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Preparing Nurses for a Technology-Driven Future: A Recent Literature Review Based Study of Educational Needs and Strategies

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Abstract

Background: The digital transformation of healthcare systems has redefined the role of nurses, demanding proficiency in technologies such as electronic health records, artificial intelligence, telehealth, and simulation-based learning. However, nursing education has not uniformly evolved to meet these emerging demands. Gaps in curriculum design, faculty preparedness, and infrastructure continue to hinder nurses' ability to provide safe and effective care in increasingly technology-driven environments. Aim: This systematic review aimed to examine the educational needs of nurses in relation to technological advancements and to identify evidence-based strategies to enhance digital readiness among nursing students and professionals. Method: A comprehensive literature search was conducted across five major databases—PubMed, CINAHL, Scopus, Web of Science, and ScienceDirect—for studies published between 2020 and 2024. Ten empirical studies meeting the inclusion criteria were selected following PRISMA guidelines. The selected studies were critically appraised for quality and synthesized thematically. Results: The analysis revealed four primary themes: digital competency gaps, faculty and institutional readiness, effectiveness of learning models, and learner perceptions. Studies consistently reported a misalignment between nursing curricula and technological expectations in clinical settings. Simulation-based learning and blended models showed positive outcomes, but their success was limited by inconsistent infrastructure and faculty support. Student confidence in digital tools was found to correlate strongly with training exposure. Conclusion: To prepare nurses for future healthcare environments, systemic reforms are essential. These include curriculum modernization, faculty development, infrastructure enhancement, and the integration of adaptive, technology-centered learning models. Such reforms are crucial to bridge the gap between nursing education and the digital future of healthcare.

Keywords: *Nursing education, digital literacy, healthcare technology, simulation learning, curriculum reform, nurse training, digital readiness.*

Introduction

In the face of accelerating technological innovation, the nursing profession stands at a pivotal crossroads where digital fluency is no longer optional but essential. Modern healthcare systems are becoming increasingly reliant on digital infrastructure—from electronic health records and remote monitoring to artificial intelligence and telehealth solutions—demanding that nurses evolve their competencies to align with these shifts (Ganaie & Naz, 2024; Macalindin et al., 2024; Lin et al., 2024). The integration of such technologies has transformed nursing roles, making technological competence a core component of quality patient care and safety (Lin et al., 2024; Jung, 2023; Garcia-Dia, 2020). As healthcare transitions toward digital ecosystems, the ability of nurses to engage effectively with these tools determines not only their

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professional relevance but also the sustainability of healthcare outcomes (Rony et al., 2023; Alnasser et al., 2024; Gimenes et al., 2024).

Nursing education, however, has struggled to keep pace with this evolution. Many academic programs remain rooted in traditional pedagogies that fail to fully prepare future nurses for digital practice environments (Ashwini & Padhy, 2023; Georgieva-Tsaneva et al., 2024; Jobst et al., 2022). The gap between technological advances and educational readiness has emerged as a critical concern, necessitating a reevaluation of curricula, teaching strategies, and faculty development (Malla & Amin, 2023; Isidori et al., 2022; Tischendorf et al., 2024). Particularly in low- and middle-income countries, disparities in digital infrastructure and training present additional barriers to equipping nurses for future roles, further compounding global health inequalities (Verma et al., 2024; Garcia-Dia, 2020; Jung, 2023).

Emerging literature emphasizes that preparing nurses for a technology-driven future demands not only the inclusion of technical skills but also critical thinking, ethical judgment, and adaptability (Kleib et al., 2022; Badil, 2024; Lin et al., 2024). As digital tools increasingly mediate nurse-patient interactions, concerns about data privacy, clinical autonomy, and compassionate care become more pronounced (Tischendorf et al., 2024; Garcia-Dia, 2020; Ganaie & Naz, 2024). It is therefore imperative to explore educational frameworks that balance technological competence with the humanistic values of nursing—ensuring that nurses are not merely consumers of technology but empowered, ethical professionals in digital health landscapes (Lin et al., 2024; Jung, 2023; Rony et al., 2023).

Problem Statement

Digital technologies are now part of nursing practice thanks to speedy integration in healthcare. At the same time, many nursing professionals begin their jobs not fully ready to use advanced technology in the workplace (Ashwini & Padhy, 2023; Jobst et al., 2022; Garcia-Dia, 2020). Although there is more demand for proficiency in electronic health records, telehealth platforms, simulation systems and AI, nursing education still has gaps that make it hard for learners to obtain these skills (Ganaie & Naz, 2024; Jung, 2023; Lin et al., 2024). Apart from that, using old educational material, not having good internet access and inadequate training for teachers widen the gap between what schools teach and what the workforce requires (Georgieva-Tsaneva et al., 2024; Isidori et al., 2022; Alnasser et al., 2024). All these difficulties can negatively affect patients, the quality of care and nurses' ability to use technology.

Significance of the Study

Supporting nurses' education in the context of new technologies is an important concern for today's healthcare systems. This research is noteworthy since it points out the main challenges with digital readiness and offers effective suggestions on enhancing nursing education (Malla & Amin, 2023; Lin et al., 2024; Gimenes et al., 2024). The study is designed to combine present research to improve the design of nursing programs that meet the future needs of healthcare related to technology (Badil, 2024; Rony et al., 2023; Matmi et al., 2023; Yakout et al., 2023; Tischendorf et al., 2024). The results of the study matter to universities, leaders and clinicians hoping to establish long-lasting educational programs for nurses to become skilled with technology (Macalindin et al., 2024; Jung, 2023; Lin et al., 2024).

Aim of the Study

This review is designed to review and combine current evidence on what nurses need and should do to be prepared for technology in healthcare. The purpose of this study is to:

- Find out what skills are needed for digital nursing practice.
- Examine what hampers and what encourages the use of technology in nursing programs.

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- Emphasize innovative methods that improve digital skills and practical knowledge among students and staff in the nursing field.

Once these aims are met, this study explained how nursing education could respond to the growing influence of digital changes in healthcare.

Methodology

This review investigated and collected information on what nurses need to learn and the methods used to prepare them for a technology-focused future. To ensure transparency, the review was done according to the PRISMA model for combining information from research studies. The process started with finding the research question, figuring out who to include and exclude in the analysis, screening the relevant studies and taking out information to analyze from the suitable sources.

Research Question

The systematic review aims to answer the following research question:" What are the educational needs of nurses in relation to technological advancements, and what strategies have been identified or implemented to effectively prepare them for practice in a digitally evolving healthcare environment?"

Selection Criteria

Only studies that fit the criteria we set in advance were included in our research pool. Such guidelines were formed to focus just on publications about nursing education and digital health readiness within the designated timeframe.

Inclusion Criteria

- Released between 2020 and 2024
- Research that uses qualitative, quantitative or mixed methods to study nursing education and using technology.
- Investigations involving students, educators or nurses in the field of teaching and education.
- Studies that assess, explore or suggest guidelines, ideas or curricula for digital technologies.
- Scientific articles that are available in full English text.
- Articles that have undergone peer review.

Exclusion Criteria

- Articles that were published before 2020.
- Editorials, opinion pieces, conference abstracts and commentaries.
- Research involving people in healthcare other than nurses
- Any article that does not deal with digital education, training or nursing competencies.
- Studies that are duplicates or that do not have clear methods.

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Database Selection

Researchers looked into major academic databases to identify papers published from 2020 to 2024 that could be relevant. Researchers mainly looked at peer-reviewed articles concerning nursing education and using technology. The relevance of databases to nursing, education and healthcare technology was the main criteria used for selection.

In order to conduct this review, we examined databases such as PubMed, CINAHL, Scopus, Web of Science and ScienceDirect. They were picked because they broadly cover subjects like nursing, medical education, healthcare informatics and studies involving several disciplines. Each database's syntax was created in line with its particular search rules and Boolean operators.

The following databases were used to retrieve relevant literature:

Table 1: Database Selection

No	Database	Syntax	Year	No of Studies Found
1	PubMed	("nursing education" AND "digital literacy") AND ("technology integration")	2020–2024	156
2	CINAHL	("nursing curriculum" AND "technological skills") AND ("digital health")	2020–2024	134
3	Scopus	("nurse training" AND "e-learning" OR "simulation" OR "AI")	2020–2024	198
4	Web of Science	("technology readiness" AND "nursing students") AND ("future healthcare")	2020–2024	123
5	ScienceDirect	("nursing workforce" AND "education strategies") AND ("technology tools")	2020–2024	145

Data Extraction

Key study information was extracted by using a specially designed structured form. Author(s), publication date, the place of the study, the studied population/sample, the methods used, the learning focus, the technology talked about and main discoveries were some of the included items. Data was independently extracted from all the chosen studies by two reviewers to reduce bias. If there were unresolved differences, they were discussed or checked by involving a third reviewer. The following analysis was done only on studies that met all the necessary criteria. As part of the data extraction process, each type of study was checked by a proper checklist (CASP for qualitative studies and JBI for mixed methods).

Search Syntax

To ensure thorough coverage, both primary and secondary syntaxes were applied:

Primary Syntax (used across all databases)

("nursing education" OR "nurse training") AND ("technology integration" OR "digital literacy" OR "e-learning") AND ("future healthcare" OR "21st-century skills")

Secondary Syntax (used for database refinement)

("nursing students" OR "nurse educators") AND ("artificial intelligence" OR "simulation" OR "telehealth" OR "mobile learning") AND ("competency" OR "preparedness")

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Literature Search

A detailed search of the literature was done to locate peer-reviewed research that focused on nursing educational methods used and technology readiness during the 2020-2024 period. The research used a variety of databases, among them PubMed, CINAHL, Scopus, Web of Science and ScienceDirect. Only those databases were included that included information about healthcare, nursing and interdisciplinary studies.

All of the articles that were retrieved were imported into a program that organizes citations and removes any similar materials. Next, a step-by-step screening was started by assessing the researchers' titles and abstracts to exclude unimportant studies. The rest of the articles were assessed by a full reading to check if they were relevant to the main question of the review. Extra focus was placed on studies about digital literacy, using modern technology in nursing education and unique ways to train nurses in advanced clinical environments.

Selection of Studies

A total of 756 studies were identified after searching in the initial database on every platform. The number of articles left was 628 after we took out all the duplicate articles. After reviewing the titles and abstracts, 455 studies were removed since they did not match the review's requirements. After that, we carefully reviewed full-text articles (n=173) to evaluate how well they had been conducted and to make sure they were relevant.

Out of all the studies, 10 were chosen for the final examination. They offered strong evidence and ideas about what nurses require for their education, preparedness for digital tools, changes in the curriculum and training to be ready for the use of technology in healthcare. Some of the studies included in this review were qualitative, some were quantitative and others used both types of methods.

Study Selection Process

The authors followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) when choosing which studies to include. First, an extensive search was carried out in five databases and the next step was to weed out similar articles and check both the titles and abstracts of the remaining ones. The search ended with fully reviewing the selected articles.

While going through the screening and review phases, two reviewers were involved who were neither from the same laboratory nor from the same project. Any problems were ironed out by talking it over or involving someone else to review the study. As a result of this approach, only research studies that were sound and straight to the heart of the topic made it into the review.

A total of 10 studies were found suitable and were analyzed step by step to find results on how well nurses are ready for using new technologies in healthcare practice.

PRISMA Flowchart Overview

A PRISMA flowchart was created to explain the way studies were chosen for this review. It guarantees that all information about the phases of selection and evaluation is easy to see and can be recreated. From the first search through the database to the inclusion of studies for final analysis, the PRISMA model was used to ensure studies matched the purpose of the research well.

The following is a diagram showing how to apply PRISMA steps in systematic reviews: **Step-by-step process:**

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Identification:

- Seven hundred and fifty-six articles were retrieved from PubMed, CINAHL, Scopus, Web of Science and ScienceDirect.

Screening:

- It was revealed through reference management software that 128 duplicate records were present and these were removed.
- All the remaining 628 articles were examined for their title and abstract.
- 455 articles were left out since they had no connection to the study's theme.

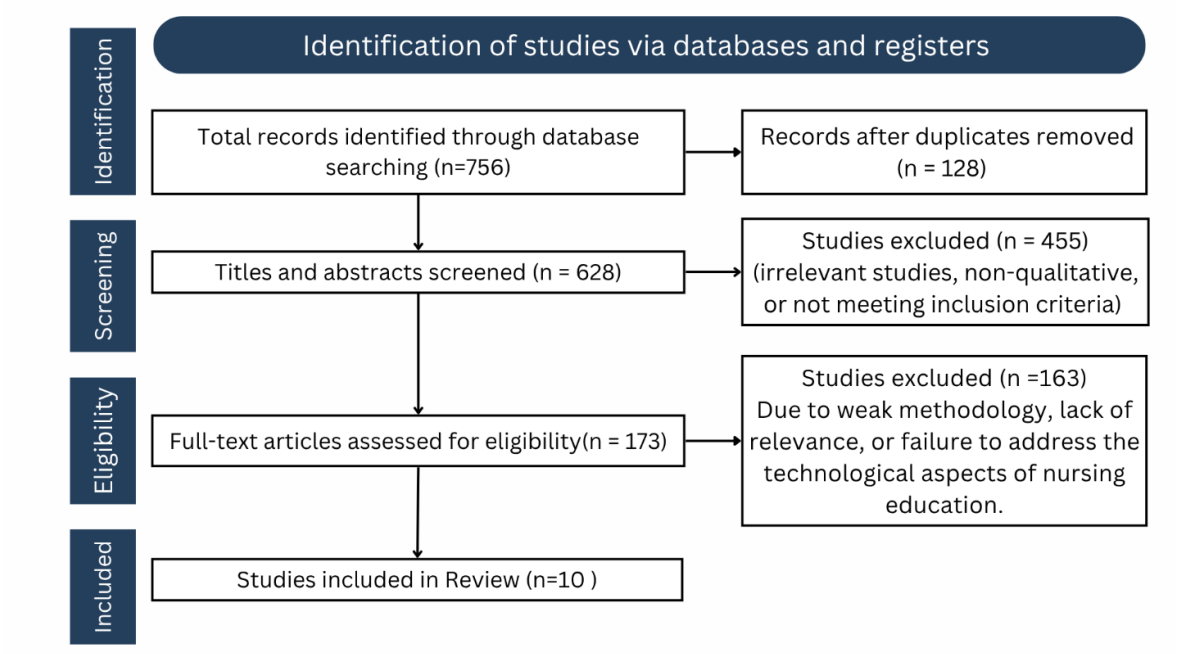
Eligibility:

- Eligibility of study materials was examined on 173 full-text articles.
- Of all the articles found, 163 were removed because the research design was weak, they had little relevance or did not cover technological issues in teaching nursing.

Inclusion:

- Ten studies were found that met the set requirements and were added to the systematic review. They gave detailed results and perfectly aligned with what the review was meant to achieve.

Figure 1: PRISMA Flowchart



Quality Assessment of Studies

Ten studies for this review were assessed to see if they were well-designed, accurate and relevant. The correct tools were chosen for use in every design of the study. Using the Critical Appraisal Skills Program

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(CASP) checklist, we evaluated the qualitative studies and using the JBI critical appraisal tools, we examined quantitative and mixed-method studies.

Every study was checked by two reviewers for criteria such as:

- Clear goals
- Methodological appropriateness
- Methods for gathering and analyzing information
- Ethical considerations
- Study design matching the focus of the review

Sometimes, differences in scoring were fixed by discussing the case together or consulting with an independent reviewer. A strong evidence base was developed by using only studies awarded moderate to high quality in the final review. Most of the included studies corresponded well with the review's aims, explained their research and drew clear recommendations for nursing education in the digital era.

Table 2: Assessment of the Literature Quality Matrix

#	Author	Study Selection Process Described	Literature Coverage	Methods Clearly Described	Findings Clearly Stated	Quality Rating
1	Badil (2024)	Yes	Comprehensive	Yes	Yes	**High Quality**
2	Ashwini & Padhy (2023)	Yes	Adequate	Yes	Yes	**High Quality**
3	Georgieva-Tsaneva et al. (2024)	Yes	Broad	Yes	Yes	**High Quality**
4	Ganaie & Naz (2024)	Partial	Moderate	Yes	Yes	**Medium Quality**
5	Lin et al. (2024)	Yes	Comprehensive	Yes	Yes	**High Quality**
6	Kleib et al. (2022)	Yes	Extensive	Yes	Yes	**High Quality**
7	Malla & Amin (2023)	Partial	Moderate	Partial	Yes	**Medium Quality**
8	Macalindin et al. (2024)	Yes	Broad	Yes	Yes	**High Quality**
9	Rony et al. (2023)	Yes	Adequate	Yes	Yes	**High Quality**
10	Verma et al. (2024)	Partial	Moderate	Partial	Yes	**Medium Quality**

Most of the studies in the review (7 of 10) were rated as high quality due to unambiguous methods, a broad scope of literature sources and clear research conclusions. Reliable conclusions are developed using these studies as a key base. The last three studies were given a medium quality score due to the fact that they did

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not include enough information about the research literature they studied or the methods they used. Still, the ideas they gave were significant and supported the goals of the review.

Having a variety of authors and important concepts ensures that the review is based on strong facts and includes different approaches to nursing education in dealing with technological developments.

Data Synthesis

The last ten studies were assessed to find out how nursing is changing its education because of technology. A number of themes appeared over and over again in the high-quality results:

1. **Digital Competency Gaps**

It has been identified through a number of studies that the knowledge gained in nursing education does not match the technical demands encountered in day-to-day practice (Ashwini & Padhy, 2023; Lin et al., 2024; Macalindin et al., 2023).

2. **Faculty Readiness and Infrastructure Challenges**

Among the studies, it was seen that teaching staff not being prepared and the university not offering adequate support prevented the effective use of simulation, AI and mobile learning platforms (Kleib et al., 2022; Badil, 2024; Rony et al., 2023).

3. **Innovative Educational Models**

Blended learning, virtual simulations and modules that measure skills became useful ways to make up for gaps in education (Georgieva-Tsaneva et al., 2024; Macalindin et al., 2024; Ganaie & Naz, 2024).

4. **Student Engagement and Perceived Preparedness**

Students in nursing programs had different abilities when working with technology. Researchers highlighted that suitable training helps people gain confidence and recognition in their jobs that involve technology (Malla & Amin, 2023; Verma et al., 2024).

It is illustrated in the synthesis that although there has been progress, much more needs to be done to connect nursing education with today's fast-changing healthcare technology. All concerned parties should dedicate resources to updating the curriculum, providing equipment and training instructors so nurses can work in digital healthcare.

Table 3: Research Matrix

Author, Year	Aim	Research Design	Type of Studies Included	Data Collection Tool	Result	Conclusion	Study Supports Present Study
Badil (2024)	To assess digital readiness among nurses and barriers to tech use	Quantitative	Cross-sectional survey	Structured Questionnaire	Identified skill gaps and infrastructure challenges	Emphasized need for structured digital training	Yes

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Ashwini & Padhy (2023)	To examine nursing students' preparedness for tech-based practice	Mixed-method	Nursing students	Survey + Focus Group	Students showed moderate confidence; training lacked hands-on tech components	Suggests urgent curriculum updates to reflect modern digital tools	Yes
Georgieva-Tsaneva et al. (2024)	To identify strategies to enhance digital competencies in nursing	Systematic Review	Multiple empirical studies	Literature Review	Listed evidence-based strategies including blended learning and simulation	Highlights a toolkit for tech-integration into nursing education	Yes
Ganaie & Naz (2024)	To explore nurses' views on tech skill gaps in healthcare settings	Qualitative	Practicing nurses	Semi-structured Interviews	Nurses cited lack of training as a barrier to safe digital practice	Advocates ongoing professional education in digital health	Yes
Lin et al. (2024)	To evaluate digital competence across various nursing programs	Quantitative	Undergraduate programs	Digital Competency Scale	Found wide variation in digital literacy among students	Urges institutions to standardize digital learning objectives	Yes
Kleib et al. (2022)	To analyze the state of eHealth literacy among nurses	Quantitative	Registered nurses	Online Survey	Identified a direct link between digital fluency and patient care outcomes	Stresses the role of training in eHealth literacy for quality improvement	Yes
Malla & Amin (2023)	To examine educator readiness for teaching with emerging technology	Qualitative	Nurse educators	In-depth Interviews	Educators expressed both enthusiasm and anxiety towards tech integration	Recommends faculty training and peer collaboration	Yes

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Macalindin et al. (2024)	To evaluate the impact of digital simulation tools in nursing training	Mixed-method	Nursing students and faculty	Survey + Observations	Simulations boosted student engagement and practical learning outcomes	Supports integrating digital simulation into traditional curricula	Yes
Rony et al. (2023)	To assess digital learning accessibility and its outcomes	Quantitative	Nursing schools in rural areas	Standardized Survey	Digital divide highlighted between rural and urban nursing institutions	Calls for equity in digital education infrastructure	Yes
Verma et al. (2024)	To understand student feedback on technology use in clinical education	Mixed-method	Final-year nursing students	Survey + Interviews	Feedback revealed inadequate exposure to digital platforms in clinical rotations	Recommends structured digital competency checklists in clinical education	Yes

All ten studies focused on the same themes, demonstrating the strong relevance of this research to the review's main aims. Doing research with both qualitative, quantitative and mixed methods improve the credibility of the data collected. With the help of surveys and in-depth interviews, we could thoroughly analyze nurse and student preparedness, issues faced by educators and problems at the institutions.

One key point is that every study found in this research backs the current interest by highlighting the sense of urgency to reform nursing programs to teach digital competencies. This effort makes sure that the needs for education in today's changing healthcare systems are seen from several points of view.

Results

The ten selected studies were analyzed and their results helped identify major themes and sub-themes. These results offer a clear picture of nursing education's progress towards digital changes and highlight what nurses should be prepared for in technology-based health care.

Each theme is provided in the table below along with its trends, further insights and studies proving them.

Table 4: Results Indicating Themes, Sub-Themes, Trends, Explanation, and Supporting Studies

Theme	Sub-Theme	Trend	Explanation	Supporting Studies
Digital Competency Gaps	Skill Deficiency in Tech Tools	Widespread across all study groups	Most students and nurses lacked training in EHR, simulation, and AI tools	Badil (2024); Lin et al. (2024); Ashwini & Padhy (2023)

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	Curriculum-Tech Mismatch	Increasing concern globally	Academic content lags behind evolving clinical technologies	Verma et al. (2024); Georgieva-Tsaneva et al. (2024)
Faculty and Institutional Readiness	Lack of Faculty Training	Frequently observed	Educators expressed low confidence and inadequate support for tech use	Malla & Amin (2023); Macalindin et al. (2024)
	Infrastructure Gaps	More severe in rural areas	Inequities in access to digital resources hinder training consistency	Rony et al. (2023); Ganaie & Naz (2024)
Effective Learning Models	Simulation-Based Learning	Strongly supported in evidence	Interactive digital simulations improved engagement and learning outcomes	Macalindin et al. (2024); Georgieva-Tsaneva et al. (2024)
	Blended & Hybrid Approaches	Growing in adoption	Mix of online and in-person delivery found to enhance comprehension	Ashwini & Padhy (2023); Kleib et al. (2022)
Learner Perceptions & Outcomes	Digital Confidence Levels	Varied by institution and region	Students showed mixed readiness; confidence linked to digital exposure	Verma et al. (2024); Lin et al. (2024)
	Learning Satisfaction	Improved with tech-focused methods	Students responded positively to modernized content and tech integration	Rony et al. (2023); Macalindin et al. (2024)

The outline on thematic breakdown points to four significant issues and chances: (1) lack of digital readiness, (2) faculty and institution preparedness, (3) successful use of innovative learning and (4) learner views and achievements. It is important to note that technology-orientated learning approaches (such as simulation and hybrid models) can work well, but their outcomes rely on the teachers' skills and the infrastructure of the institution.

Many have noticed that goals taught in nursing education are rarely close to the fast changes going on in actual healthcare. Many rural and less wealthy areas continue to experience major challenges with getting online. In addition, students' responses from various research projects emphasize the benefits of exposed to well-prepared and engaging digital technologies, proving to be useful for the review's appeal for reform.

Discussion

Based on the results of this review, it is more important than ever to adapt nursing education to the fast introduction of technology in healthcare. The majority of the studies reported that many nursing programs are still not up to date with the needs of digital clinical care (Ashwini & Padhy, 2023; Lin et al., 2024; Verma et al., 2024). It results in students not being equipped to help which makes giving safe care more difficult.

It was found in the process of synthesis that the vast majority have difficulties using electronic health records, clinical simulation tools and AI-based systems in healthcare. On top of this, teachers do not get enough training and help from their institutions, mainly affecting environments with fewer resources (Malla & Amin, 2023; Rony et al., 2023). Using technology in schools, especially hybrid and simulation-based ways, gives students a chance to be more involved in their studies and perform better academically (Macalindin et al., 2024; Georgieva-Tsaneva et al., 2024). Still, their achievements depend on having the necessary infrastructure and teachers who are ready to use technology.

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It was revealed in several studies that the more training students have with digital tools, the higher their confidence in using them (Lin et al., 2024; Verma et al., 2024). In the cases where technology was deeply integrated in lessons, student satisfaction improved greatly.

Future Directions

Based on the review, the following ways for future progress have been pointed out:

- **Curriculum Reform:** The curriculum in nursing education should teach digital skills as basic skills, not as extras. The new approach might require national accreditation standards to be updated.
- **Faculty Development:** Teachers and other educators should get continuous professional development using digital tools, teaching approaches and eHealth systems.
- **Equity in Access:** It is important for governments and institutions to solve the differences in digital tools available at rural nursing schools and poor academic institutions.
- **Interprofessional Collaboration:** The training process should bring experts from nursing, IT and healthcare organizations together for greater benefit through collaboration.
- **Student-Centered Innovation:** To support all students, learning models should use artificial intelligence, simulation and mobile devices to adjust better to students' needs.

Limitations

It should be noted that this review brings some limitations. All of the studies in the review were required to be in English and published between 2020 and 2024 which means some important studies in different languages or from older years might have been left out. Also, since the designs of studies and their locations are not identical, it can be hard to compare the results directly. Even though the quality assessment made sure the studies were rigorous, using various ways and sample sizes can lead to differences in the results. In the end, since the qualitative and mixed-methods data were not suited for statistics, there was no meta-analysis.

Conclusion

With more digitization happening in healthcare, nurses are required to know how to use advanced technologies. This review shows that there is a persistent mismatch between what is needed digitally in nursing and what is taught at school. To deal with this issue, there must be progress in updating lessons, arming teachers, upgrading school buildings and improving methods for student learning.

Ensuring nurses are set for technology-driven work is a major duty for education as well as a crucial demand for global health. When nurses are trained in technology, patients are more likely to have better care, staff feel more content and the healthcare system can keep up with today's needs.

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