

Challenges and Opportunities in Digital Learning Technologies for Nursing Education in Low-Resource Settings: A Scoping Review

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Abstract

The use of digital learning technologies is becoming increasingly popular worldwide. However, there is a lack of published evidence regarding their application in nursing education, particularly in low-resource settings. To inform the development of digital learning guidelines for use in such contexts, a scoping review was conducted to examine the use of these technologies and the associated challenges. The review question was: What are the challenges and opportunities associated with the use of digital learning technologies in nursing education in low-resource settings? The Joanna Briggs Institute (JBI) scoping review methodology was followed. The databases Scopus, Academic Search Complete, PubMed, and CINAHL were searched using the following criteria: student nurses and nurse educators in nursing education institutions; low-resource settings, defined as low- and middle-income countries; and the use of digital learning technologies. Studies involving non-nursing health professions were excluded. Retrieved papers were screened by title and abstract, with full text reviews conducted as needed. Data were analysed thematically using the digital competence framework. Few studies have been conducted in African countries. Key themes included the use of digital learning technologies in general, their application in clinical teaching and theoretical instruction, and the emergence of artificial intelligence in nursing education. Most reported uses were related to students' online learning experiences. The main challenges were



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linked to pedagogical competence, along with the need for administrative and technical competencies, thus extending the existing digital competence framework.

Keywords: challenges; digital learning technologies; nursing education; low-resource settings; student nurse

Introduction

The technological boom of the twenty-first century led to a widespread adoption of digital learning technologies in higher education institutions (Loureiro et al. 2021; Meum et al. 2021). Similarly, nursing education has metamorphosed from traditional education methods to the present period of sophisticated application of digital learning technologies (Ajetha and Kumar 2024; Balante et al. 2023), mostly in blended settings. Digital learning technology tools include devices such as desktop computers, laptops, smartphones, and tablets which are used to provide a range of digital applications delivered via the internet (Feerick et al. 2022). In addition, in 2023 and 2024 there was a rapid global increase in the use of generative artificial intelligence (GenAI) in education.

In nursing education institutions, digital learning technologies are widely used to enhance teaching, learning, and assessment (Feerick et al. 2022; Loureiro et al. 2021; Meum et al. 2021). These technologies have expanded access to educational resources through dedicated platforms (Feerick et al. 2022; Ličen and Prosen 2023). Education for nurses has benefited from the use of digital learning technologies, which have been reported to improve student motivation (Ličen and Prosen 2023) and broaden the knowledge of nursing students (Meum et al. 2021). The rise of internet-based tools has also enabled online learning, online textbooks, massive open online courses (MOOCs), and the adoption of learning management systems (Meum et al. 2021), leading to calls for the incorporation of digital learning technologies into nursing curricula (Ličen and Prosen 2023; Loureiro et al. 2021).

The availability of digital technologies necessitates that student nurses become proficient in their use within nursing education (Chipps et al. 2022) and it highlights the need for equitable access and competent use among students and staff in nursing. However, the adoption of digital learning technologies varies across regions due to differences in access to resources and infrastructure (Feerick et al. 2022). Although their use in nursing education has been documented, it is predominantly reported in high-income countries, with limited information available on formal guidelines for their use (Chipps et al. 2022). While many nurse educators state that guidelines for digital learning technologies are important (Meum et al. 2021), there is a dearth of guidelines in low-middle-income settings (UNICEF 2021).

To support the development of guidelines for using digital learning technologies in nursing education—particularly in low-resource settings, defined here as low- and

middle-income countries based on the World Bank classification—a search was conducted for existing published guidelines in this context. However, none were found. As a result, a scoping review was conducted to examine the use and challenges of digital learning technologies in nursing education institutions in low-resource settings, with the aim of identifying implications for digital education competence that could inform and underpin future guideline development. Thus, this review was guided by the following question: What are the challenges and opportunities in digital learning technology for nursing education in low-resource settings?

Methods

Design

The review followed the updated scoping review methodology developed by the Joanna Briggs Institute (JBI) (Peters et al. 2022), which was chosen for its rigorous and comprehensive approach to mapping the evidence and its alignment with the PRISMA-ScR checklist standard for reporting. The review process involved five key steps: (i) identifying the research question; (ii) locating relevant studies; (iii) selecting studies; (iv) charting the data; and (v) analysing and presenting the findings. The selection and review process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines.

Search Strategy

The databases searched were Scopus, CINAHL Plus, MEDLINE (PubMed), and Academic Search Complete using the participants, context, and concept (PCC) framework, as outlined in Table 1. The search string comprised synonyms such as digital education technology OR virtual learning OR online learning OR e-learning OR artificial intelligence learning OR LLM AND (nursing education OR nursing institution). As previously defined, low-resource settings refer to low- and middle-income countries based on the World Bank classification. The review included all peer-reviewed literature published in English between 2012 and 2024, with 2012 chosen to reflect the significant growth of digital learning technologies in higher education institutions. The search concluded on January 20, 2024. In addition, a separate search on artificial intelligence (AI) in nursing education was conducted; due to a lack of studies on AI in nursing in low-income countries, this search included studies from other countries.

Table 1: Search terms inclusion and exclusion criteria

PCC framework	Inclusion criteria	Exclusion criteria
Participants	Nursing educators, student nurses, and studies, where most of the participants were nurses or student nurses	Other health professionals
Context	Nursing education, nursing education institutions, low-middle-income countries, low-resource countries, Global South	High-income countries
Concept	Digital education technologies, virtual learning, online learning, e-learning, AI learning	Traditional education methods

Study Selection

The search results were imported into EndNote, where duplicate papers were identified and removed. Two reviewers screened papers for relevance based on the PCC criteria, while a third reviewer resolved any conflicts. The final search was completed in January 2024. The initial search did not apply any country restrictions.

Data Analysis and Presentation

The final selected papers were extracted and reviewed using thematic analysis, with data managed in Excel. The student and two supervisors held three consecutive weekly sessions to select and refine themes based on the PCC framework. In addition, the thematic analysis applied the digital competence framework by McGarr and McDonagh (2021)—which includes pedagogical, digital, and ethical competence—to analyse challenges and their implications for guideline development. Pedagogical competence includes subject knowledge, teaching methods, and expertise in workplace skills (McGarr and McDonagh 2021). Digital competence includes knowledge and use of digital technologies, understanding their potential, and employing them effectively in teaching, and being aware of strategies and value (McGarr and McDonagh 2021). Ethical competence focuses on the awareness of student equality, prioritising learning experiences, considering differences in digital literacy, and recognising how compatibility issues with different digital devices and applications could alter the variables of digital competence and learning (McGarr and McDonagh 2021; Ryhtä et al. 2021). During the analysis, two additional competence categories emerged: administrative and technological.

Results

Search Outcome

The stages of paper retrieval, review, and selection are outlined in Figure 1. A total of 381 papers were identified with six additional papers added after a targeted search. Of these papers, 197 were excluded as irrelevant or duplicates. The remaining 190 papers underwent title and abstract screening, resulting in the exclusion of 143 papers:

136 focused on high-income countries, six involved both high- and middle-income countries where nurses were not the majority participants, and one paper was unavailable. The country was determined using the World Bank classification of countries.

Initially, 45 papers were selected for full text review, but two were excluded as the majority of the participants were not nurses. The final set included 43 papers, three of which specifically addressed artificial intelligence—two from high-income countries and one from a low-resource setting.

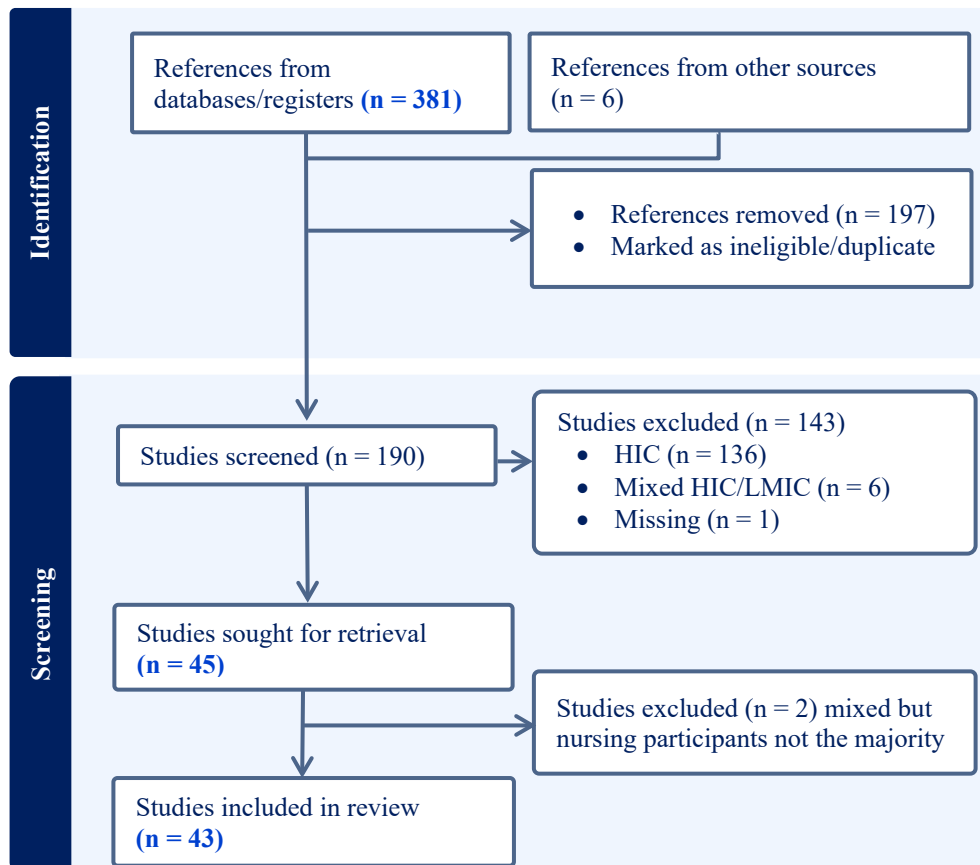


Figure 1: Selection and review process using PRISMA-ScR

Summary of Included Papers

The features of the papers are summarised in Table 2. The included papers used a variety of research methods to examine the use of digital education technology in low- and middle-income countries. These methods comprised mixed methods (2 papers, 4.7%), qualitative approaches (7 papers, 16.3%), quantitative approaches (24 papers, 55.8%), and literature reviews (10 papers, 23.3%). All studies were published between 2012 and 2023, with the majority ($n = 41$, 95.3%) published from 2018 onwards. Approximately

one-third of the articles ($n = 14$, 32.6%) were from Africa. More than half ($n = 23$, 53.4%) focused specifically on online learning, and most ($n = 32$, 74.4%) involved nursing students as the primary participants.

Table 2: Summary of papers ($n = 43$)

Characteristic	Frequency (n, %)
Year	
2012–2017	2 (4.7%)
2018–2023	41 (95.3%)
Type of study	
Quantitative/survey	11 (25.6%)
Quasi-experimental (QE)	10 (23.3%)
Narrative	5 (11.6%)
Survey/interview	2 (4.6%)
Randomised control trials	2 (4.6%)
Focus groups	2 (4.6%)
Correlation	2 (4.6%)
Scoping	2 (4.6%)
Others	7 (16.3%)
Countries	
Africa	14 (32.6%)
Other LMIC countries	29 (67.4)
Focus of papers	
Online learning	23 (53.4%)
Digital education technology use	10 (23.3%)
Mobile learning and teaching	5 (11.6%)
Teleteaching	2 (4.7%)
Artificial intelligence	3 (7.0%)
Participants	
Students	32 (74.4%)
Educators	6 (14.0%)
Nursing	4 (9.3%)
Nurses	1 (2.3%)

Characteristics of Included Papers

The educational uses of digital learning technologies were categorised into three main areas: theory-based teaching and learning ($n = 20$), clinical teaching and learning ($n = 13$), and integrated use across both theory and clinical settings ($n = 10$). These categories are outlined in Table 3. From this analysis, four key themes emerged and are discussed in the sections below: (1) use of digital learning technologies, (2) use of digital learning technologies in clinical teaching and learning, (3) educational use of technologies for learning and teaching, and (4) emergence of AI in nursing education.

Theme 1: Digital Learning Technologies Use

Studies reported the use of various digital devices and technologies in nursing education, highlighting their role in fostering creative engagement among learners (Gause et al. 2022). High levels of competence were noted, particularly in the use of devices such as computers (Harerimana and Mtshali 2020).

The Use of Smartphones in Digital Learning

Mobile smartphone use in nursing education was assessed in five papers (Alvarez et al. 2017; Nikpeyma et al. 2021; Valdez et al. 2020; Willemse et al. 2019; Yalcinkaya and Cinar Yucel 2023). Studies that specifically focused on smartphones assessed the benefits and challenges of using them as tools in learning situations (Nikpeyma et al. 2021).

Most studies (85.5%) reported high smartphone ownership and use in nursing education (Yalcinkaya and Cinar Yucel 2023), including for clinical learning (Alvarez et al. 2017). Another study found that 94.7% of students felt motivated by their educators to use digital devices (Harerimana and Mtshali 2019). Overall, mobile phones have been shown to enhance interaction between nursing students and educators in teaching and learning contexts (Willemse et al. 2019). Applications such as WhatsApp, Notebook, and Calendar support information storage and sharing, facilitating collaborative learning in both academic and clinical environments (Nikpeyma et al. 2021; Willemse et al. 2019).

Teleteaching

Videoconferencing refers to the use of technology to deliver remote lectures or education sessions. While tele-education was previously conducted using traditional videoconferencing equipment (Chipps et al. 2012), advances in technology and internet bandwidth quality have significantly enhanced its quality and accessibility. Modern platforms such as Zoom are now widely used, with studies reporting high levels of satisfaction among users (Cunha et al. 2023).

General Use and Satisfaction

Four papers assessed the use of, and satisfaction with, information communication technology (ICT) in clinical learning and teaching (Hao et al. 2022; Hareriman and Mtshali 2019, 2020; Matlhaba 2023). An additional five papers focused on the integrated use of ICT in theoretical and clinical learning and teaching (Bester et al. 2021; de Abreu Moniz et al. 2016; Gause et al. 2020; Guven Ozdemir and Sonmez 2021; Nsouli and Vlachopoulos 2021), with overall positive satisfaction reported across all studies.

Challenges

Bester et al. (2021) examined the barriers and enablers to ICT use, while Nsouli and Vlachopoulos (2021) focused on user attitudes and the need for training. Challenges reported across studies included issues with device compatibility and the limitations of small screen sizes that impede the use of digital devices (Nikpeyma et al. 2021). Although the adoption of digital technologies is important for learning, students may also be at risk of experiencing digital burnout (Durmuş et al. 2022; Harerimana and Mtshali 2020).

Theme 2: Digital Learning Technologies Use in Clinical Teaching and Learning

In the 13 papers that explored the use of digital education in clinical teaching and learning, four distinct educational strategies were identified. These included the use of extended reality technologies—such as virtual and augmented reality (n = 5), WhatsApp for communication and learning (n = 1), online course platforms (n = 2), and web conferencing tools (n = 1). These strategies are outlined below.

WhatsApp

Willemse et al. (2019) reported on the effective use of mobile learning and teaching through WhatsApp to facilitate integrated learning while students were in clinical placement.

Extended Reality

Five papers focused on the use of extended reality technologies—including virtual and augmented reality—in clinical teaching (Alvarez et al. 2017; Botha et al. 2020; Botha et al. 2021; Ganji et al. 2022; Wu et al. 2023). Alvarez et al. (2017) examined learning and teaching through the use of mobile phones to host a pain management teaching programme. Botha et al. (2020; 2021) assessed the feasibility of and students' satisfaction with virtual reality as opposed to high-fidelity simulation. Ganji et al. (2022) evaluated a virtual clinical training protocol for midwifery students in a gynaecology course. Wu et al. (2023) explored the use of virtual reality in a clinical context by simulating an operating room scenario involving a patient undergoing an appendectomy, aiming to familiarise students with English-language surgical terminology. In a related study, Shamsaee et al. (2021) found that students' search skills improved after engaging with virtual education. Overall, the studies reported that students demonstrated enhanced clinical performance following exposure to virtual reality-based learning (Ganji et al. 2022).

Online Courses

Two papers specifically reported on the use of online courses for clinical learning with Dhakal et al. (2023) evaluating a course on respectful maternity care and Öztürk and Güneş (2023) assessing an online course on medication management.

Challenges

Overall, the challenges reported in clinical learning and teaching included costs, particularly for virtual reality (Wu et al. 2023), internet quality (Willemse 2019), the need for training (Botha et al. 2020; Cunha et al. 2023), limitations in addressing clinical learning (Botha et al. 2020; Ganji et al. 2022; Harerimana and Mtshali 2019), and the compatibility of mobile devices for this teaching and learning modality (Alvarez et al. 2017).

Theme 3: Educational Use of Technologies for Learning and Teaching

The literature used different terms synonymously with online learning, including virtual learning, digital learning, and virtual training. In this study, more than half of the papers (n = 23; 53.4%) focused on online learning and teaching, with 11 specifically addressing theory-based instruction. These papers focused on changes in knowledge, attitudes towards use of online learning, and the challenges experienced.

Use and Attitudes

Several studies assessed the effectiveness of online learning in nursing education and student perceptions of it. In a study to determine the effectiveness of online learning in enhancing perception, 75% of the students demonstrated good knowledge following an online course on midwifery care (Dhakal et al. 2022). Similarly, Öztürk and Güneş (2023) found that students taught using online learning showed a better understanding than those taught through traditional methods. Ganji et al. (2022) specifically reported enhanced comprehension of gynaecological diseases through virtual reality-based instruction.

Attitudes toward online learning were generally positive in several studies. For example, a study on blended learning revealed that 93% of the students had positive attitudes towards online learning course content (Öztürk and Güneş 2023). However, other studies revealed mixed perceptions. Guven Ozdemir and Sonmez (2021) found that 65% of students did not consider online learning to be more effective than traditional methods. Likewise, Savci et al. (2022) reported that 62.2% of students preferred face-to-face engagement to online learning.

Challenges

Key impediments to online learning included poor internet connectivity, power outages, limited access to digital devices, and high data costs (Jarvis and Baloyi 2023; Molefe and Mabunda 2022). Another challenge was the uncertainty surrounding the long-term effectiveness of online learning, as clinical proficiency was not evaluated in some studies (Dhakal et al. 2022; Öztürk and Güneş 2023). Additionally, during the COVID-19 pandemic, technical glitches were frequently reported as barriers to assessment and teaching (Molefe and Mabunda 2022).

Theme 4: Emergence of Artificial Intelligence in Nursing Education

Three studies reviewed the emergence of AI and its impact, influence, and role in nursing education (Buchanan et al. 2021; Hwang et al. 2022; Rani et al. 2021). It is worth noting that since the time of this review, additional studies on the role of AI in nursing education have been published, and these were addressed in the literature review section.

Uses and Awareness

Rani et al. (2021) reported that AI aids student self-directed learning by providing students with an opportunity to access summarised educational resources; however, the acceptability of AI for learning depends on users' cognition, understanding, and level of interest (Hwang and Chien 2022). Some students underrated the capacity for AI engagement (Hwang and Chien 2022).

Challenges

Buchanan et al. (2021) recommended that nurse educators be equipped with foundational knowledge of AI to enhance their proficiency and advocated for the integration of AI into the nursing curriculum to support future development. However, a key challenge identified was the potential overreliance on AI, which could hinder critical thinking and creativity (Rani et al. 2021).

Table 3: Characteristics of the studies

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Theoretical learning and teaching							
Alshawish et al. (2021)	To compare students' learning outcomes, perceptions of their educational environment, and satisfaction with blended learning vs. traditional classroom settings.	Quantitative (QE): Measurement Perception of educational environment	Nursing students (n = 102) Blended teaching section (n = 49) vs. traditional classroom (n = 53)	Blended learning	Palestine	<u>Outcomes</u> ↑Students interested in online learning ↑Access to digital devices ↑Effectiveness of blended learning <u>Challenges</u> ↑Technical difficulties in operation	Pedagogical competence Technical competence
Durmuş et al. (2022)	To investigate digital burnout levels in nursing students.	Quantitative (survey): Measurement Digital burnout Digital ageing Digital deprivation Emotional exhaustion	First- to fourth-year nursing students (n = 361)	DET use	Turkey	<u>Outcomes</u> ↑Monitoring of technology use ↑Opportunity to transform online learning <u>Challenges</u> ↑ Unequal access to digital resources	Administrative competence Ethical competence
Khodaei et al. (2022)	To determine the effect of the online flipped classroom on nursing students' self-directed learning readiness and metacognitive awareness.	Quantitative (QE): Measurement Metacognitive awareness Self-directed learning Management of self	Nursing students (n = 34)	Online learning and teaching	Iran	<u>Outcomes</u> ↑Self-directed learning ↑Confidence in online flipped learning ↑Perceived effectiveness of flipped learning	Pedagogical competence Ethical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
		Learning desire Self-control				<u>Challenges</u> ↑Lack of experience with flipped learning	Administrative competence
Ogolodom et al. (2023)	To evaluate the experiences of nursing and radiography undergraduate students regarding online learning in Nigerian universities during the COVID-19 pandemic.	Quantitative (QE): Measurement Online attitude Online learning usability Challenges of online learning	Nursing students (n = 540)	Online learning and teaching	Nigeria	<u>Outcomes</u> ↑Convenience of online learning ↑Positive attitude towards online learning <u>Challenges</u> ↑Connectivity issues ↑Lack of electricity and financial resources	Pedagogical competence Technical competence Administrative competence
Savci et al. (2022)	To evaluate the association between perceived sociability, social intelligence, and loneliness in online learning among nursing students.	Quantitative (survey): Measurement Sociability Loneliness Social intelligence	Nursing students (n = 246)	Online learning and teaching	Turkey	<u>Outcomes</u> ↑Preference for F2F teaching ↑Cognitive benefits of online learning ↑Low level of socialisation <u>Challenges</u> ↑Difficulty reinforcing clinical knowledge	Pedagogical competence Administrative competence
Seki Öz and Ayhan (2022)	To examine the effects of psychiatric nursing e-course taught via distance learning on students' beliefs about mental illnesses.	Quantitative (QE): Measurement Belief towards mental illness	Nursing students (n = 147)	Online learning and teaching	Turkey	<u>Outcomes</u> ↑Effectiveness of e-course in reducing stigma ↑Increase self-directed learning ↑Use of mobile data for access	Pedagogical competence Technical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Shamsaee et al. (2021)	To investigate the effect of virtual education on undergraduate nursing students' information literacy competency for evidence-based practice (EBP).	Quantitative (QE): Measurement Information sources Knowledge about search operators Information searching skills	Nursing students (n = 80) [experimental n = 40; control n = 40]	Online learning and teaching	Iran	<u>Outcomes</u> ↑Improvement in information literacy ↑Use of online learning tools <u>Challenges</u> ↑Low internet speed	Pedagogical competence Technical competence
Singh et al. (2021)	To provide preliminary data to the stakeholders regarding the feasibility and acceptability of e-learning.	Quantitative (survey): Measurements Teaching methods Online teaching E-learning attitude	Nursing students (n = 684)	Online learning and teaching	India	<u>Outcomes</u> ↑Competence in computer use ↑ Health concerns related to technology use ↑Student ownership of devices <u>Challenges</u> ↑Lack of digital devices and internet	Pedagogical competence Administrative competence Technical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Suliman et al. (2022)	To measure the effectiveness of two teaching strategies (providing online synchronous classes vs. asynchronous classes) on nursing students' knowledge of legal and ethical issues and their ability to make legal and ethical decisions.	Quantitative (RCT): Measurements Knowledge and ability for decision-making.	Nursing students (n = 128) [Experimental = 64 ; control = 64]	Teleteaching	Jordan	<u>Outcomes</u> ↑Understanding of ethical dilemmas ↑Active participation in online classes ↑Engagement with ethical decision-making <u>Challenges</u> ↑Internet connectivity issues	Pedagogical competence Ethical competence Administrative competence
Valdez et al. (2020)	To determine the relationship between the utilisation of SNS, the perceived benefits of SNS, and the potential of SNS for improving the study habits of nursing students.	Quantitative (survey): Measurements Utilisation of SNS Benefits of SNS	Nursing students (n = 1,137)	Mobile learning and teaching	Israel, Iraq, Oman, the Philippines, and Turkey	<u>Outcomes</u> ↑Improved study habits through SNS ↑Perceived reliability and accessibility of SNS <u>Challenges</u> ↑Risk of SNS addiction ↑Absence of SNS usage policy	Pedagogical Competence Ethical competence Administrative competence
Yalcinkaya and Cinar Yucel (2023)	To determine nursing students' attitudes towards and readiness for mobile learning.	Quantitative (survey): Measurements Mobile learning attitude	Nursing students (n = 290)	Mobile learning and teaching	Turkey	<u>Outcomes</u> ↑Frequent smartphone use ↑Willingness to use mobile learning in future <u>Challenges</u> ↑High cost of mobile devices	Pedagogical competence Administrative competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Zhang et al. (2022)	To explore the relationship between online learning engagement, academic self-concept, and deep learning in online courses for Chinese nursing students, as well as the mediating effect of academic self-concept on the relationship between online learning engagement and deep learning in these courses.	Quantitative (survey): Measurements Online engagement (Learning) Self-concept (Academics)	Nursing students (n = 594)	Online learning and teaching	China	<u>Outcomes</u> ↑Engagement in online learning ↑Academic self-concept ↑Need for course improvement	Pedagogical competence Administrative competence
Mokoena-de Beer and Moloko (2022)	To explore and describe nurse lecturers' experiences with online teaching during the COVID-19 pandemic at a public university in Gauteng, South Africa.	Qualitative (interviews): Measurements Experience	Nursing educators (n = 6)	Online learning and teaching	South Africa	<u>Outcomes</u> ↑Increased time for teaching preparation ↑No knowledge of LMS use <u>Challenges</u> ↑Insufficient training for online teaching	Technical competence Administrative competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Molefe and Mabunda (2022)	To explore and describe the experiences of students in a nursing college regarding online teaching and learning during the onset of the COVID-19 pandemic.	Qualitative (focus groups)	Second-, third-, and fourth-year nursing students (n = 22)	Online learning and teaching	South Africa	<u>Outcomes</u> ↑Knowledge gains ↑Accessibility, flexibility, and environmental benefit <u>Challenges</u> ↑Lack of orientation, data provision, and clinical exposure	Pedagogical competence Ethical competence Administrative competence
Mulu and Nyoni (2023)	To develop, validate, and test standards for evaluating the quality of undergraduate nursing e-learning programmes in Kenya.	Qualitative (Delphi)	Nursing educators Round 1 (n = 14) Round 2 (n = 14) Round 3 (n = 8)	Online learning and teaching	Kenya	<u>Outcomes</u> ↑Educator and learner proficiency ↑ Feasibility and usability of standards in LMICs <u>Challenges</u> ↑Inadequate e-learning support	Pedagogical competence Ethical competence Administrative competence
Nikpeyma et al. (2021)	To identify and investigate the barriers and facilitators to using mobile devices for education from the perspective of nursing students.	Qualitative (interviews)	Nursing students (n = 22)	Mobile learning and teaching	Iran	<u>Outcomes</u> ↑Ease of mobile device use ↑Access to comprehensive information ↑Reduced interpersonal communication <u>Challenges</u> ↑High data costs	Technical competence Pedagogical competence Administrative competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Jarvis and Baloyi (2023)	To explore the transition to online teaching, learning, and assessment in the nursing discipline.	Review (narrative)	Nursing educators (n = 22) Nursing students (n = 291)	Online learning and teaching	South Africa	↑Risk of device contamination in clinical settings <u>Outcomes</u> ↑Access to digital materials ↑Implementation of online teaching and learning <u>Challenges</u> ↑Connectivity issues, data cost, and load shedding	Pedagogical competence Administrative competence
Molato and Sehularo (2022)	To explore and describe recommendations made to address the online learning challenges in nursing education during the COVID-19 pandemic.	Review (narrative)	Nursing students (n = 9 articles)	Online learning and teaching	South Africa	<u>Outcomes</u> ↑Orientation of staff and students ↑Monitoring of academic dishonesty	Administrative competence
Raoufi et al. (2020)	To develop an e-learning model for nursing education.	Review (narrative)	Nursing educators (n = 12)	Online learning and teaching	Iran	<u>Outcomes</u> ↑Supportive legislation for e-learning ↑Emphasis on digital etiquette ↑Provision of hardware and software <u>Challenges</u> ↑Budget and policy constraints	Administrative competence Ethical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Costa et al. (2022)	To analyse nurses' motivation to learn, motivation to transfer, knowledge acquisition, and satisfaction with an e-learning course about neonatal pain assessment.	Quantitative (QE): Measurements Knowledge acquisition Satisfaction Motivation	Nurses (n = 30)	Online learning and teaching course	Brazil	<u>Outcomes</u> ↑Increased knowledge ↑Engagement improves learning ↑Quality patient care/safety <u>Challenges</u> ↑Limited access to e-learning tool	Pedagogical competence Administrative competence
Clinical learning and teaching							
Alvarez et al. (2017)	To evaluate the learning outcomes of undergraduate nursing students regarding the assessment of acute pain in adults and newborns before and after an online educational intervention.	Quantitative (QE): Measurement Satisfaction	Nursing students (n = 75)	Mobile learning (XR)	Brazil	<u>Outcomes</u> ↑Adaptation of technology to learner needs ↑Creative integration of technology ↑Effective teaching of pain management <u>Challenges</u> ↑Compatibility issues with mobile devices	Pedagogical competence Technical competence
Botha et al. (2021)	To understand nursing students' perceptions of the use of virtual reality as a possible alternative to high-fidelity simulation.	Quantitative (QE): Measurement Satisfaction Usability	Third-year nursing students (n = 34) (n = 6 pilot)	Online learning (XR)	South Africa	<u>Outcomes</u> ↑Positive experience with VR <u>Challenges</u> ↑Minor usability issues identified during the pilot testing	Technical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Botha et al. (2020)	To determine whether a viable, home-made XR solution could be developed, with the potential for future expansion to incorporate additional scenarios.	Quantitative (expert review): Measurement Feasibility Usability	Experts (n = 4; 2 nursing)	Online learning (XR)	South Africa	<u>Outcomes</u> ↑Improvements in XR-based learning experiences <u>Challenges</u> ↑Need for training, orientation, and haptic feedback	Technical competence Administrative competence
Cunha et al. (2023)	To analyse how nursing students feel in relation to their participation and learning in an escape room activity taking place in an online environment.	Quantitative (survey): Measurement Educational practice Perception	Nursing students (n = 73)	Teleteaching – Zoom	Brazil	<u>Outcomes</u> ↑Satisfaction with Zoom-based activities ↑Positive student engagement ↑Enhanced self-efficacy and emotional response <u>Challenges</u> ↑Technical difficulties during activity	Pedagogical competence Ethical competence Technical competence
Ganji et al. (2022)	To design, implement, and evaluate a virtual clinical training protocol for midwifery internship in a gynaecology course.	Quantitative (QE): Measurement Knowledge Clinical skills	Nursing students (n = 47)	Online learning (XR)	Iran	<u>Outcomes</u> ↑Improved knowledge and skills through virtual clinics ↑Student satisfaction with virtual learning <u>Challenges</u> ↑Virtual learning has little effect on interview skills	Pedagogical competence Technical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Harerimana and Mtshal (2019)	To explore nursing students' perceptions and expectations regarding the use of technology in nursing education.	Quantitative (survey): Measurement Perceived use of technology	Nursing students (n = 150) [Undergraduate n = 121; postgraduate 29]	DET use	South Africa	<u>Outcome</u> ↑Educator encouragement of device use ↑Use of technology to promote creative thinking ↑Positive student perception of technology <u>Challenge</u> ↑Need for skill development	Pedagogical competence Ethical competence Administrative competence
Harerimana and Mtshali (2020)	To establish the role played by technology in nursing education through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).	Quantitative (survey): Measurement Computer usability Perceived technological role	Nursing students (n = 150)	DET use	South Africa	<u>Outcome</u> ↑Usability influences technology perceptions ↑Technology supports professional education ↑Promotion of self-directed learning	Administrative competence Pedagogical competence
Öztürk and Güneş (2023)	To assess the effect of blended learning with an e-learning material on the medication dosage calculation (MDC) test performance of undergraduate nursing students.	Quantitative (QE): Measurement Attitude Usability Benefits and challenges	Second year nursing students (n = 95)	Online learning and teaching course	Turkey	<u>Outcome</u> ↑Blended learning implementation <u>Challenge</u> Student satisfaction not adequately assessed	Administrative competence Pedagogical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Wu et al. (2023)	To understand the affordances and constraints of a fully immersive VR system in facilitating language learning for English as a foreign language (EFL) nurse.	Mixed methods	Year 2 nursing students (n = 10)	Online Learning - XR	China	<u>Outcomes</u> ↑VR supports language learning ↑Simulation of real-world clinical settings <u>Challenges</u> ↑Health risks, affordability, and limited technical support	Pedagogical competence Technical competence Ethical competence Administrative competence
Matlhaba (2023)	To explore the advantages and challenges of using digital technology in clinical education for undergraduate nursing students during the COVID-19 pandemic.	Review (integrative): Measurement Challenges Uses	Nursing students (n = 18 articles)	DET use	South Africa	<u>Outcomes</u> ↑Digital technology enhances clinical learning ↑Boosts confidence and competence <u>Challenges</u> ↑Resistance to digital tools ↑Limited ability to convey emotions	Pedagogical competence Administrative competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Willemsse et al. (2019)	To explore the experiences of undergraduate nursing students who participated in a mobile learning enactment aimed at enhancing their learning experiences in clinical placement.	Qualitative (reflective journal): Measurements Experiences	Second year nursing students (n = 101)	Mobile learning (WhatsApp)	South Africa	<u>Outcome</u> ↑Improved access to information ↑Enhanced communication <u>Challenges</u> Poor data access and internet quality Disapproval from clinical facilities	Pedagogical competence Technical competence Administrative competence
Hao et al. (2022)	To systematically synthesise the available literature on the application of digital education for undergraduate nursing and medical interns during the COVID-19 pandemic.	Review (systematic): Measurements Application of DET	Nursing students (n = 16 studies)	DET use	China	<u>Outcome</u> ↑Support for remote learning via digital education ↑Improved clinical performance <u>Challenge</u> ↑High equipment costs	Pedagogical competence Administrative competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Integrated theory and clinical learning and teaching							
Ferreira da Silva et al. (2020)	To assess layout quality, visual identity, and content of the online “Neonatal Pain Assessment Program.”	Quantitative (survey): Measurement Quality Visual identity and content	Nursing staff (n = 24) [nurses n = 18; others n = 6]	Online learning and teaching course	Brazil	<u>Outcome</u> ↑Integration of technology in training ↑Improved ergonomics and self-directed learning <u>Challenges</u> ↑ Difficulty in assessing course quality	Pedagogical competence Administrative competence
Gause et al. (2022)	To explore and describe technology usage for teaching and learning in nursing education.	Review (integrative): Measurement DET use	Nursing educators (n = 19 papers)	DET use	South Africa	<u>Outcomes</u> ↑Use of technology in nursing education ↑Checking academic dishonesty <u>Challenges</u> ↑Limited access to clinical skills videos	Ethical competence Administrative competence
Bester et al. (2021)	To explore the barriers and enablers of ICT adoption by a diverse group of student nurses in a private nursing education institution in the Free State province.	Qualitative (focus group): Measurement Barriers Enablers	Nursing students (n = 17)	DET use	South Africa	<u>Outcomes</u> ↑Convenience and safety of ICT in hospitals ↑Promotion of self-assessment <u>Challenges</u> ↑Theft, load shedding, and high data costs	Technical competence Pedagogical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Nsouli and Vlachopoulos (2021)	To investigate the attitudes of nursing teaching staff toward the use of ICT in nursing education.	Mixed methods: Measurement Attitudes	Nursing educators (n = 18)	DET use	Lebanon	<u>Outcomes</u> ↑Faculty knowledge updated via ICT ↑Training opportunities provided <u>Challenges</u> ↑Lack of ICT policy ↑Pressure on educators to learn technology	Administrative competence Pedagogical competence
de Abreu Moniz et al. (2016)	To evaluate the use of educational technology, the “Health-Environment Integrated Panel” with nursing graduates.	Qualitative (survey): Measurement Use Challenges	Second-year nursing students (n = 18)	DET use	Brazil	<u>Outcomes</u> ↑Usability of educational technology ↑Motivation to learn <u>Challenges</u> ↑Challenges with realism ↑Conflict with dichotomous curricula	Technical competence Pedagogical competence Administrative competence
Güven Özdemir and Sonmez (2021)	To determine the relationship between nursing students’ levels of technology addiction and their attitudes toward e-learning during the COVID-19 pandemic.	Quantitative (survey): Measurements Addiction to technology Attitude to online	First- to fourth-year nursing students (n = 434)	Online learning and teaching	Turkey	<u>Outcomes</u> ↑Low levels of addiction ↑Positive attitude towards e-learning ↑Self-directed learning <u>Challenges</u> ↑Limited internet access	Administrative competence Pedagogical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Dhakal et al. (2023)	To explore Nepalese nursing students' evaluation of an online education module on respectful maternity care.	Quantitative (QE): Measurement Content and structure Delivery method Relevancy Delivery method	Third-year BSc Nursing students (n = 89) [Intervention n = 40; control n = 49]	Online learning and teaching course	Nepal	<u>Outcomes</u> ↑Online education promoted respectful maternity care learning <u>Challenges</u> ↑Witnessing of disrespectful clinical practices	Pedagogical competence Ethical competence
Fadaeina et al. (2022)	To investigate the effect of an online cultural care training programme on cultural competence and self-efficacy among postgraduate nursing students.	Quantitative (RCT): Measurement Awareness Cultural care Preparation in care Cultural skill	Postgraduate nursing students (n = 90) [Experimental n = 45; control n = 45]	Online learning and teaching course	Iran	<u>Outcomes</u> ↑Increased cultural competence ↑Improved self-efficacy in care ↑Recommendation for more practical sessions <u>Challenges</u> ↑Lack of blended learning approach	Ethical competence Pedagogical competence
Artificial intelligence							
Buchanan et al. (2021)	To summarise the current and predicted influences of AIHTs on nursing education in the next 10 years and beyond.	Review (scoping)	Nursing students (n = 27 articles: 20 expository, 6 quantitative, and 1 qualitative)	AI	Canada	<u>Outcomes</u> ↑Improved content comprehension ↑Support for meeting learning needs <u>Challenges</u> ↑Need for awareness and sensitivity in AI use	Pedagogical competence Ethical competence

Author(s)	Aim	Method	Participants	Concept	Context	Key findings	Framework domains informing guideline development
Hwang et al.(2022)	To conduct a systematic review of the dimensions of nursing activities, research samples, research methods, roles of AI, applied AI algorithms, evaluation measure of algorithms, and research foci.	Review (systematic)	Educators (n = 102 reviews)	AI	Taiwan	<u>Outcomes</u> ↑AI supports training, assessment, and evaluation <u>Challenges</u> ↑Most research focused only on AI design	Administrative competence Pedagogical competence
Rani et al. (2021)	To explore the potential impact of ChatGPT on nursing education, discussing its benefits, challenges, and implications.	Review (narrative)	Educator	AI (ChatGPT)	India	<u>Outcomes</u> ↑Support for problem-solving and self-directed learning ↑Assistance in meeting educational needs <u>Challenges</u> ↑Potential for factual inaccuracies and misuse	Technical competence Pedagogical competence Administrative competence

Note: General AI: Artificial intelligence; DET: Digital education technology; F2F: Face-to-face; ICT: Information Communication Technology; LMICs: Low- and middle-income countries; LMS: Learning management systems; QE: Quasi-experimental; RCT: Randomised control trial; SNS: Social networking sites; VR: Virtual reality; XR: Extended reality

Implications for Areas of Competence Required in the Use of Digital Learning Technologies in Nursing Education

Four areas of competence emerged from the findings, each with implications for the use of digital learning in nursing education in low-resource settings: pedagogical, ethical, technical, and administrative competence. The first two align with the existing framework, where pedagogical competence refers to expertise in applying teaching pedagogy through digital learning technologies, and ethical competence focuses on student equality issues such as access (McGarr and McDonagh 2021; Ryhtä et al. 2021). In contrast, administrative and technical competence are additional items identified in this review that were not elaborated in the original framework (McGarr and McDonagh 2021).

Discussion

The scoping review focused on the current use of digital learning technologies and the challenges they present in nursing education in low-resource settings. The aim was to identify areas of competence to inform the development of guidelines for using digital learning technologies in nursing education in low-resource settings. The key issues emerging from the review are discussed below.

Increased Use of Digital Learning Technologies and Associated Challenges

The review clearly highlighted an increase in the use of online teaching and learning in nursing education, including clinical learning, in low-resource settings. Online and mobile learning are now recognised in nursing education and nurse educators should consider integrating digital learning technologies to facilitate nursing courses (Alshawish et al. 2021; Bester et al. 2021). This is because digital technologies are effective for self-directed learning, meeting learning needs, improving students' comprehension, and enhancing student engagement (Buchanan et al. 2021; Ferreira da Silva et al. 2020; Rani et al. 2021). It is also effective in practical nursing courses as it aids access to clinical information and brings the real world of clinical situations into student's awareness (Willemse et al. 2019; Wu et al. 2023). Social media was perceived to play a small role in skill acquisition (Valdez et al. 2020), and the emergence of digital and artificial learning in nursing education was thought to augment on-site learning (Nsouli and Vlachopoulos 2021).

Challenges for Low-Resource Settings in the Use of Digital Learning Technologies in Nursing Education

The challenges associated with online learning are primarily grouped into four areas: ethical concerns related to digital device use, infrastructure and connectivity issues, the need for digital literacy training, and the need for administrative and technical support (Ng 2022).

Access to digital devices, infrastructure, and connectivity is a major ethical issue in low-resource settings, characterised by inequitable access and a significant digital divide between low- and high-income countries. Access to digital education devices is critical for modern learning; however, several significant issues impede this access (Haleem et al. 2022). The high cost of digital education devices such as smartphones, laptops, and tablets is a major barrier to access. These devices require a substantial financial investment, which poses an issue for less privileged families and low-income communities (Afzal et al. 2023). This financial challenge can exacerbate educational inequalities, leaving students at a significant disadvantage.

Reliable internet access is essential for utilising digital education devices effectively; however, there is a significant digital divide, with many students lacking access to high-speed internet, especially in rural and remote areas (Zarei and Mohammadi 2022). The infrastructure required to support digital education is often lacking in low-resource countries and schools need robust technological infrastructure—including sufficient bandwidth, reliable electricity, and secure networks—to facilitate digital learning (Singh et al. 2021).

These challenges have profound implications for nursing education. Without affordable digital devices, reliable internet access, and adequate infrastructure, students are unable to fully participate in digital learning, leading to a widening educational gap (Alenezi et al. 2023). The disparity in access can result in unequal educational opportunities, affecting students' academic performance and prospects. Addressing these issues requires coordinated efforts from governments, educational institutions, and the private sector.

Digital Literacy

One of the major challenges is the need for training to ensure digital literacy (Durmuş et al. 2022; Hao et al. 2022; Harerimana and Mtshali 2020) for students and nurse educators in nursing education. Most student nurses expect their educators to be highly competent in digital literacy and demonstrate the capacity to use digital devices in teaching-learning situations (Harerimana and Mtshali 2019). This implies that to meet the digital learning needs of student nurses, the nursing education institution must provide digital literacy capacity building to enhance the skills of nurse educators for e-learning (Molato and Sehularo 2022).

Need for Administrative and Technical Support

Administrative and technical support are crucial in fostering an educational environment where digital learning technologies can thrive. Administrative support involves policymaking, resource allocation, and the establishment of a supportive culture, while technical support ensures that digital learning tools are effectively utilised and maintained (Jarvis and Baloyi 2023). This involves training, troubleshooting, and

infrastructure management. The need for administrative and technical support in the use of digital learning technologies is evident as the potential benefits of digital education tools cannot be fully realised without it (Haleem et al. 2022).

Effective administrative support ensures that the necessary policies, resources, and culture are in place, while technical support guarantees that the tools are used efficiently and effectively. The integration of digital learning technologies in nursing education offers immense benefits, but its success hinges on the availability of robust administrative and technical support (da Silva Tiago and Mitchell 2024). By addressing these needs, nursing education programmes can create a dynamic and effective learning environment that prepares future nurses for the challenges of modern healthcare.

Administrative competence involves a combination of technical skills, organisational abilities, and strategic planning. In the context of digital learning technologies, it is essential for both students and academic staff to develop a deep understanding of how to use digital tools to enhance learning and teaching (da Silva Tiago and Mitchell 2024). Students must develop digital literacy skills to navigate and utilise digital learning technologies effectively. This includes understanding how to access online resources, participate in virtual classrooms, and use various digital tools for learning. Administrators can support this by integrating digital literacy into the curriculum and providing access to digital learning resources (da Silva Tiago and Mitchell 2024). By developing clear policies, providing professional development, managing resources effectively, and fostering a culture of collaboration and innovation, administrators can support the effective integration of digital tools in education (Jarvis and Baloyi 2023). This, in turn, enhances the teaching and learning experience, preparing students for the demands of the digital age.

Emergence of AI and Associated Challenges in Nursing Education

The studies also reviewed the emergence of the impact, influence, and role of AI in nursing education; however, there has subsequently (after the review) been an increase in published articles in this area. There have been concerns about nursing education since the inception of AI, specifically regarding large language models such as ChatGPT (Lifshits and Rosenberg 2024). This could be due to concerns about the responsible use of AI by students in maintaining academic honesty. However, AI-driven assessment platforms offer nursing students opportunities for immersive learning, allowing for the development of critical thinking and decision-making skills in safe environments (Liu et al. 2023). Furthermore, AI can aid in personalised learning experiences, adapting educational content to individual student needs and pacing (Glauber et al. 2023).

Despite its promising potential, the integration of AI in nursing education presents multiple challenges. One significant concern is the lack of familiarity and comfort with technology among educators and students. Many nursing faculty members may not have received training in AI tools, which can hinder effective implementation (Marković

2023). The use of AI raises ethical questions about data security, patient privacy, and the potential for bias in AI algorithms, which could impact clinical decision-making (Božić 2024). Moreover, the rapid pace of technological advancement requires continuous updates to curricula, which can strain institutional resources and faculty workloads. It would also be interesting to read about its impact on academic integrity.

Implications for Guideline Development

Pedagogical Competence

The review strongly highlighted the need for pedagogical competence. As online learning becomes an integral part of nursing education (Athilingam et al. 2024), it has been shown to promote active participation, cognitive immersion, and self-directed learning among students (Ganji et al. 2022), as well as improved participation (Alshawish et al. 2021). In this context, the pedagogical competence of the educator is key. Educators need to design appropriate teaching and learning strategies using appropriate digital learning technologies (Ganji et al. 2022). The development of pedagogical competence among educators in nursing education institutions is imperative (Ganji et al. 2022).

Administrative Competence

From the articles included in this review, the need for administrative competence emerged. The administrative aspects of using digital learning technologies are important to ensure the continuous, effective, and appropriate use of technology for online education. This would include policy development, training, and standard operating procedures for the use of digital education technology (Chipps et al. 2012).

Technical Competence

Technical competence has been identified as a necessary skill for performing online tasks related to educational goals. The educators and nursing education institutions are not set up to support the technical requirements for using digital technologies (Mokoena-de Beer and Moloko 2022); however, constant on-the-job training and regular usage are encouraged to gain mastery (Yalcinkaya and Cinar Yucel 2023). Technical specifications should be provided to guide the use of technology (Chipps et al. 2012) and infrastructure should be in place to provide support.

Ethical Competence

The use of digital technologies was found to be suitable for nursing education; however, barriers such as poor internet connectivity and inadequate infrastructure hindered students' access (Willemse et al. 2019). A second ethical competence pertains to the ethical use of digital technologies, especially clinical areas (Buchanan et al. 2021).

Conclusion

The study explored the uses and challenges of digital learning technologies in low-resource nursing education institutions to identify the key competence domains required for effective implementation. These findings will serve as the foundation for developing a set of guidelines to support the integration of these technologies in similar contexts.

Limitation

The rapid expansion of digital learning technologies highlights the need for ongoing updates to this review, given the growing body of literature. Specifically, this is a focused review of the use of AI in nursing education and its implications for low-resource settings.

Competing Interest

The authors hereby declare that there are no conflicts of interest.

Authors' Contributions

All the authors participated in the study.

IO: Writing, review, editing; validation; methodology; investigation; formal analysis; data curation; conceptualisation.

FD: Writing, review, and editing; validation; supervision; methodology; conceptualisation.

JC: Writing, review, and editing; validation; supervision; methodology; investigation; formal analysis; data curation; conceptualisation.

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Data Availability

The study data for this research is available, and the corresponding author can be contacted upon request.

Disclaimer

The expression of opinion in the content of this article primarily reflects the views of the authors and does not represent the position of the organisation affiliated with them.

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