



Virtual reality in undergraduate operating theatre nursing education: a scoping review protocol

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ABSTRACT

Introduction: Virtual reality has emerged as an innovative tool in nursing education, enabling immersive and interactive learning experiences that may support the development of technical and non-technical skills. In undergraduate training, access to real surgical environments is often restricted due to safety, ethical and logistical concerns, which limits experiential learning in the operating theatre. Virtual reality may represent a valuable complement; however, current evidence is dispersed and has not yet been systematically summarized, justifying the need to map existing knowledge.

Objectives: To map the published evidence on the use of virtual reality in undergraduate nursing education within the operating theatre context, identifying modalities, educational purposes, learning outcomes, and existing research gaps.

Methodology: Following Joanna Briggs Institute methodology and PRISMA-ScR reporting guidelines, this scoping review will comprehensively map the existing evidence on the use of virtual reality (Concept) in undergraduate nursing education (Population) within the operating theatre setting (Context). Searches will be conducted in MEDLINE (via PubMed), Scopus, Web of Science, CINAHL Complete, SciELO and the Cochrane Library. Grey literature will also be systematically explored through multiple sources, including Repositório Científico de Acesso Aberto de Portugal, international dissertation and thesis repositories such as ProQuest Dissertations & Theses Global, and websites of relevant professional organizations and academic institutions. Study selection and data extraction will be carried out independently by two reviewers using a pre-designed tool, and the findings will be synthesized descriptively, supported using charts and tables to map key concepts, evidence types, and research gaps.

Results: The review is expected to map virtual reality technologies, educational approaches, competencies targeted, and measured outcomes in undergraduate perioperative nursing education, as well as research gaps and methodological limitations.

Conclusion: This protocol supports the transparent and rigorous development of a scoping review on virtual reality in undergraduate operating theatre nursing education. The expected findings may inform educational planning, guide simulation design and support future research in perioperative nursing education.

Contributions: Conceptualization: CM, PA and VN; Data curation: CM, PA, VN, JA and AP; Formal Analysis: CM, PA, VN, JA and AP; Methodology: CM, PA and VN; Project administration: CM, PA and VN; Resources: Not applicable; Supervision: CM, PA, VN, JA and AP; Validation: PA, VN, JA, AP; Writing – original draft: CM; Writing – review & editing: CM, PA and VN.

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RESUMO

Introdução: A realidade virtual tem emergido como uma ferramenta pedagógica inovadora no ensino de enfermagem, proporcionando experiências imersivas que podem potenciar o desenvolvimento de competências práticas, sobretudo em cenários de elevada complexidade como o bloco operatório. No ensino pré-graduado, o acesso a ambientes cirúrgicos reais é frequentemente limitado por questões éticas, de segurança e de logística, pelo que a realidade virtual poderá constituir uma alternativa educacional pertinente. Contudo, a evidência disponível permanece dispersa e não sistematizada, justificando a necessidade de mapear o conhecimento existente.

Objetivos: Mapear a evidência publicada sobre o uso da realidade virtual no ensino pré-graduado de enfermagem em contexto de bloco operatório;

Metodologia: Seguindo a metodologia do Joanna Briggs Institute e as diretrizes de relato PRISMA-ScR, esta revisão de escopo irá mapear de forma abrangente as evidências existentes sobre o uso da realidade virtual (Conceito) na formação de enfermagem de graduação (População) no ambiente da sala de cirurgia (Contexto). As pesquisas serão realizadas no MEDLINE (via PubMed), Scopus, Web of Science, CINAHL Complete, SciELO e Cochrane Library. A literatura cinzenta também será explorada sistematicamente através de múltiplas fontes, incluindo o Repositório Científico de Acesso Aberto de Portugal, repositórios internacionais de dissertações e teses, como o ProQuest Dissertations & Theses Global, e sites de organizações profissionais e instituições académicas relevantes. A seleção dos estudos e a extração dos dados serão realizadas de forma independente por dois revisores, utilizando uma ferramenta pré-concebida, e os resultados serão sintetizados de forma descritiva, apoiados por gráficos e tabelas para mapear conceitos-chave, tipos de evidência e lacunas na investigação.

Resultados: Espera-se identificar as tecnologias aplicadas, os conteúdos educativos desenvolvidos e os desfechos reportados, bem como reconhecer lacunas e limitações na produção científica existente.

Conclusões: Este protocolo permitirá estruturar de forma rigorosa a *scoping review* proposta, contribuindo para a consolidação da evidência relativa ao uso da realidade virtual no ensino pré-graduado de enfermagem em contexto perioperatório, podendo ainda servir de base para o desenvolvimento de futuros estudos nesta área.

Introduction

The operating theatre (OT) service is one of the most complex and dynamic environments in hospital healthcare, requiring precision, skill and meticulous coordination between the multidisciplinary team. In this context, perioperative nursing plays a crucial role, ensuring not only the well-being and safety of the surgical patient throughout the process, but also the effectiveness of the procedures performed.¹ Perioperative nurses are responsible for activities ranging from OT preparation to immediate post-operative care, requiring highly specialized training that combines technical knowledge and skills with advanced critical thinking.²

Undergraduate nursing education must address the challenge of preparing future nurses for this demanding scenario by integrating teaching methodologies that accurately reflect the complexities of the OT into academic curricula. Currently, most undergraduate nursing degree programs adopt a superficial or insufficient approach to perioperative nursing. Recent reviews indicate an increasing interest in using virtual reality (VR) in nursing education, highlighting its potential to improve knowledge, technical performance, and learner engagement.^{3,4} However, these studies focus on general nursing

education or broad simulation approaches, with no synthesis specifically examining VR in perioperative training or the OT context. This gap limits a comprehensive understanding of how VR can support the development of the theoretical knowledge and practical skills essential for working safely and effectively at this critical stage of surgical care.

The population, concept, and context of this review were defined to address this gap. The population consists of undergraduate nursing students, as they must develop competencies suited to the complexities of the OT during their foundational training.⁵ The concept centers on VR, selected for its capacity to support immersive, repeatable, and interactive learning within controlled settings.⁶ The context focuses on the OT, given its central importance to patient safety and surgical outcomes and the well-documented constraints on direct student access to real surgical environments.

In this review, "VR" refers to computer-generated, three-dimensional environments that facilitate realistic interaction and experiential learning.⁷ As an educational strategy, VR enables the simulation of clinical scenarios without direct exposure to patient-related risks, supports repeated practice without physical resource limitations, and

enhances knowledge retention through immediate feedback.^{6,8} These features are particularly relevant in perioperative nursing education, an area that encompasses care provided before, during, and after surgery and requires both advanced technical skills and rapid, effective decision-making. However, the extent, characteristics, and outcomes of VR use in this specific educational context remain to be systematically mapped.

Studies indicate that immersive virtual simulation can significantly improve nursing students' knowledge and skills.⁵ One study showed that integrating VR and high-fidelity simulation increased students' knowledge, problem-solving ability, and nursing performance.⁹

Another study showed that, prior to clinical practice, virtual visits to the OT, based on VR, reduce students' stress and anxiety about the surgical environment and increase their levels of self-confidence. Thus, it is essential to understand how the use of these technologies can influence not only the acquisition of skills, but also the emotional and psychological preparation necessary for safe and confident performance in highly complex contexts, such as the OT.¹⁰

Nursing students' attitudes towards VR training in surgical contexts are shaped by both human and technological factors, including the level of immersion, ease of use, and the realism of the scenarios.^{5,6} While emerging evidence suggests positive effects on confidence, empathy, and communication, challenges remain in terms of access, acceptance, and the need for pedagogically standardized content, which must be addressed to maximize the effectiveness of this training approach in perioperative nursing education.

Key concepts such as "immersive simulation" and "perioperative nursing" will be clearly defined based on applicable literature, providing a robust framework for understanding the review's scope. Preliminary research suggests that evidence compatible with the PCC criteria exists, demonstrating the feasibility of this review.

A scoping review is the most suitable methodological approach for this investigation, as it aims to map, describe, and synthesize dispersed evidence rather than assess effectiveness.¹¹

Specifically, this review aims to map the current use of VR in undergraduate nursing education within the operating theatre context, identifying the types of technologies employed, educational approaches adopted, learning outcomes reported, and gaps in the existing literature. The findings are intended to inform the design of future research and the evidence-based integration of VR into perioperative nursing curricula.

Methodology

This scoping review will be conducted in accordance with the methodology proposed by Joanna Briggs Institute (JBI)

for scoping reviews. The review protocol has been prospectively registered on the Open Science Framework (OSF) with the project DOI: <https://doi.org/10.17605/OSF.IO/UBS5H>.

Review question

This scoping review is guided by the following primary question: What evidence exists on the use of VR in undergraduate nursing education in the OT context?

The following secondary questions further delineate the scope of the review:

Q1: *What types of VR technologies have been used in undergraduate nursing education in a perioperative context?*

Q2: *What are the reported results (perceptions, benefits, challenges, and limitations) associated with the use of VR in this context?*

Q3: *What instruments or methods have been used to evaluate the effectiveness of VR in this context?*

Q4: *What challenges and barriers exist in the implementation of VR in undergraduate nursing education in a perioperative context?*

Q5: *What knowledge gaps can be identified in the existing literature?*

Inclusion criteria

Considering the JBI recommendations for scoping reviews, we defined inclusion criteria based on the mnemonic 'PCC,' which stands for population, concept, and context.

Population

The population of this scoping review will consist of undergraduate nursing students, regardless of their year of study, who attend courses or training activities related to perioperative nursing or the OT. Studies involving exclusively trained nurses or students from other health-related courses (e.g., medicine) or health professionals from other areas will be excluded, as will studies involving students from other disciplines, unless the results relating to nursing students are clearly identified, reported separately, and relevant to the objectives of this review.

Concept

The concept of interest refers to the use of VR as a pedagogical strategy in nursing education, including immersive virtual environments, VR-based simulations, and other educational VR applications (for example: 3D simulation or serious games) designed to support the development of cognitive, technical, and non-technical skills, such as clinical judgement, decision-making, surgical patient safety, and perioperative performance. Studies using other educational technologies (e.g., high-fidelity non-virtual simulation, traditional e-learning) without a VR component will be excluded.

Context

The context includes formal nursing education settings, namely higher education institutions, simulation laboratories, and other academic or clinical-educational settings (e.g., OT services in hospitals) where OT nursing education is provided as part of a degree programme.

Types of sources

This scoping review will consider a wide range of evidence sources, in accordance with the recommendations of JBI, with the aim of comprehensively mapping the use of VR in perioperative nursing education in undergraduate teaching. Primary studies with quantitative, qualitative, and mixed-method designs will be included. Quantitative designs may include experimental and quasi-experimental studies, such as randomized and non-randomized clinical trials, intervention studies with pre- and post-intervention assessment, and interrupted time series studies, as well as analytical observational studies (cohort studies, case-control studies, and analytical cross-sectional studies) and descriptive observational studies (descriptive cross-sectional studies, case series, and case reports). Qualitative studies exploring the experiences, perceptions, and learning processes of nursing students regarding the use of VR in the context of perioperative training will also be considered, including approaches such as phenomenology, grounded theory, ethnography, qualitative description, and action research. In addition, relevant, systematic and scoping reviews will be included only for the purpose of identifying primary studies and mapping conceptual frameworks, and their findings will not be double-counted. As well, will be included as conceptual literature, including theoretical studies, discussion papers and expert opinions, provided they contribute to understanding the role of VR in perioperative nursing education at the undergraduate level.

In line with the JBI methodology for scoping reviews, no restrictions will be applied regarding language or publication date. This methodological choice aims to ensure comprehensive mapping of the available evidence, minimising the risk of publication bias and allowing the identification of the temporal evolution of knowledge on the subject.

Search strategy

Regarding research strategy, JBI¹² recommends a three-phase search process that should be used in developing a comprehensive search strategy: The first phase involved conducting an initial limited search of the MEDLINE (via PubMed) and CINAHL (via EBSCO) databases to find studies on the phenomenon of interest, using the search terms: “nurse students”, “perioperative nursing”, “surgical nursing education”, “immersive simulation”, “virtual reality” and “operating room OR OT”.

In the relevant studies, the words contained in the titles and abstracts were analysed, as well as the indexing terms used to describe the studies, to develop a comprehensive search strategy for MEDLINE (via PubMed), Scopus, Web of Science, CINAHL complete, SciELO and Cochrane Library. The search strategies will be adapted and individualized for each database of published studies, since each one uses its own controlled vocabulary.

The free/natural terms and MeSH terms defined for the search are outlined in Appendix 1, while the proposed search strategy for one of the databases is presented in Appendix 2.

Sources of unpublished studies, namely grey literature, include RCAAP (Portugal's Open Access Scientific Repository), international dissertation and thesis repositories such as ProQuest Dissertations & Theses Global, and websites of relevant professional organizations and academic institutions. The second phase involves conducting specific database searches in each of the bibliographic databases and information sources selected and mentioned above. The third phase involves including any additional relevant studies in the bibliographic reference lists of all studies selected for review.

Study/source of evidence selection

All identified bibliographic references will be exported to the Rayyan software,¹³ where duplicates will first be removed and then used for screening and selecting studies. The analysis will begin with the titles and abstracts, based on the inclusion and exclusion criteria described above. In the next phase, the full text will be analyzed and, after this analysis, only studies that meet the inclusion criteria will be retained, with the remainder being excluded.

This selection process will be reviewed by two independent reviewers. Any disagreements that may arise between the reviewers will be discussed directly between them, sharing their opinions and the reasons behind their assessments. This exchange of information can clarify points of view and help to reach a consensus. If the disagreement persists, it may be necessary to consult a third reviewer.

Given that this is a scoping review, the methodological quality of the included studies will not be assessed, since the aim is to map the scientific evidence on the topic.

The study selection process will be presented using a flow diagram in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). This flow diagram details the identification, screening, eligibility, and inclusion of sources of evidence, including the removal of duplicates and the application of the inclusion criteria.¹¹

Data extraction

The data will be extracted by two independent reviewers using a structured data extraction tool developed specifically for this scoping review, based on the data extraction template recommended by the JBI for reviews of this scope. The extraction tool will be pre-tested on a subset of included studies (n = 3 to 5) to assess its clarity, consistency, and suitability for the review's objectives and research question. After this pilot phase, any necessary adjustments may be made, and the final version of the extraction form will be included as an appendix in the full review. If there are substantial changes to the instrument after the pilot test, these will be explicitly reported and justified in the final publication, ensuring methodological transparency.

The data extraction tool may be refined iteratively, if necessary, throughout the extraction process to accommodate the diversity and complexity of the evidence sources included. All modifications made will be documented and described in detail in the final scoping review. A draft of the data extraction form is presented in Appendix 3.

Key variables to be extracted will include, but are not limited to: the type and classification of VR technology (e.g., head-mounted display, desktop VR, cave automatic virtual environment, 360° video), the level of immersion (fully immersive, semi-immersive, or non-immersive), the hardware and software used (device brand and model, development platform or commercial application), the duration and structure of the VR intervention (number of sessions, total exposure time, and integration within the curriculum), the underpinning pedagogical or theoretical framework (e.g., Kolb's experiential learning cycle, Jeffries simulation framework, Bloom's taxonomy), and the specific perioperative competencies targeted (e.g., surgical safety verification, aseptic technique, instrument handling, patient positioning, team communication).

Data extraction will be performed independently by two reviewers, with discrepancies resolved by consensus or, when necessary, by a third reviewer. Where relevant, the authors of the included studies may be contacted for clarification or to obtain missing data relevant to answering the review questions. In accordance with the JBI methodological guidelines for scoping reviews, no formal critical appraisal of the methodological quality of the included sources of evidence will be performed. The aim of this review is to map the extent, nature, and characteristics of the available evidence, identifying knowledge gaps, convergences, and thematic trends, rather than assessing the risk of bias or the individual methodological quality of the studies.

Data analysis and presentation

In accordance with the JBI¹⁴ guidelines for scoping reviews, the synthesis of the information collected will be presented predominantly in the form of tables, with the aim of

facilitating the systematic and transparent mapping of the extracted data,^{14,15} as exemplified in Table 1. These tables will be complemented by a descriptive narrative synthesis, intended to contextualize the results, followed by an interpretative discussion that will establish the relationship between the evidence identified, the objective of the review and the respective research questions.

The narrative summary will allow for the integration and critical description of the main characteristics of the included sources of evidence, highlighting recurring patterns, areas of convergence, and knowledge gaps in the use of virtual reality in perioperative nursing education at the undergraduate level. The implications of the results for nursing practice, academic teaching, and future research will also be discussed.

Table 1: Characteristics of the included studies.

N.º	
Author(s)	
Year	
Country	
Study Aim	
Study Design	
Sample (n)	
VR Technology Type	
Hardware/Software	
Level of Immersion	
Intervention Duration	
Pedagogical/Theoretical Framework	
Perioperative Competencies Targeted	
Outcomes Measured	
Key Findings	
Reported Limitations/Gaps	

Note: VR: Virtual Reality; VR Technology Type: e.g., head-mounted display (HMD), desktop VR, cave automatic virtual environment (CAVE), 360° video, serious game; Level of Immersion: fully immersive, semi-immersive, or non-immersive; Intervention Duration & Structure: number of sessions, total exposure time, single vs. repeated exposure, curricular integration; Pedagogical/ Theoretical Framework: e.g., Kolb's experiential learning cycle, Jeffries simulation framework, Bloom's taxonomy, Tanner's clinical judgment model (if reported).

Conclusion

This scoping review aims to systematically map the existing evidence on the use of VR in undergraduate nursing education within the OT. The review will identify and categorize the types of immersive technologies described in the literature, the educational approaches adopted, the

perioperative content addressed, and the outcomes assessed in relation to teaching and learning processes.

In addition, the review will chart the methodological characteristics of the included studies and map reported gaps in the evidence base. No assumptions are made regarding the nature, effectiveness, or impact of the interventions identified.

The findings will be presented in a structured narrative synthesis, organized in accordance with the objectives of the review, and supported by tabular and graphical representations where appropriate. This approach will facilitate a comprehensive overview of how VR has been examined within undergraduate nursing education in the operating theatre context.

By systematically mapping the scope, characteristics, and extent of the available evidence, this protocol provides a transparent methodological framework for the conduct of the scoping review and supports reproducibility and future research development in this field.

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Appendix 1

Appendix 1: Table of free/natural terms and the Mesh terms defined for the search

	Free/natural terms	Mesh terms	CINAHL
Population	"nursing student*" OR "nursing education"	"students, nursing" OR "education, nursing"[no expl] OR "education, nursing, baccalaureate"	"students, nursing" OR "students, nursing, baccalaureate" OR "education, nursing" OR "education, nursing, baccalaureate"
Concept	"virtual simulation" OR "virtual reality" OR "3D simulation" OR "serious games" OR "virtual environment" OR "VR" OR "AR" OR "XR" OR "immersive technolog*"	"virtual reality" OR "augmented Reality" OR "computer simulation"	"virtual reality+" OR "computer simulation"
Context	perioperative OR intraoperative OR surg* OR operati*	"perioperative care" [NO EXPLO] OR "intraoperative care" OR "perioperative period" [no expl] OR "intraoperative period" OR "perioperative nursing" [NO EXPL] OR "operating room nursing" OR "operating rooms"	"perioperative care" OR "intraoperative care" OR "intraoperative period" OR "perioperative nursing" OR "operating room nursing" OR "operating rooms"

Appendix 2: Complete search strategy

A comprehensive search was conducted in MEDLINE (via PubMed) in January 2026. The search strategy combined both index terms (MeSH) and free-text terms related to three concepts PCC. Boolean operators (AND/OR) were used to combine search blocks. No restrictions were applied to language or publication type

Search number	Search query	Results
#1	"nursing student*" [Text Word] OR "nursing education" [Text Word] OR "students, nursing" [MeSH Terms] OR "education, nursing" [MeSH:NoExp] OR "education, nursing, baccalaureate" [MeSH Terms]	129 198
#2	"virtual simulation" [Text Word] OR "virtual reality" [Text Word] OR "3D simulation" [Text Word] OR "serious games" [Text Word] OR "virtual environment" [Text Word] OR "VR" [Text Word] OR "AR" [Text Word] OR "XR" [Text Word] OR "immersive technolog*" [Text Word] OR "virtual reality" [MeSH Terms] OR "augmented Reality" [MeSH Terms] OR "computer simulation" [MeSH Terms]	449 202
#3	perioperative [Text Word] OR intraoperative [Text Word] OR surg* [Text Word] OR operati* [Text Word] OR "perioperative care" [MeSH:NoExp] OR "intraoperative care" [MeSH Terms] OR "perioperative period" [MeSH:NoExp] OR "intraoperative period" [MeSH Terms] OR "perioperative nursing" [MeSH:NoExp] OR "operating room nursing" [MeSH Terms] OR "operating rooms" [MeSH Terms]	4 780 229
#4	((("nursing student*" [Text Word] OR "nursing education" [Text Word] OR "students, nursing" [MeSH Terms] OR "education, nursing" [MeSH:NoExp] OR "education, nursing, baccalaureate" [MeSH Terms]) AND ("virtual simulation" [Text Word] OR "virtual reality" [Text Word] OR "3D simulation" [Text Word] OR "serious games" [Text Word] OR "virtual environment" [Text Word] OR "VR" [Text Word] OR "AR" [Text Word] OR "XR" [Text Word] OR "immersive technolog*" [Text Word] OR "virtual reality" [MeSH Terms] OR "augmented Reality" [MeSH Terms] OR "computer simulation" [MeSH Terms])) AND (perioperative [Text Word] OR intraoperative [Text Word] OR surg* [Text Word] OR operati* [Text Word] OR "perioperative care" [MeSH:NoExp] OR "intraoperative care" [MeSH Terms] OR "perioperative period" [MeSH:NoExp] OR "intraoperative period" [MeSH Terms] OR "perioperative nursing" [MeSH:NoExp] OR "operating room nursing" [MeSH Terms] OR "operating rooms" [MeSH Terms])	87

Results: Total records retrieved in MEDLINE (via PubMed): 87

Appendix 3: Data extraction tool

Scoping review details	
Scoping review title	Virtual reality in undergraduate operating theatre nursing education: a scoping review of Current Evidence
Review objective/s	To map the scientific evidence on the use of virtual reality in undergraduate nursing education within the operating theatre context
Review question/s	What is the published evidence for the use of virtual reality in undergraduate nursing education in the operating theatre context?
Inclusion/exclusion criteria	
Population	Undergraduate nursing students, regardless of their year of study, involved in teaching/learning perioperative or operating room nursing
Concept	Virtual reality as an educational strategy, including immersive environments, virtual reality simulation, and VR-based digital applications used for the development of skills in perioperative nursing
Context	Perioperative nursing education in higher education, including academic institutions, simulation laboratories, and educational-clinical settings (operating room context)
Types of evidence sources	Quantitative, qualitative, mixed methods studies; theoretical papers; discussion papers; systematic reviews; grey literature
Evidence source details and characteristics	
Citation details	Author(s), date, title, journal, volume, issue, pages
Country	Country of study
Context	Clinical or educational setting; healthcare environment
Participants	Nursing student in undergraduate education age/sex (if relevant); number of participants
Details/results extracted from the source of evidence (in relation to the concept of the scoping review)	
Identification of methodologies	Study type; methodological design; approach (quantitative, qualitative, mixed methods); sample size and characteristics (number of nursing students, year of study); VR technology type and classification (e.g., head-mounted display, desktop VR, CAVE, 360° video, serious game); hardware used (device brand and model); software or platform (commercial application, custom-developed, open-source); level of immersion (fully immersive, semi-immersive, non-immersive – classified according to the reported characteristics or, where available, using frameworks such as Milgram's reality–virtuality continuum); intervention duration and structure (number of sessions, total exposure time, single vs. repeated exposure, curricular integration); pedagogical or theoretical framework underpinning the intervention (if reported); debriefing strategy (if applicable); and educational context (simulation laboratory, clinical setting, classroom, or blended environment).
VR Intervention characteristics	Type and classification of VR technology; hardware and software specifications; level of immersion; intervention duration, frequency, and structure; pedagogical or theoretical framework; debriefing strategy (if applicable).
Impacts on training/teaching	Effects of virtual reality on the teaching-learning process (knowledge acquisition, development of technical and non-technical skills, clinical judgment, decision-making, student engagement and satisfaction).
Improvements in surgical patient care	Indirect or potential outcomes associated with improved patient safety, operating room preparation, error reduction, adherence to protocols, and simulated clinical performance.
Guidelines for educational policies	Implications for educational policies, curricular integration of virtual reality, institutional requirements, teacher training, and alignment with teaching standards in perioperative nursing.
Recommendations for practice	Recommendations for implementing virtual reality in nursing education (types of scenarios, frequency of use, integration with traditional simulation, necessary resources).
Research recommendations/suggestions	Gaps identified, needs for future research, methodological suggestions, long-term impact assessment, and comparative studies.
Relevant bibliographic references	Key references cited in the study that support the use of virtual reality in perioperative nursing education.