for research to remain current and relevant. The depicted trend is illustrated in Figure 1 (see Figure 1). Upon querying the international electronic resources section with the keyword "Artificial Intelligence in nursing education," the database yielded the results outlined here (Centria-Finna, 2022).




Furthermore, through the exclusion of older studies, the authors can access more recent and pertinent information concerning the study phenomenon, aligning more closely with contemporary professional contexts. The utilization of precise search terms pertinent to the subject matter enables the exclusion of irrelevant studies, thus enhancing the relevance and applicability of findings to the thesis at hand.

Peer review ensures research validity and quality for publication, making peer-reviewed articles more reliable. This thesis exclusively relies on peer-reviewed scientific publications for their evidence-based knowledge. It excludes non-peer-reviewed studies, opinion pieces, and editorials. Full-text analysis is prioritized over abstracts to avoid misconceptions. English is chosen as the primary language due to its universal scientific usage and due to availability of the published studies in English language. The purpose of peer review is to evaluate the accuracy and caliber of research prior to publication. Its primary objective is to uphold scientific integrity by identifying and filtering out articles of dubious validity or inferior quality, thereby endowing peer-reviewed articles with greater reliability compared to their non-peer-reviewed counterparts (Wiley 2022).

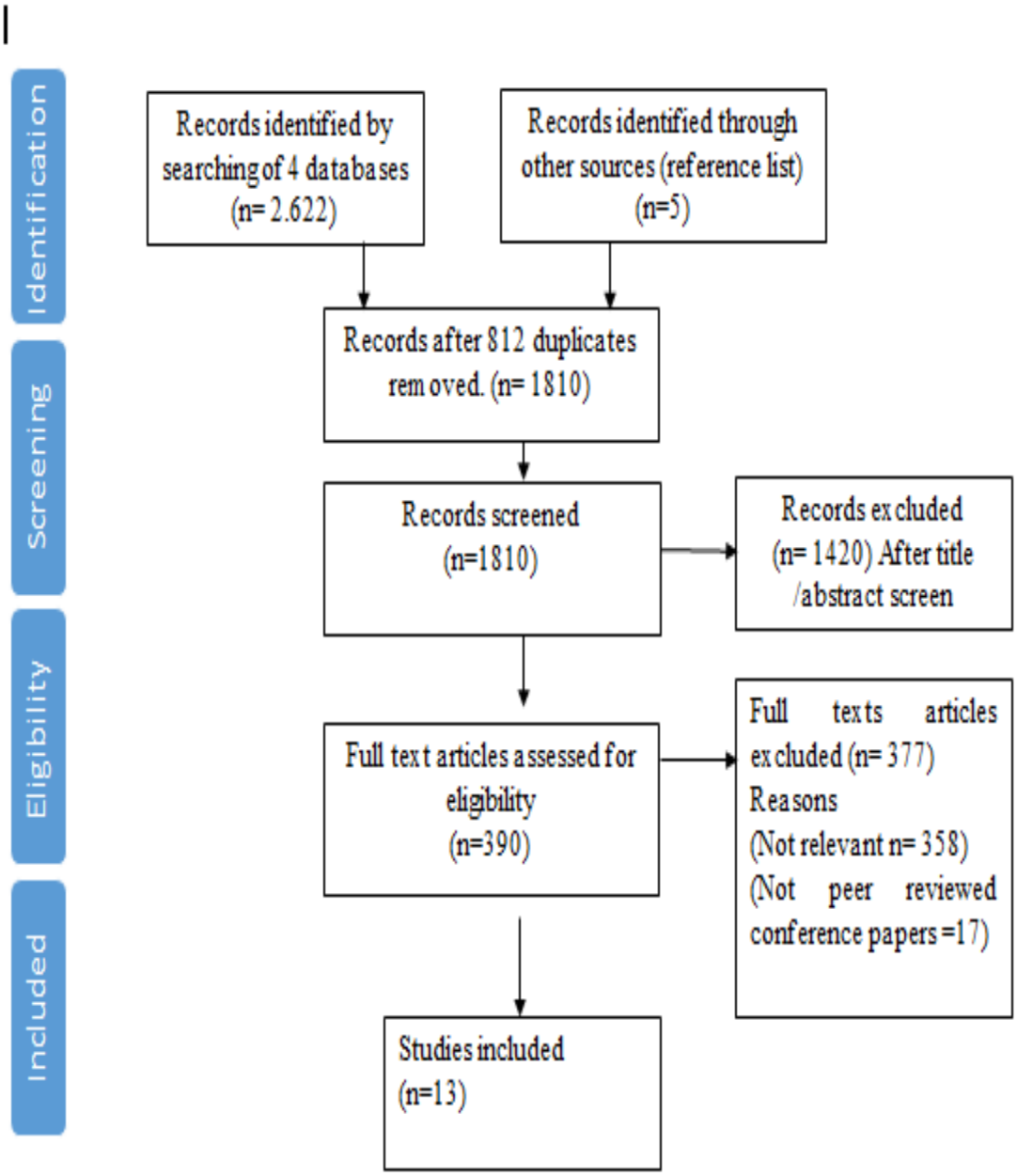



FIGURE 2 Flow chart outlining literature search and selection process. Prisma flow diagram (Adapted from Moher, Liberati, Tetzlaff & Altman 2009)

TABLE 2 the chosen articles for the analysis (n =13).

| Authorss, title & Country | Purpose of the study | Methods | Study participants/subjects/sample | Main results |
|---|---|---|---|---|
| Choi, E. P. H., Lee, J. J., Ho, M., Kwok, J. Y. Y., & Lok, K. Y. W. (2023). Chatting or cheating? The impacts of ChatGPT and other artificial intelligence language models on nurse education. Hong Kong | To explore the effects of ChatGPT and similar AI language models on nurse education, focusing on how these technologies might influence critical thinking skills, independent thought, and communication among Nursing students. | The research methodology employed is likely qualitative in nature, involving literature review and analysis of existing concerns and debates regarding the use of ChatGPT in academia, particularly in Nursing education. | The study participants include nursing students and educators, as well as possibly experts in artificial intelligence or education technology. The sample consists of individuals from various educational institutions or nursing programs. | The study underscores the importance of balancing the integration of AI technologies like ChatGPT with traditional learning methods to ensure the Holistic development of Nursing students and the preservation of critical thinking skills essential for Nursing practice. Students can benefit from learning how to utilize ChatGPT effectively, enriching discussions by incorporating diverse perspectives and additional information. Nurse educators may review ChatGPT logs, identifying student misconceptions to enhance teaching materials, respecting student privacy and autonoour. While ChatGPT has potential for educational improvement, concerns exist about its impact on critical thinking. Further research is needed to understand its effects on learning outcomes, educator workload, and ethical considerations. Despite its growing use, AI technology should complement rather than replace human interaction. |
| Fealy, S., Irwin, P., Tacgin, Z., See, Z. S., & Jones, D. (2023). Enhancing Nursing Simulation Education: A Case for Extended Reality Innovation. Australia | To explore the use of extended reality (XR) technology in Nursing education.<br><br>To investigate how XR technology, including augmented, mixed, and virtual reality (AR, MR, VR), | Document analysis of three case studies developed at one regional university in Australia. | Three case studies developed at one regional university in Australia. | The integration of XR technologies in Nursing education provides a ground-breaking approach, surpassing traditional methods by enabling 3D visualization, dynamic observation, and immersive experiences. Collaboration between educators and XR Specialists at an Australian university resulted in three impactful case studies, showcasing XR's potential to enhance simulated learning. XR's diverse media |

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| | can offer immersive, hands-on learning experiences for Nursing students. | | | capabilities offer students active engagement in virtual environments, facilitating skill acquisition in psychomotor, affective, and cognitive domains. |
| Hu, Y., Yuan, X., Ye, P., Chang, C., Hu, Y. H., Zhang, W., & Li, K. (2023). Virtual Reality in Clinical Nursing Practice Over the Past 10 Years: Umbrella Review of Meta-Analyses. China. | to synthesize the combined evidence from meta-analyses that assessed the effects of nurses using VR technology on nursing education or patient health outcomes. | Umbrella review by searching Web of Science, Embase (Ovid), Cochrane Library, PubMed, and relevant reference lists. Eligible studies were published between December 1, 2012, and September 1, 2023 | 768 records were identified; 74 meta-analyses were included for review studies were meta-analyses of randomized controlled trials (RCTs), cross-over studies, pre-post studies, interrupted time series studies, quasi-controlled trials, case reports, controlled trials, or controlled clinical trials | The clinical applications of Virtual Reality (VR) in Nursing practice predominantly focus on various specialties including neurology, paediatrics, oncology, surgical and wound care, and gerontology. The integration of XR technologies into Nursing education offers innovative solutions for Enhancing simulated learning experiences. Frameworks such as Technological Pedagogical Content Knowledge (TPCK) and the Substitution, Augmentation, Modification, Redefinition (SAMR) model guide educators in effectively Integrating technology. However, empirical efficacy testing and sustainable integration into curriculum remain key challenges that need to be addressed to fully harness the potential of XR in Nursing education. |
| Jans, C., Bogossian, F., Andersen, P., & Levett-Jones, T. (2023). Examining the impact of virtual reality on clinical decision making – An integrative review. Australia | To examine the impact of virtual reality on clinical decision making in undergraduate nurses through an integrative review. | An integrative review was conducted using Whittemore and Knafl's framework for integrated reviews. Data sources included healthcare Databases between 2010 and 2021 | Undergraduate Nursing students | The use of virtual reality (VR) has shown its potential to improve undergraduate nurses' critical thinking, clinical reasoning, clinical judgment, and clinical decision-making skills. The review highlighted the positive impact of virtual simulation and serious gaming on developing clinical decision-making skills among undergraduate nursing students. Further research is required to determine the effectiveness of 3D Immersive virtual reality in developing, improving, and Enhancing undergraduate nursing students' clinical decision-making skills. |
| Kim, J., & Jeong, H. (2023). Instructor's | to understand instructors' experiences | Focus group interviews were conducted online | 15 participants of nursing instructors who applied XR to | Findings suggest that XR education in nursing requires careful consideration of |

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|---|---|---|---|---|
| Experience of Extended Reality Applied to Nursing Education. Korea | with XR-applied nursing practicum education | from August 12, 2022, to September 2, 2022, and the data were analyzed using qualitative content analysis | undergraduate nursing students and nurses. including 10 nursing professors in charge of the baccalaureate nursing program and five nurses in charge of educating new or experienced nurses | design elements, environment, instructor preparation, and systematic research to maximize its effectiveness and address potential limitations. Collaboration among educators, experts, and institutions is crucial for advancing XR education in nursing |
| Lee, J. J., Tsang, V. W. Y., Chan, M. M. K., O'Connor, S., Lokmic-Tomkins, Z., Ye, F., Ho, M. (2023). Virtual reality simulation-enhanced blood transfusion education for undergraduate nursing students: A randomised controlled trial. Hong Kong, China | To develop virtual reality (VR) Simulation for blood transfusion (BT) practice and investigate its effectiveness with Nursing students. The aim was to address limitations in clinical placement for Nursing students by adopting technology-guided Simulation pedagogies, specifically VR simulation, for clinical skills education in the context of blood transfusion. | The study utilized a single-blinded, two-arm randomized controlled trial (RCT) design. VR Simulation videos were developed for blood transfusion education, and Nursing students were randomly allocated into intervention and control groups. | The study recruited a total of 151 Nursing students enrolled in a Nursing undergraduate course at a university in Hong Kong. Convenience sampling was utilized, and all undergraduate Nursing students enrolled in the 'Nursing of Adults' course were invited to participate. The students were evenly distributed between the intervention and control groups, with no statistically significant differences observed in demographic characteristics between the groups. | The results of the review highlight the evolving role of artificial intelligence (AI) in nursing education. Various machine learning techniques, such as decision trees and deep learning algorithms, are used to predict outcomes like student attrition and graduation. Challenges persist regarding the knowledge and attitudes of nursing professionals towards AI in healthcare, emphasizing the need for enhanced education and training. While AI offers potential benefits in personalized learning and predictive analytics, careful consideration of ethical implications and the Equitable integration of AI into Nursing education is essential for its effective implementation. |
| Mäkinen, H., Haavisto, E., Havola, S., & Koivisto, J. (2023). Graduating nursing students' user experiences of the immersive virtual reality simulation in learning. Finland | To describe Nursing students' user experiences of highly Immersive virtual reality Simulation. | The research method employed was a qualitative descriptive study enriched with quantitative data. Data collection included individual interviews with Graduating nursing students (n = 41). | The study participants consisted of graduating Nursing students, with a total sample size of 41 students. Demographic characteristics of the participants included gender distribution, age range, and previous Gaming experiences. Most participants were women (85%) and aged 21-25 years. Additionally, over half of the participants had no previous experience with VR technology. | The research strongly advocates for the adoption of highly Immersive virtual reality (VR) simulations in nursing education, emphasizing the need for simulations to accurately replicate real-life Nursing scenarios. Technical support is deemed essential when integrating new technologies into educational settings. Additionally, the study underscores the significance of user experience (UX) considerations within an educational framework. |

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|---|---|---|---|---|
| O'Connor, S. 2021. Artificial intelligence and predictive analytics in nursing education. United Kingdom, United States | To review the application of artificial intelligence (AI) in Nursing education, exploring its history, current status, challenges, and potential future directions. | A literature review synthesizing various studies and perspectives on the use of AI in Nursing education. It includes scoping reviews, empirical studies, surveys, and theoretical discussions. | The study participants include Nursing students, nurse faculty, practicing nurses, and researchers in the field of Nursing education. Sample sizes vary across studies, ranging from online survey participants to participants in empirical studies involving AI-based interventions. | Study recommended use of machine learning techniques such as decision trees, neural networks, and deep learning algorithms in predicting outcomes like student attrition and graduation. . |
| O'Connor, S., Yan, Y., Thilo, F. J. S., Felzmann, H., Dowding, D., & Lee, J. J. (2022). Artificial intelligence in nursing and midwifery: A systematic review. United Kingdom, Hong Kong, Switzerland, and Ireland. | To synthesize literature on the application of Artificial Intelligence (AI) in Nursing and midwifery, aiming to understand its real-world applications across various domains within these professions. | The researchers conducted a systematic review Data extraction, analysis, and presentations were done using a descriptive summary. The review followed the PRISMA checklist for conduct and reporting. | The study did not involve direct participants but synthesized literature from 140 articles related to AI in Nursing and midwifery. | AI was predominantly applied in clinical practice to direct patient care, with fewer studies focusing on administration, management, or education. Emphasized the need for digital health datasets to support testing, use, and evaluation of AI in Nursing and midwifery, along with the development of Curricula to educate professionals about AI to lead and participate in digital healthcare initiatives. |
| O'Connor, S., Kennedy, S., Wang, Y., Ali, A., Cooke, S. & Booth, R. G. 2022. Theories informing technology enhanced learning in nursing and midwifery education: A systematic review and typological classification. United Kingdom and Canada. | To synthesize literature on theories that inform technology-enhanced learning in Nursing and Midwifery education, aiming to understand the theoretical frameworks underpinning digital interventions supporting learning in these fields. | Systematic review methodology. | The study did not involve direct participants but synthesized literature from 33 studies, primarily focusing on undergraduate Nursing students utilizing various technology-enhanced learning interventions, including online, mobile, blended, virtual reality, or digital simulations in university settings. | The review identified twenty-nine distinct learning theories. Kolb's Experiential Learning Theory and Driscoll's Constructivist Learning Theory were the most commonly reported theories. Theories were employed to inform the design of technology-enhanced learning interventions or to explain how these interventions could enhance student learning. The review emphasizes the need for more rigorous research to examine the effectiveness of theoretical frameworks in informing and explaining technology-enhanced learning in Nursing education. |

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| O'Connor, S., Yan, Y., Thilo, F. J. S., Felzmann, H., Dowding, D., & Lee, J. J. (2022). Artificial intelligence in nursing and midwifery: A systematic review. United Kingdom and Canada. | To examine the potential of open artificial intelligence (AI) platforms in Nursing education, specifically focusing on their role in assisting students in academic writing tasks and the associated risks of plagiarism and erosion of academic integrity. | A descriptive approach, discussing the functionality and implications of open AI platforms in Nursing education. It showcases the application of AI chatbots in generating written content, particularly in academic contexts, and discusses potential risks and limitations. | The study does not involve direct participants but rather discusses the implications of AI technology for Nursing education, with a focus on Nursing students, faculty, and academic institutions. | AI chatbots, including platforms like ChatGPT, have the potential to support personalized learning experiences for Nursing students, offering assistance in tasks such as language learning, tutoring, and time management.<br>While AI chatbots can help prevent plagiarism by providing citation assistance and guidance on academic integrity, there are concerns about their responsible and ethical use. Misuse of AI chatbots could inadvertently lead to plagiarism, erosion of assessment quality, lack of accountability among students, and devaluation of educational assessments. |
| Park, S., & Yoon, H. G. (2023). Effect of Virtual-Reality Simulation of Indwelling Catheterization on Nursing Students' Skills, Confidence. Republic of Korea. | The study examines the Impact of Virtual-Reality (VR) Simulation on Nursing students' skills, confidence, and Satisfaction in Performing indwelling catheterization. | A quasi-experimental design compared VR practice in a simulated hospital environment with traditional mannequin practice in an open laboratory. | 44 sophomore Nursing students participated, showing increased skills in both groups, with significantly higher confidence and satisfaction in the VR group. | Findings suggest VR practice enhances confidence and satisfaction, offering a potential solution to improve complex nursing skills.<br>The study emphasizes the importance of innovative educational methods like VR Simulation in Nursing skill development, particularly in challenging procedures like indwelling catheterization. |
| Wolf, R. R., & Wolf, A. (2023). Using AI to Evaluate a Competency-Based Online Writing Course in Nursing. United States | To explore the impact of a 14-week fully online competency-based writing course on master's Nursing students' self-efficacy, task value, and writing performance. | Study utilizes a quasi-experimental design to investigate the experience of master's Nursing students in a discipline-specific online writing course and measure its effects on students' writing capacity, self-efficacy, and task value. Pre- and post-intervention assessments were conducted using an AI-powered writing assessment (IntelliMetric®) and the SAWSES self-efficacy survey. | A total of 64 participants Participants were master's Nursing students enrolled in a, initially enrolled as 68, were included in the study after excluding four students who dropped out of the course. | Improvement in Self-Efficacy: Significant Improvements were observed in students' self-efficacy across all three subscales for writing self-efficacy, including writing essentials, relational reflective writing, and creative identity. Post-intervention scores were significantly higher than pre-intervention scores, indicating a significant enhancement in students' reported self-efficacy after completing the Writing Workshop. The effect sizes for these differences were large, demonstrating both clinical and statistical significance. The study also highlights the effectiveness of the cognitive apprenticeship approach, showing significant |

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| | | | | growth in students' writing performance with an effect size matching the desired effects of one-on-one tutoring. |

### 4.4 Data analysis

In this thesis, using content analysis, 13 articles (n=13) were analysed. Content analysis is a summarized form describing the study phenomenon in an organized manner chronologically, existing research will be presented first then the research studies derived from the concept, reading the full text of each published article using data extraction form, including the authors of the article, publication year, aim of the study, research methods, main results, and analyzing the content by finding similarities, differences, strengths, weakness, gaps, providing critique and synthesizing the results (Wood & Haber 2017, 77;79.) The table 2 below shows all the study articles (n= 13) in alphabetical order, and it provides a summary of every article, containing original result, condensed meaning, category, and subcategory. (TABLE 3.)

TABLE 3. Content analysis on Application of Artificial intelligence in nursing education.

| Original Result | Condensed Meaning | Subcategory | Category |
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| The study underscores the importance of balancing the integration of AI technologies like ChatGPT with traditional learning methods to ensure the Holistic development of nursing students. Choi et al. 2023<br><br>AI chatbots have the potential to support personalized learning experiences for nursing students, offering assistance in tasks such as language learning, tutoring, and time management. O'Connor et al. 2022<br><br>AI chatbots, including platforms like ChatGPT, have the potential to support personalized learning experiences for nursing students. O'Connor et al., 2023 | Importance of balancing AI integration with traditional educational methods. | ChatGPT support personalized nursing learning experiences. | Application of AI in nursing education. |

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| The integration of XR technologies in Nursing education provides a ground-breaking approach, surpassing traditional methods.<br>Fealy et al 2023<br><br>The integration of XR technologies into Nursing education offers innovative solutions for Enhancing simulated learning experiences.<br>Hu et al., 2023 | XR technologies offer innovative approaches and improve learning experience. | XR enhance simulated learning experience for nursing students. | Extended Reality (XR) in nursing education. |
| The use of virtual reality (VR) has shown its potential to improve undergraduate nurses' critical thinking, clinical reasoning, clinical judgment, and clinical decision-making skills.<br>Jans et al. 2023<br><br>Findings suggest VR practice enhances confidence and satisfaction, offering a potential solution to improve complex nursing skills. Particularly in challenging procedures like indwelling catheterization.<br>Park & Yoon 2023<br><br>Study recommended use of VR simulation, in nursing education include enhanced knowledge and satisfaction with blood transfusion practice among nursing students Lee et al., 2023<br><br>The research strongly advocates for the adoption of highly immersive virtual reality (VR) simulations in nursing education.<br>Mäkinen et al., 2023 | VR improves clinical decision-making skills. It enhances confidence and satisfaction, offering a potential solution to improve demonstration of complex nursing skills. | VR enhance simulated learning experience and clinical decision making for nursing students. | Virtual Reality (VR) in nursing education. |
| Study emphasized the need for digital health datasets to support testing, use, and evaluation of AI in Nursing and midwifery, along with the development of Curricula to educate professionals about AI to lead and participate in digital healthcare initiatives.<br>(O'Connor et al. 2022). | Nurses and educators required to be educated on the use of AI in nursing and to be involved in digital healthcare initiatives. | Importance of Digital health dataset learning for nursing students and educators. | Application of AI in nursing education |
| Significant Improvements were observed in students' self-efficacy across all three subscales for writing self-efficacy.<br>Wolf et al., 2023 | Strong recommendation for using AI to Evaluate a Competency-Based Online Writing Course in Nursing | AI enhance Competency-Based Online Writing in Nursing | Application of AI in nursing education |

# 5 RESULTS

In this chapter, study articles are analyzed by analysing the content. The first chapter describes the general information about the study articles such as study database, country of the study, method of research and study participants. The following subchapters focusing on answering the research questions: 1.) How is artificial intelligence being applied in nursing education? And 2.) What are the benefits of using artificial intelligence technologies and in nursing education?

## 5.1 General information about the study articles

The total 13 studies originate from different countries all over the world, One study from Finland (Mäkinen et al., 2023), four studies were conducted in Hong Kong, China (Choi et al., 2023; Hu et al., 2023; Lee et al., 2023; Lee et al., 2023) while two studies originated from Australia (Fealy et al ., 2023; Jans et al., 2023). Additionally, there was two studies each from Korea (Kim & Jeong 2023; Park & Yoon 2023), one study from the United Kingdom (O'Connor, 2021), one study from the United States (Wolf & Wolf, 2023), and two studies from the United Kingdom and Canada (O'Connor et al., 2022; O'Connor et al., 2022), and one study from United Kingdom, Hong Kong, Switzerland, and Ireland (O'Connor et al., 2022.) while another study in United Kingdom, and United States (O'Connor, S. 2021) This diverse geographic distribution underscores the global interest and investigation into innovative educational methods in nursing education.

Three studies employed a qualitative methodology: Choi et al. (2023), Kim & Jeong (2023), and Mäkinen et al. (2023), one study conducted document analysis: Fealy et al. (2023), one study conducted an integrative review: Jans et al. (2023).one study descriptive literature review: O'Connor (2021) Three studies were systematic reviews: O'Connor et al. (2022), O'Connor et al. (2022) & O'Connor et al. (2023). Hu et al. (2023) employed an umbrella review technique in one research. Lee et al. (2023) conducted one study using a randomized controlled trial design, whereas two studies using a quasi-experimental methodology conducted by Wolf & Wolf (2023) and Park & Yoon (2023).

## 5.2 Application of artificial intelligence in nursing education

In the next section, the authors will show the innovative technologies which is applied in nursing education, including artificial intelligence (AI) applications, extended reality (XR), and virtual reality (VR). A study explored the impacts of AI language models like ChatGPT on critical thinking skills and communication among nursing students, stressing the need for balanced integration with traditional methods, the author applied artificial intelligence through a sophisticated chatbot developed by OpenAI, to analyze its impact on nurse education. They explored how ChatGPT's capabilities could impact critical thinking development, learning outcomes, and interpersonal skills among nursing students. (Choi et al. 2023)

In addition, a recent study used an open-source AI platform to simulate student assessments and scientific writing tasks, illustrating potential applications in nursing. It shows that artificial intelligence, exemplified by AI chatbots like ChatGPT, is revolutionizing nursing education by providing personalized learning through tutoring. Homework helps that mimicking human interaction to effectively engage students (O'Connor et al. 2023). In addition, AI is applied in nursing education through various technology-enhanced learning approaches based on theories such as constructivism. These approaches include online, mobile and blended learning, as well as digital simulation, which is primarily used in universities to improve student outcomes. (O'Connor et al. 2022).

The integration of artificial intelligence technologies, particularly extended reality (XR) technology, is increasingly prevalent, as evidenced by case studies developed at a regional university in Australia. Utilizing virtual reality, augmented reality, and mixed reality, these case studies, such as Compromised Neonate and Road to Birth, offer immersive learning experiences aimed at replicating real-world healthcare environments (Fealy et al 2023).Virtual reality (VR) interventions, particularly in neurology nursing, pediatric nursing, surgical and wound care, oncological nursing, and older adult nursing, showing effectiveness in enhancing learning outcomes and patient health across various nursing specialties (Hu et al. 2023). By working together, XR technology specialists and nursing educators are able to create synchronous and asynchronous learning experiences that go beyond conventional simulation media (Fealy et al 2023).

A recent study, using simulation of 3 dimension VR shows that application in nursing education enhances practical complex nursing skills of the students such as performing indwelling catheterization, as evidenced by a quasi-experimental study involving sophomore nursing students

where practicing VR in a simulated healthcare unit improved skills in comparison to traditional mannequin-based practice in an open laboratory setting (Park & Yoon 2023). Another study support the result, demonstration of Virtual reality in educating nurses to enhance blood transfusion practice, as shown by a randomized controlled trial involving nursing students who received VR simulation videos alongside traditional blood transfusion education methods, resulting in improved knowledge and satisfaction with blood transfusion practice (Lee et al. 2023).

Virtual reality (VR) interventions have demonstrated potential in enhancing critical thinking, clinical reasoning, and clinical decision making abilities, these VR interventions center on non-technical skills such as clinical decision making, communication, situational awareness, stress management, leadership, and teamwork skills among undergraduate nurses (Jans et al. 2023). Another study from Finland on Artificial intelligence, exemplified by highly realistic head-mounted display virtual reality (VR) simulation, is applied in nursing education to provide authentic learning experiences for graduating nursing students, as evidenced by a qualitative descriptive study involving 41 participants who emphasized the incorporation of nursing care, virtual reality simulation, and education (Mäkinen et al. 2023). Moreover, Artificial intelligence, through automated essay scoring systems like IntelliMetric®, is applied in nursing education to efficiently and reliably assess writing skills, addressing challenges in online teaching and evaluation of scholarly writing interventions, as demonstrated in a quasi-experimental study involving master degree nursing students enrolled in a fully competency-based online writing course. (Wolf et al. 2023). In the next section, the authors will explain the benefits of application of AI in nursing education.

### 5.3 Benefits of Application of artificial intelligence in nursing education

In the forthcoming section, an exploration of the benefits derived from the application of AI into nursing education will be undertaken, complemented by a review of several scholarly investigations into cutting-edge technologies like artificial intelligence (AI) applications, ChatGPT, extended reality (XR), and virtual reality (VR). A recent study discussed the benefits of using ChatGPT in nursing education, reveals that ChatGPT has ability to produce human-like assistive writing tasks such as essays, produce literature summaries that provide appropriate and contextual interactions (Choi et al. 2023).

In addition, digital interventions are another way in which artificial intelligence technology is used in nursing education to enhance the learning experiences of nursing students. According to O'Connor et al. (2022), the use of these techniques enhances experiential learning and constructivist methods, which improves student engagement and understanding, especially in complex nursing ideas. Additionally, there are several ways to integrate AI technology into nursing education. XR techniques help train students for the challenges of professional practice by making simulated learning experiences more realistic and accessible. These immersive platforms also help students engage more, understand material, and retain their skill, which in turn helps them become more confident and prepared for the demands of nursing practice in the era of the AI revolution (O'Connor et al. 2022.) This integration underscores the transformative potential of artificial intelligence in advancing nursing education and preparing future healthcare professionals (Fealy et al 2023).

A recent study on the use of head-mounted displays and Pico VR glasses, among other VR platforms, provides immersive learning experiences with varied session lengths and frequencies, facilitating comprehensive and engaging nursing education (Hu et al. 2023). Additionally, a another Australian study confirms the findings that the use of virtual reality (VR) in nursing education enhances students' clinical reasoning, CDM, critical thinking, and clinical judgment among undergraduate nursing students, as indicated by perceived benefits to the improvement of clinical decision-making skills among students (Jans et al. 2023).

In addition, utilization of VR simulation in nursing education improve skills, students confidence, and students satisfaction, demonstrated by improved nursing skills in demonstrating insertion of indwelling catheter, a significant increase in confidence levels, and higher scores in satisfaction between nursing student in the Virtual reality practice group in comparison with the control group, suggesting VR practice as a valuable educational method for enhancing difficult and complex nursing skills (Park & Yoon 2023). Furthermore, VR simulation, in nursing education include enhanced knowledge and satisfaction with blood transfusion practice among nursing students, evidenced by greater post-intervention scores for student satisfaction, self-confidence, and knowledge of blood transfusions in the group that received VR simulation in contrast to the control group, suggesting VR simulation as an effective tool for improving blood transfusion education outcomes (Lee et al. 2023). Using highly realistic virtual reality simulation in nursing education include improved usability and user experience with the high realistic virtual simulation being evaluated as user friendly and supportive of learning, highlighting its strong support for nursing education and emphasizing the value of technical support when implementing new technologies (Mäkinen et al. 2023).

# 6 ETHICAL ISSUES AND TRUSTWORTHINESS

Code of ethics have been developed to guide researchers and ethical consideration when doing research is crucial and should be taken into account even if humans participants are not included in this study( Polite, &Beck, 2003-141,159.). Regarding AI implications in nursing education, the authors will critically assess the potential benefits of utilization of AI in nursing education, and to be sure that the usage of artificial intelligence in nursing education aligned with the ethical principles of beneficence and non-maleficence, AI also may affect security of data, privacy, transparency, and accountability. (Näreaho, Kettunen, Kärki, & Päällysaho 2020)

The research followed strict ethical guidelines, including thorough data gathering to prevent bias, properly citing original authors, using clear search methods, setting criteria for including/excluding data, and ensuring originality to maintain the research's credibility and honesty. (Polite &Beck 2003, 144; 158) Agreement was done on the topic, schedule, material background and right to use access rights and ownership of the research data and results, and on responsibility and supervision (Näreaho, Kettunen, Kärki, & Päällysaho 2020.)

Ensuring the reliability of content analysis is crucial, depending on the quality and comprehensiveness of the data collected. Thus, meticulous data collection, analysis, and reporting procedures are interconnected and imperative for Enhancing trustworthiness. Achieving trustworthiness entails thorough preparation, advanced analytical skills, and transparent reporting. Key trustworthiness concerns during the preparation stages revolve around ensuring the reliability of the data collection method, the appropriateness of the sampling strategy, and the selection of a relevant unit of analysis. (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, & Kyngäs 2014.)

The trustworthiness are ensured through meticulous data collection, analysis, and reporting procedures. The comprehensive data collection process involved accessing international databases using relevant keywords such as artificial intelligence, nursing, nursing education, virtual reality, and AI technology. Thirteen articles meeting inclusion criteria were selected for analysis, which was conducted through content analysis. Additionally, the study employed strict inclusion and exclusion criteria, ensuring the relevance and quality of the selected articles.

The trustworthiness of the results is further strengthened by the utilization of a descriptive literature review methodology, which provides a systematic and organized approach to summarizing existing research findings. In addition, pruning old studies and focusing on publications between 2019 and 2024 ensures that research results are current and relevant to the current professional context. The excluded articles were not relevant studies, editorial articles, not peer-reviewed articles, or conference documents. Moreover, transparent reporting of the research process and conclusions improves the overall trustworthiness of the research.

However, the inherent subjective interpretation of content analysis and relying on published publications can result in significant limits, which do not necessarily reflect the entire research on the topic. In order to correct these limitations and improve reliability, future studies could have more previous studies, using other databases and use different researchers to analyze the data to ensure consistency, since the topic of the study is a trend and is updated daily.

# 7 DISCUSSION

In this chapter, the authors discuss the main essential conclusions of the study and summarize results of integrating artificial intelligence (AI) into nursing education in relation to theoretical framework, We thoroughly investigate the results from the perspectives of both nursing students and nursing educators, discuss and share recommendations for future nursing research studies, reflect on what is the authors learning experiences and authors' professional development during the journey of the thesis.

## 7.1 Results Discussion

The integration of artificial intelligence (AI) into nursing education is trending topic and our study shows that AI is being implemented in nursing education in many countries, opens up significant prospects for enhancing nursing education outcomes and preparing future nurses for the challenges of modern healthcare systems. The results of the literature review highlight numerous major themes and implications for the use of AI technologies in nursing education.

A recent research in Hong Kong explored the effects of ChatGPT nursing education with focus on critical thinking skills, communication, and independent thoughts revealed that it is essential for nursing educators to know the importance of integration of AI technological methods with the traditional educational methods in enhancing the learning outcome among nursing students (Choi et al. 2023). Moreover, a study from United Kingdom, Hong Kong, Switzerland, and Ireland emphasized the need for digital health datasets to support testing, use, and evaluation of AI in nursing and midwifery, along with the development of Curricula to educate professionals about AI to lead and participate in digital healthcare initiatives (O'Connor et al. 2022). Another study from UK and USA, support the importance of utilization of chatbots in supporting personalized learning experiences for nursing students, offering help with tasks such as language learning, tutoring and time management (O'Connor et al. 2023).

A recent study from Australia supports the use of extended reality (XR) technologies and virtual reality in nursing curriculum; it improves nursing students' critical thinking, clinical reasoning, and decision-making skills (Fealy et al. 2023). Another study from China supports as well the finding of

integration of XR technologies into nursing education which offers innovative solutions for enhancing simulated learning experiences among nursing students (Hu et al. 2023). The integration of XR technologies in nursing education provides a ground breaking approach, surpassing traditional methods by enabling 3D visualization, dynamic observation, and immersive experiences. Collaboration between educators and XR Specialists at an Australian university showcasing XR's potential to enhance simulated learning, offer students active engagement in virtual environments, facilitating skill acquisition in psychomotor, affective, and cognitive domains (Fealy et al. 2023).

In addition, the utilization of virtual reality simulations (VR) in nursing curriculum offers new options for improving simulated learning experiences, especially in complex nursing work that nurses can practice without causing harm to patients, such as inserting an indwelling catheter or performing a blood transfusion using virtual reality. The use of virtual reality (VR) has been demonstrated potential for improvement critical of nurses thinking, clinical reasoning, clinical judgment and clinical decision-making skills (Jans et al. 2023). The results suggest VR practice increase confidence and satisfaction, Offers a possible solution improve complex nursing skills especially in a challenging situation procedures such as indwelling catheterization (Park & Yoon 2023). Explore the recommended use of VR simulation, in nursing education contains additional information and Satisfaction with blood transfusion nursing students (Lee et al. 2023)

Nevertheless, the benefits of using artificial intelligence technologies in nursing education include increases in students' writing proficiency and self-efficacy that are statistically significant and have high effect sizes observed post-intervention, highlighting the efficacy of AI-powered assessment in enhancing scholarly writing capacity and informing instructional practices , thus advocating for the integration of required scholarly writing courses and the use of AI-driven automated essay scoring to assess students' writing development and effectiveness of instruction (Wolf et al. 2023). Another research showcased the importance of utilization of AI in nursing education highlighting improved personalized learning, plagiarism prevention through citation guidance, and enhanced organizational support for students (O’Connor et al. 2023).

### 7.1.1 Considerations for nursing educators

Utilization of  AI technology in nursing curriculum has contributed to the success in learning and teaching for both students and educators (O’Connor 2021)It is essential for nursing educators to

consider balancing the traditional educational methods with AI technologies when integrating AI technologies into nursing curriculum (Choi et al. 2023). In addition, Faculties of nursing and midwifery need to invest more in educators to be up to date and gain the skills and knowledge required to teach Artificial intelligence-based technologies in nursing curriculum (O'Connor et al. 2022). Collaboration required between XR and VR specialists and nursing educators to produce nursing curriculum tailored to students' needs based on AI technology that will enhance learning experiences for the students and improve the study outcome (Fealy et al. 2023). Educators are encouraged to utilize VR Simulation to complement traditional methods in selecting user-friendly teaching approaches that will enhance the learning outcome and improve the students' competence and confidence in complex nursing procedures (Mäkinen et al. 2023).

### 7.2 Recommendations for further research

Although this thesis has provided useful insights into the use of artificial intelligence in nursing education, there are several areas where further research is needed to increase understanding and improve nursing education outcomes. Future research with more intensive data collection and analysis using more research studies could examine the long-term effects of AI integration on student learning and performance, as well as actions to avoid ethical concerns in the use of AI.

Furthermore, studies focusing on the impact of AI on clinical decision-making and patient outcomes in nursing would help expand our understanding of the role of AI in nursing; the authors are also interested in future research on the application of artificial intelligence in nursing management. In addition, more research is needed to determine the effectiveness of artificial intelligence technology in nursing clinical practice. Moreover, studies needed to assess the feedback from students and educators who have utilized AI in nursing education.

### 7.3 Reflections on Learning Process and Professional Growth

During the writing phase of this thesis, the authors experienced challenges on the limited research in the topic of application of artificial intelligence in Finland and the vast amount of research studies that are not matching the inclusion criteria, with the invaluable support and continuous guidance from our supervisor, we succeeded to have this study. Furthermore, we have gained significant learning and

professional development, especially in research skills and knowledge acquisition in the field of nursing research. The authors have improved their skills in conducting literature reviews and content analyses. this expertise has not only helped us gather important information for our thesis, but this procedure improved the authors' critical thinking and academic writing skills and laid the groundwork for future academic endeavors.

Moreover, we have gained better information about the trending role of artificial intelligence in nursing education. Exploring the literature on artificial intelligence in nursing education has expanded our knowledge base in this area. We gained insight into many artificial intelligence technologies used in nursing education, such as chatbots, virtual assistants, augmented extended reality and virtual reality simulations. Additionally, we have learned to critically evaluate the ethical implications of AI technologies, such as concerns about academic integrity and privacy. This increased understanding of ethical considerations will certainly shape our future as nurses and ensure that we approach technological integration in healthcare with sensitivity and responsibility. In addition to expanding our research ability and knowledge, investigating the impact of artificial intelligence in nursing education has given us a better understanding of the contexts of modern healthcare and the importance of staying up-to-date with technological advancement at the era of AI.

**REFERENCES**

AI HLEG: High-Level Expert Group on Artificial intelligence, 2019. A Definition of AI: Main Cababilities and Disciplines [Ebook]. *European Commission, Brussels*: Available at https://www.aepd.es/sites/default/files/2019-12/ai-definition.pdf. Accessed 01 December 2023.

Bajgain, B., Lorenzetti, D., Lee, J. & Sauro, K. 2023. Determinants of implementing artificial intelligence-based clinical decision support tools in healthcare: A scoping review protocol. *BMJ* open, 13(2), p. e068373. Available at: https://doi.org/10.1136/bmjopen-2022-068373. Accessed 01 December 2023.

Centria 2022. Centria Guide for Thesis and Academic Writing 2022. Available at: https://libguides.cen- tria.fi/c.php?g=691790&p=4956688. Accessed 01 December 2023.

Choi, E. P. H., Lee, J. J., Ho, M., Kwok, J. Y. Y., & Lok, K. Y. W. (2023). Chatting or cheating? The impacts of ChatGPT and other artificial intelligence language models on nurse education. *Nurse education today, 125*, 105796. Available at: https://doi.org/10.1016/j.nedt.2023.105796. Accessed 01.04.2023

De Gagne, J. C. (2023). The State of Artificial Intelligence in Nursing Education: Past, Present, and Future Directions. *International journal of environmental research and public health, 20*(6), 4884. Available at: https://doi.org/10.3390/ijerph20064884 Accessed 01.04.2023

De Gagne, J. C. (2023). Renewed Urgency: Reimagining Roles in Nursing and Academia Amidst Rapid AI Advancements. *International journal of environmental research and public health, 20*(11), 5963. Available at: https://doi.org/10.3390/ijerph20115963. Accessed 04 April 2024.

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative Content Analysis: A Focus on Trustworthiness. *SAGE open,* 4 (1), 215824401452263. Available at: https://doi.org/10.1177/2158244014522633. Accessed 02 December 2023.

Fealy, S., Irwin, P., Tacgin, Z., See, Z. S., & Jones, D. (2023). Enhancing Nursing Simulation Education: A Case for Extended Reality Innovation. *Virtual worlds, 2*(3), 218-230. Available at: https://doi.org/10.3390/virtualworlds2030013. Accessed 12 December 2023.

Hu, Y., Yuan, X., Ye, P., Chang, C., Hu, Y. H., Zhang, W., & Li, K. (2023). Virtual Reality in Clinical Nursing Practice Over the Past 10 Years: Umbrella Review of Meta-Analyses. *JMIR* serious games, 11, e52022. Available at: https://doi.org/10.2196/52022. Accessed 01 January 2024.

International Council of Nurses (ICN), 2002, *Nursing definitions*, Available at: https://www.icn.ch/nursing-policy/nursing-definitions. Accessed 01 April 2024

Jans, C., Bogossian, F., Andersen, P., & Levett-Jones, T. (2023). Examining the impact of virtual reality on clinical decision making – An integrative review. *Nurse education today, 125*, 105767. Available at: https://doi.org/10.1016/j.nedt.2023.105767. Accessed 12 December 2023.

Kim, J., & Jeong, H. (2023). Instructor's Experience of Extended Reality Applied to Nursing Education. *Clinical simulation in nursing*, 84, 101450. Available at https://doi.org/10.1016/j.ecns.2023.101450. Accessed 01 January 2024.

Korhonen, T. 2020. Competence requirements and contents (180 ECTS credits) for general nurse education. Available at: https://blogi.savonia.fi/ylesharviointi/2020/01/15/competence-requirements-and-contents-180-ects-credits-for-general-nurse-education/. Accessed 01 January 2024.

Lee, J. J., Tsang, V. W. Y., Chan, M. M. K., O'Connor, S., Lokmic-Tomkins, Z., Ye, F., Ho, M. (2023). Virtual reality simulation-enhanced blood transfusion education for undergraduate nursing students: A randomised controlled trial. *Nurse education today*, 129, 105903. Available at: https://doi.org/10.1016/j.nedt.2023.105903. Accessed 01 January 2024.

LoBiondo-Wood, G. & Haber, J. 2017. Nursing Research: Methods and Critical Appraisal for Evidence-Based Practice. Available at: https://studylib.net/doc/25686734/nursing-research-methods-and-critical-appraisal-for-evide. Accessed 16 September 2023.

Lyijynen, V, & Jänis, S., 2020. Tekoälyn näkyvyys hoitotyössä : Kartoittava katsaus nykytilaan ja mahdollisuuksiin 1–24, p. Available at: https://urn.fi/URN:NBN:fi:amk-2020071219537. Accessed 08 October 2023.

Mäkinen, H., Haavisto, E., Havola, S., & Koivisto, J. (2023). Graduating nursing students' user experiences of the immersive virtual reality simulation in learning – A qualitative descriptive study. *Nursing open, 10*(5), 3210-3219. Available at: https://doi.org/10.1002/nop2.1571. Accessed 02 December 2023

Moher, D., Liberati, A., Tetzlaff, J. & Altman, D-G. 2009. The prisma group (2009). Available at: https://guides.lib.lsu.edu/c.php?g=872965&p=6269176. Accessed 20 December 2023.

Näreaho, S., Kettunen, J., Kärki, A., & Päällysaho, S. 2020. Rectors' *Conference of Finnish Universities of Applied Sciences* Available at: (ARENE) ethical recommendations for writing a thesis. Accessed 05 September 2023

Nightingale, F., 1860, Notes on nursing, what it is, what it's not, D. Appleton, *New York, NY. [Google Scholar]* Available at:https://books.google.fi/books?hl=en&lr=&id=xox1828Wjn4C&oi=fnd&pg=PA1&ots=VWAyakkMTA&sig=d1dF34wvtw15-mxqUnuk4LywPj0&redir_esc=y#v=onepage&q&f=false Accessed 04 April 2024.

O'Connor, S. 2021. Artificial intelligence and predictive analytics in nursing education. *Nurse education in practice*, 56, p. 103224. Available at: https://doi.org/10.1016/j.nepr.2021.103224. Accessed 02 September 2023.

O'Connor, S. (2023). Corrigendum to "Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse?" [Nurse Educ. Pract. 66 (2023) 103537]. *Nurse education in practice, 67*, 103572. Available at: https://doi.org/10.1016/j.nepr.2023.103572. Accessed 01 December 2023.

O'Connor, S., Yan, Y., Thilo, F. J. S., Felzmann, H., Dowding, D., & Lee, J. J. (2022). Artificial intelligence in nursing and midwifery: A systematic review. *Journal of Clinical Nursing,* 00, 1–18. Available at: https://doi.org/10.1111/jocn.16478. Accessed 02 December 2023.

O'Connor, S., Kennedy, S., Wang, Y., Ali, A., Cooke, S. & Booth, R. G. 2022. Theories informing technology enhanced learning in nursing and midwifery education: A systematic review and typological classification. *Nurse education today*, 118, p.105518. Available at: https://doi-org.ezproxy.centria.fi/10.1016/j.nedt.2022.105518. Accessed 08 October 2023.

Park, S., & Yoon, H. G. (2023). Effect of Virtual-Reality Simulation of Indwelling Catheterization on Nursing Students' Skills, Confidence, and Satisfaction. *Clinical simulation in nursing*, 80, 46-54. Available at: https://doi.org/10.1016/j.ecns.2023.05.001. Accessed 08 January 2024.

Polit, DF & Beck, CT 2003. Nursing research: Principles and methods. 7th ed. Philadelphia: Lippincott. Available at: Nursing research: principles and methods | Centria-kirjasto | Centria-Finna. Accessed 08 October 2023.

Romare, C., & Skär, L. (2023). The use of smart glasses in nursing education: A scoping review. *Nurse education in practice, 73*, 103824. Available at: https://doi.org/10.1016/j.nepr.2023.103824. Accessed 08 January 2024.

Robert N. (2019). How artificial intelligence is changing nursing. *Nurs Manage*. 2019 Sep;50(9):30-39. Available at https://doi.org/10.1097/01.numa.0000578988.56622.21 PMID: 31425440; PMCID: PMC7597764. Accessed on 08/01/2024.

Sharma, M., & Sharma, S. (2023). A holistic approach to remote patient monitoring, fueled by ChatGPT and Metaverse technology: The future of nursing education. *Nurse education today, 131*, 105972. Available at: https://doi.org/10.1016/j.nedt.2023.105972. Accessed 08 January 2024.

Van Bulck, L., Couturier, R., & Moons, P. (2023). Applications of artificial intelligence for nursing: Has a new era arrived? *European journal of cardiovascular nursing : journal of the Working Group on Cardiovascular Nursing of the European Society of Cardiology, 22*(3), Pages e19–e20, Available at: https://doi.org/10.1093/eurjcn/zvac097. Accessed 01 January 2024

Wiley. 2022. *What is peer review?* Available at: https://authorsservices.wiley.com/Reviewers/journal-reviewers/what-is-peer-review/index.html. Accessed 08 March 2024.

Wolf, R. R., & Wolf, A. (2023). Using AI to Evaluate a Competency-Based Online Writing Course in *Nursing. Online learning* (Newburyport, Mass.), 27(3). Available at: https://doi.org/10.24059/olj.v27i3.3974. Accessed 08 January 2024.

Zhang, S.2019. Nursing technology: the application and development of scene simulation in nursing education. 1–22, p. Available at: https://urn.fi/URN:NBN:fi:amk-2019060916183. Accessed 09 October 2023.