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Participating experience of virtual reality teaching among nursing students: a meta-synthesis of qualitative studies



Kai Liu¹, Fang Han^{2†}, XiaoQin Li², WenFeng Fu², Yanxue Zheng^{2*†} and Xing Gao^{2*†}

Abstract

Objective To systematically evaluate research on nursing students' experience of participating in teaching virtual reality technology.

Methods A computerized search of PubMed, Web of Science, Wiley Online Library, China Knowledge Network, Wanfang Database, CINAHL(Cumulative Index to Nursing and Allied Health Literature), and China Biomedical Literature Service System was conducted to search for qualitative studies on nursing students' experiences of participating in teaching with virtual reality technology, with a time frame from 2013 to 2023. The quality of the Literature was evaluated using the quality evaluation criteria of Australian JBI evidence-based healthcare centers, and the results were summarized and integrated using the aggregative integration method.

Results A total of 9 studies were included, ultimately distilling 37 findings from the original studies, which were outlined to form 7 new categories, yielding three integrated findings: strengths and needs of virtual reality teaching and learning experiences; weaknesses and challenges of virtual reality teaching and learning experiences; and future applications and possibilities of virtual reality teaching and learning.

Conclusion By combining the advantages of virtual reality technology with the occurrence of nursing teaching, nursing students can experience immersive experiential learning at any time and any place without time and space constraints, and the overall cognitive pleasure of nursing students to this virtual teaching system is good. However, it is necessary to enrich further the details of teaching content design and optimize virtual reality's technical experience.

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Keywords Nursing education, Nursing students, Virtual reality, Experience, Meta-integration

Introduction

Virtual Reality (VR) technology utilizes computer technology to create a virtual, realistic environment [1]. Users can interact with this virtual world through specific input and output devices, allowing them to actively participate and influence their actions within the virtual space. Experiencers use user terminals, such as VR headsets or allin-one machines, to view images generated by computer simulations, listen to corresponding sounds, and engage in a multi-sensory immersive experience that includes visual, auditory, and tactile elements. This interaction facilitates a sense of immersion through mutual reactions and feedback [2].

VR technology can visualize abstract knowledge and deepen the understanding of training objects [2]. The perceptual, interactive, and conceptual features of virtual reality technology help students understand and master knowledge more profoundly and faster, make up for the problem of insufficient traditional medical teaching resources, and enhance the teaching effect [3]. Currently, virtual reality technology is applied to anatomy, surgical skills, and surgery in medical education at home and abroad [4]. Tan Huan et al. applied virtual simulation technology in the classroom of medical imaging examination technology, which enhanced the enthusiasm of students to participate in experimental teaching and improved the effect of experimental teaching [5]. Ly Yunli et al. used virtual teaching technology in the operation technology training of gastrointestinal surgical nursing, which effectively enhanced the enthusiasm of nursing students to learn and improved theoretical knowledge and teaching satisfaction [6]. Marie et al. [7] developed a virtual simulator that can train device nurses to prepare preoperative devices for more than 100 surgeries. It is verified that the system can be widely used in training primary or vocational device nurses, and the virtual system allows instrumentation nurses to acquire relevant skills in a safe environment. Furthermore, VR has been used by healthcare workers to improve empathy when nursing patients with autism and dementia [8]. It has also been used for education about deteriorating patients [9].

Nursing is a specialty that serves patients and requires many operational skills in clinical work. Traditional plane teaching materials lack interactive and three-dimensional characteristics; giving the training object substantive and efficient guidance is complex. VR technology can make the skills training process with better authenticity and feedback, increase the effect of skills training, and effectively reduce the risk of clinically accurate operation to the patient.VR learning makes the experience of the traditional anatomical atlas more focused, enjoyable, and effective than conventional and improves the experience of the person's learning motivation [10, 11]. Virtual reality technology has been initially explored in several clinical nursing fields. For nursing students, virtual reality technology is currently used to learn nursing operation skills and develop nursing competence in complex scenarios [12]. The technology is now more widely used in nursing education in developed countries [13].

However, at present, domestic and international studies mostly use quantitative methods to assess students' learning outcomes, and there are fewer studies on students' subjective perceptual experience in the process of using VR for learning, which can not yet comprehensively reflect the quality of virtual reality technology teaching [14]. In recent years, relevant researchers have gradually begun to pay attention to students' actual experiences and have conducted relevant qualitative studies to explore students' experiential feedback [15–16]. For example, Singleton H assessed the performance of nursing students after virtual training in caring for diabetic patients with deteriorating conditions, and the results suggested that virtual reality education improved the students' clinical skills experience [17].

However, there is a lack of comprehensive studies that integrate the authentic experiences and evaluations of nursing students utilizing VR technology in their teaching and learning processes. Therefore, this study aims to organize the genuine experiences and assessments of nursing students regarding VR technology through meta-integration, providing a reference for enhancing the application of virtual reality in nursing education and improving nursing teaching practices.

Information and methods

Search strategy

Computerized systematic search PubMed, Web of Science, Wiley Online Library, China Knowledge Network, Wanfang Database, China Biomedical Literature Service System. To search for qualitative studies on virtual reality experiences of nursing students with a search time frame of 2013 to 2023. The search strategy of subject and free word was used. The Chinese search terms were "students/nurses/nursing," "virtual/virtual reality/virtual simulation/virtual environment/VR virtual reality/virtual reality technology," and "qualitative research/qualitative research/rooted theory/phenomenology/ethnography/ narrative." Ethnography/Narrative,". English search terms are virtual realit*/patient simulat*/virtual patient/virtual simulation/educational virtual/instructional virtual, qualitative research/ experience*/attitude*/feel*/response*/ interview/phenomenology, nurs*/education of nursing/

nursing students. For example, the specific search strategy is based on PubMed, as shown in Fig. 1.

Literature inclusion and exclusion criteria

Inclusion Criteria: ① Population (P): The research targets nursing students. ② Interest of Phenomena (I): The focus is on the cognition, attitudes, and experiences of undergraduate nursing students regarding virtual reality teaching and learning. ③ Context (Co): The study examines participation in virtual reality technology teaching both on and off campus. ④ Study Design (S): The research must be qualitative, including phenomenology, grounded theory, descriptive research, case studies, and action research.

Exclusion Criteria: ① Non-Chinese and non-English literature. ② Literature that is not available in full text. ③ Literature that is published repeatedly. ④Literature that is non-qualitative in nature.

Literature screening and data extraction

Two researchers trained in evidence-based nursing methodology and qualitative research independently searched and screened the literature. They extracted information and cross-checked their findings. Any disagreements were resolved through discussion or by consulting a third researcher for additional judgment. Each researcher had experience using virtual simulation platforms and studying virtual reality-related topics. The extracted data included the author, country of publication, publication date, research methodology, object of study, phenomenon of interest, and main findings.

Evaluation of the methodological quality of the literature

Quality evaluation was conducted independently by two investigators using the JBI Evidence-Based Health Care Center Quality Evaluation Criteria [18] for Qualitative Research. A third researcher was invited to co-discuss decisions regarding the inclusion of literature in cases of disagreement. The evaluation involved ten criteria, with each being rated as "yes," "no," or "unclear." Studies were categorized as Grade A, B, or C based on their ratings: Grade A (\geq 8 out of 10 criteria met), Grade B (5–7 criteria met), and Grade C (\leq 4 criteria met). Literature graded as C was excluded due to substantial methodological concerns.

Meta-integration methodology

Pooled meta-integration methods were employed to synthesize the results. After thoroughly understanding the research methodology of qualitative studies, the researchers recapitulated the findings of similar studies through repeated readings and analysis. This process led to the formation of new categories, which were later summarized to create a new interpretation of the integrated results [20].

#1("Virtual Reality"[Mesh]) OR ((((((((Reality, Virtual[Title/Abstract]) OR Educational[Title/Abstract])) (Virtual OR (Educational Reality, Virtual Realities[Title/Abstract])) OR (Educational Virtual Reality[Title/Abstract])) OR (Reality, Educational Virtual[Title/Abstract])) OR (Virtual Realities, Educational[Title/Abstract])) OR (Virtual Reality, Instructional[Title/Abstract])) OR (Instructional Virtual Realities[Title/Abstract])) OR (Instructional Virtual Reality[Title/Abstract])) OR (Realities, Instructional Virtual[Title/Abstract])) OR (Reality, Instructional Virtual[Title/Abstract])) OR (Virtual Realities, Instructional[Title/Abstract]))

#2("Students, Nursing"[Mesh]) OR (((((((Pupil Nurses[Title/Abstract]) OR (Student, Nursing[Title/Abstract])) OR (Nurses, Pupil[Title/Abstract])) OR (Nurse, Pupil[Title/Abstract])) OR (Pupil Nurse[Title/Abstract])) OR (Nursing Student[Title/Abstract])) OR (Nursing Students[Title/Abstract]))

Total retrieval type:#1 AND #2

Results

Literature search results and essential characteristics of the included literature

Initial inspection of the Literature 2378, after the deletion of duplicates to obtain 1926 pieces of Literature; through the reading of the title and the abstract of 25 pieces of literature screening; through the reading of the full text of the final screening of 9 pieces of Literature to meet the requirements of the [19-25], the literature search flow chart is shown in Fig. 2, included in the essential characteristics of the Literature in Table 1.



Table 1 Ba	sic characte	ristics of the ir	Inded	literature $(n=9)$		
Inclusion of literature	Nations	Year of publication	Sam- ple size	Research methodology	Phenomena of interest	Research topics
Henna Mäkinen	Finland	2021	41	Qualitative de- scriptive study	Describe nursing students' user experiences' (UX) regarding highly immersive virtual reality (VR) simulation with head mounted display used for learning	Three themes: nursing care in the immersive VR simulation, technology in the immersive VR simulation, and learning nursing in the immersive VR simulation.
Mohamad M. Saab	Ireland	2021	26	Qualitative de- scriptive study using thematic analysis.	Nursing students' perspectives of incorporat- ing virtual reality in nurse education.	Three themes: captivating, innovative, and empowering nature of virtual reality; contextual transfer; and challenges and threats to actualization.
Mohamad M. Saab	Ireland	2021	26	Qualitative de- scriptive study	Nursing students' views of using virtual reality in healthcare	Four themes: (i) positive experiences of virtual reality; (ii) challenges to using virtual reality; (iii) settings where virtual reality can be (iii) settings where virtual reality can be implemented; and (iv) blue-sky and future applications of virtual reality
Ann-Kathrin Lange	Germany	2020	12	qualitative cohort study	The degree of acceptance of VR applications by nursing students in Germany. Various factors, including social influences, perfor- mance expectations, and effort expectations, are taken into consideration. Various factors, including social influences, performance ex- pectations, and effort expectations, are taken into consideration.	Seven themes: Performance expectancy, Effort expectancy, Social influence, Facilitating conditions, Hedonic motivation, Moderation factors, Further application possibilities
Jaehee Jeon	Korea	2020	4	qualitative study	The essential components and improvements needed in an adult nursing VR-based simula- tion training program for nursing students through focus group interviews (FGIs)	Four themes: Limitations of clinical practice, Benefits of simulation training, Need to improve simulation training, Need for VR-based simulation training training, Need to improve simulation training, Need for VR-based simulation training
Zhi Hanli	China	2022	~	qualitative study	To understand the real feelings of undergrad- uate midwifery students on the application of virtual reality technology in practice teaching, to observe the effect of the application of virtual reality technology in teaching and to provide a basis for the reform of midwifery practice teaching mode.	4 themes: professional awareness, professional skills, professional confidence, and professional advice

Inclusion of literature	Nations	Year of publication	Sam- ple size	Research methodology	Phenomena of interest	Research topics
Muhammad Hibatullah Romli	Malaysia	2022	5	Qualitative study	To explore pertaining issues on full online learning among nursing students and ofer a contingency solution.	Three themes: (i) Full online learning has ramifcations on life (it is about life; blurred division on education life and personal life; non-conducive (i) Full online learning has ramifcations on life (it is about life; blurred division on education life and personal life; non-conducive (i) Full online learning has ramifcations on life (it is about life; blurred division on education life and personal life; non-conducive environment for learning; health and well-being; human is an adaptable being while the transition takes time), (ii) Full online learning is a medium of (ii) full online learning is a medium of teaching and learning delivery but with several concerns (the boon and bane of fully online learning; challenges associated with full online learning; coping strategy in handling full online learning; and the need to develop a comprehensive and effective (ii) full online learning; and the need to develop a comprehensive and effective (ii) full online learning; challenges associated with full online learning; coping strategy in handling full online learning; and the need to develop a comprehensive and effective (ii) full online learning; challenges associated with full online learning; coping strategy in handling full online learning; or a medium of teaching and learning delivery but with several concerns (the boon and base of fully online learning; challenges associated with full online learning; coping strategy in handling full online learning; or a medium of teaching and learning; coping strategy in handling full online learning; or fully online learning; coping strategy in handling full online learning; or the boon and base of fully online learning; coping strategy in handling full online learning; other educator; teaching and learning and learning is the key (role of the educator; teaching and learning approaches; motivation and regulation)
Eva Mari Andreasen	Norway	2022	6	qualitative study	To investigate how second-year undergradu- ate nursing students evaluated the usability of the Preoperative ISBAR Desktop VR Application.	Two themes: (1) more motivational than standard learning activities and (2) technical and comprehension issues.
Hyeon- Young Kim	Korea	2021	21	Phenomenolog- ical method.	Examined the significance, nature, and struc- ture of the virtual experience of perioperative patients as undergone by nursing students during their practical training through VR and blended learning.	Seven themes: "placed in a passive position,""facing the limits of communication," "thinking of developing and improving competency as a nurse,""recognizing the importance of interacting""thinking of developing and improving competency as a nurse,"recognizing the importance of interacting with their patients,"learning vividly through experience," "engaging in a new type of participa- tients," learning, and "designing nursing knowledge."

Table 2 Evaluation of the quality of the included literature (n=9)

Inclusion of studies	1	2	(iii)	4	5	(vi)	(vii)	8	9	(10)	Quality level (grade)
Henna Mäkinen	Y	Y	Y	Y	Y	N	UN	Y	Y	Y	В
Mohamad M. Saab	Υ	Υ	Y	Υ	Υ	UN	Ν	Y	Y	Y	В
Mohamad M. Saab	Υ	Y	Y	Y	Y	UN	Ν	Y	Y	Y	В
Ann-Kathrin Lange.	Υ	Y	Y	Y	Y	Ν	Y	Y	Y	Y	В
Jaehee Jeon	Υ	Υ	Y	Y	Υ	Y	Y	Y	Y	Y	А
Zhi Hanli	Υ	Υ	Y	Y	Υ	Ν	UN	Y	Y	Y	В
Muhammad Hibatullah Romli	Υ	Y	Y	Y	Y	Ν	Ν	Y	Y	Y	В
Eva Mari Andreasen	Υ	Υ	Y	Υ	Υ	Ν	Ν	Y	Y	Y	В
Hyeon-Young Kim	Υ	Y	Y	Υ	Y	UN	Y	Y	Y	Y	В

Results of the evaluation of the methodological quality of the included literature

The methodological quality of the nine included Literature articles was evaluated as grade B in eight cases and grade A in one case. Table 2 shows the specific quality evaluation of the included Literature articles.

Meta-integration results

Through a thorough review and analysis of the nine selected pieces of Literature, the researcher distilled 37 findings from the original studies. These findings were then categorized into seven new categories and further synthesized to derive three integrated findings. The integration process is illustrated in Fig. 1.

Integration finding one: Strengths and needs of virtual reality teaching experiences

Category 1: Student immersion experience The immersion experience for nursing students encompassed a sense of presence in nursing care, including natural nursing care and the visual environment of the VR setting. Factors such as the ability to move within the environment and access to necessary nursing equipment influenced the feeling of natural nursing care. Nursing students expressed positive experiences related to immersive virtual reality simulations of care, technology, and learning [19]. They found virtual reality engaging, innovative, and empowering, fostering active participation and knowledge retention [20]. Additionally, students shared positive experiences and knowledge gained from virtual reality simulations, highlighting the effectiveness and novelty of the approach [21].

Category 2: Motivation and inspiration for nursing students Nursing students perceived using VR in nursing education as beneficial, enhancing their learning experience and understanding of the content [22]. They found VR applications manageable and engaging, attributing their positive attitudes towards these applications to social influences and the playful nature of VR learning [22]. Immersive virtual reality technology in nursing education was seen as a novel and accessible method of skill

acquisition, improving students' professional competence and confidence [20]. Communication through virtual phone calls was noted to enhance students' awareness of clear and effective communication [28].

Nursing students' experiences of being in the patient's position provided valuable insights into patient care and empathy, emphasizing the importance of holistic care and effective communication [25].

Category 3: Contribution to professional learning Participants reported that virtual reality simulations helped bridge the gap between theoretical knowledge and real-world clinical practice, enhancing their understanding and integrating nursing principles [23]. Virtual reality technology was considered a valuable tool for simulating uncommon clinical scenarios, providing a safe and effective learning environment for students to refine their skills [26]. Participants emphasized the need for realistic and up-to-date educational resources, such as procedure videos, to enhance their learning experience and align with standard practices [24]. The integration of new teaching methods, including VR and blended learning, was found to improve academic achievements and promote participatory learning experiences [25].

Integration outcome 2: Disadvantages and challenges of virtual reality teaching experience

Category 1: Difficulties encountered Despite the advantages of VR technology, participants highlighted challenges such as age limitations, technical difficulties, and side effects like dizziness during VR experiences [24]. Some students found their initial clinical practice challenging, feeling awkward and unprepared in patient interactions [22]. They also expressed dissatisfaction with limited training opportunities and experiences [23].

Category 2: Limitations in student learning and expe rience Complete online learning was noted to have implications on students' personal lives, creating challenges in communication and socialization, especially for new students [24]. Students were placed in passive roles as patients felt subjugated and lacked authority in clinical scenarios [25]. Students also emphasized dissatisfaction with outdated materials and the need for more diverse and engaging learning opportunities [26].

Integration outcome 3: Future applications and possibilities for virtual reality teaching and learning

Category 1: Facilitating conditions for the realization of virtual reality Participants believed VR was more suitable for outpatient settings and recommended its use in various educational and community settings [21]. They emphasized the importance of integrating VR into educational curricula to maximize its benefits and ease of use for students and teachers [22]. Participants desired more realistic and diverse simulation training opportunities to enhance their learning experiences [23].

Category 2: Future possibilities Participants recommended the future use of VR in health promotion, disease prevention, patient education, and empathy training for healthcare professionals [21]. They highlighted the potential of VR in enhancing empathy towards patients and improving understanding of diverse healthcare scenarios [22].

Discussion

Characterization of the included literature

One of the nine papers included in this study originated from China and was published between 2013 and 2023. All the literature included was of high quality (grade B) and highly reliable. The studies employed descriptive qualitative and phenomenological approaches to explore nursing students' experiences with virtual reality technology, aiming to enhance the teaching and learning of nursing practices.

Advantages of virtual reality teaching

Virtual reality provides various stimuli that enhance motivation, mastery of theoretical knowledge, critical thinking, operational skills, and practical responsiveness among nursing students. This technology has been proven to improve hands-on skills, learning abilities, and confidence in clinical practice, effectively bridging the gap between theory and practice [26].

Disadvantages of teaching with virtual reality

Virtual reality (VR) technology has significantly transformed medical education; however, it comes with several challenges [26]. These include limitations in simulation capabilities, varying effectiveness depending on the instructors, and potential side effects such as VR sickness [27]. Additionally, the cost and development time required for VR applications are considerable [28]. There is also a continuous need for collaboration with nursing faculty and clinical experts, which adds to the complexity. VR development is generally more expensive, and the higher the level of immersion, the longer it takes to create a program, presenting a challenge for developers. Furthermore, it is impossible to simulate the full range of clinical situations due to the limitations in the type and quantity of software that can be developed for VR systems [29, 30].

Needs for improvement and future possibilities

Integrating virtual reality technology in nursing education holds significant promise, but further development and optimization are required. Future research should focus on enhancing the realism and diversity of virtual learning experiences, improving interface design, and integrating technology seamlessly into nursing curricula. Collaboration between government, universities, and industry is essential for advancing virtual reality in nursing education, ultimately cultivating high-quality nursing professionals.

Currently, the use of virtual reality in nursing education is still being explored. Most of the existing virtual reality teaching equipment is not fully developed and requires strong support from both government and academic institutions. It is important to find ways to effectively combine virtual and real-world experiments and to fully realize the integration of virtual and practical teaching methods. At present, the scientific research foundation in this area is somewhat lacking, and there are still few established training systems for nursing. Continuous exploration and improvement are needed in system design and development to enhance this integration.

Limitations

The current study has several limitations. First, the inclusion criteria for the literature review only allowed for qualitative and mixed-method studies published in indexed journals, and written in either English or Chinese. As a result, gray literature, along with some papers and dissertations, were not considered, which could introduce information bias. Additionally, cultural and policy differences significantly influence the attitudes, opinions, and feelings of nursing students, potentially leading to varying outcomes across different regions.

Conclusion

In this study, through the Meta integration of 9 qualitative studies, By combining the advantages of virtual reality technology with the occurrence of nursing teaching, nursing students can experience immersive experiential learning anytime and anywhere without being restricted by time and space, and the overall cognitive pleasure of nursing students towards this virtual teaching system is good. However, it is necessary to enrich further the details of teaching content design and optimize virtual reality's technical experience.

Supplementary Information

The online version contains supplementary material available at https://doi.or q/10.1186/s12912-025-02941-0.

Supplementary Material 1 Supplementary Material 2

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Author contributions

All authors conceived and designed the study. ZYX, LK and GX organized and conducted the search and participated in the selection of the relevant articles and performed the quality assessment of the studies. HF, LXQ and FWF supervised the project and made the changes and corrections suggested by the reviewers.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Ethical approval was not required for this meta synthesis.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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