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Research Article

Psychological Safety in Virtual Reality Nursing Simulation: A Scoping Review of Definitions, Conceptualizations, and Challenges

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Abstract

Background: Psychological safety (PS) is a critical determinant of effective simulation-based learning, enabling students to take interpersonal risks, engage authentically, and reflect without fear of judgment. While PS has been widely studied in traditional simulation, its application within virtual reality (VR) nursing education remains underexplored. As VR technologies expand rapidly in healthcare training, understanding how PS is defined, enacted, and challenged in this context is vital to optimizing both learning outcomes and learner well-being.

Methods: A scoping review was conducted to map current evidence on PS in VR nursing simulations. Following Arksey and O'Malley's (2005) and Levac et al.'s (2010) methodological frameworks, seven databases were systematically searched for studies published between 2015 and 2025. Ten peer-reviewed articles that met eligibility criteria were analyzed through thematic synthesis.

Results: Findings revealed inconsistent definitions and conceptualizations of PS, ranging from emotional protection to inclusive, culturally responsive participation. Nine primary challenges were identified: insufficient facilitator training, mismatches in simulation fidelity (overwhelming or lacking realism), technological barriers, limited cultural humility, language-related constraints, reliance on self-report measures, small sample sizes, and restricted generalizability. Notably, few studies incorporated objective outcome measures or examined long-term impacts of VR on learner safety or performance.

Conclusion: PS in VR nursing simulation is complex and context-dependent, requiring intentional instructional design, calibrated fidelity, culturally inclusive practices, and faculty skilled in digital facilitation. Institutional investment in infrastructure and training is equally crucial. Future research should prioritize longitudinal and mixed-methods studies, equity-driven frameworks, and validated tools to assess both subjective and objective learner experiences. Embedding PS as both a pedagogical and structural priority can ensure VR simulation serves as a psychologically safe, equitable, and transformative space for nursing education.

Keywords: Psychological Safety; Virtual Reality Simulation; Nursing Education; Simulation-Based Learning; Cultural Humility; Scoping Review.

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Introduction

Simulation-based education is integral to nursing curricula. It enables learners to practice clinical skills, apply theory, and engage in reflection within structured environments designed to support learning without patient harm (Al-Hassan & Omari, 2023; Kang, Hong, & Lee, 2020). In nursing education, simulation-based learning relies on scenario design, facilitation, and debriefing to promote engagement, confidence, and skill development.

Virtual reality represents a technology-mediated form of simulation-based education. In this paper, virtual reality is defined as immersive, computer-generated environments in which learners interact through avatars or virtual representations to participate in structured clinical scenarios (Azim et al., 2022; Loizou et al., 2024). While the mode of delivery differs from face-to-face simulation, virtual reality retains core simulation elements, including learning objectives, facilitation, and debriefing. Its adoption accelerated during COVID-19 as institutions sought to maintain experiential learning when access to in-person simulation was limited (Dale-Tam et al., 2021; Liaw et al., 2021).

Across simulation modalities, psychological safety is a foundational condition for effective learning. Psychological safety is defined as the belief that individuals are able to take interpersonal risks without fear of negative consequences (Edmondson, 1999, 2018). Within simulation-based learning in nursing education, psychological safety supports active participation, reduces anxiety, and contributes to positive learning outcomes (Kim, Lee, & Connerton, 2020; Kostovich, O'Rourke, & Stephen, 2020; Eller, 2023).

Virtual reality simulation introduces distinct challenges to the enactment of psychological safety. Learners often engage through avatars in remote settings, where reduced nonverbal cues, technical barriers, and feelings of isolation can undermine trust and openness (Funao, Shimaoka, & Kako, 2025; Dale-Tam et al., 2021; Liaw et al., 2021). Facilitation strategies that support psychological safety in face-to-face simulation do not always translate directly to virtual environments, requiring intentional adaptation.

However, virtual reality introduces distinct challenges for maintaining psychological safety. In many virtual reality simulations, learners engage through avatars in remote settings, either synchronously with a facilitator or asynchronously through self-directed activities. In these contexts, reduced access to nonverbal cues, technology-mediated communication, and intermittent technical disruptions can limit facilitators' ability to assess learner comfort, respond in real time, and establish trust, which may undermine psychological safety (Funao et al., 2025; Dale-Tam et al., 2021; Liaw et al., 2021). In face-to-face simulation, facilitators commonly rely on rapport-building strategies such as informal prebriefing, observation of learner body language, real-time adjustment of communication, and guided debriefing to support psychological safety. These strategies are more difficult to enact in virtual environments, particularly when interaction is avatar-mediated or facilitator presence is limited, and therefore do not consistently translate to virtual simulation contexts (Tyerman et al., 2021). Because these altered communication dynamics and reduced observational cues affect how psychological safety is established and maintained, facilitation approaches require adaptation. Evidence from simulation literature indicates that facilitators must establish explicit expectations, use deliberate supportive communication, and intentionally structure prebriefing and debriefing processes to maintain psychological safety in virtual simulation settings (Harder et al., 2021; Eller, 2023). Persistent barriers to the implementation and maintenance of psychological safety include technical disruptions, hierarchical dynamics, and cultural mismatches, which may be amplified in digitally mediated learning environments (Kang & Min, 2019; Ziegler et al., 2024).

Studies examining virtual reality simulation in nursing education report benefits such as increased learner engagement, opportunities for repeated practice in complex or high-risk scenarios, and enhanced confidence in clinical decision-making and communication (Ko & Choi, 2024; Zhang et al., 2024). When psychological safety is intentionally prioritized, virtual reality simulation has the potential to support inclusive and engaging learning experiences for nursing students and to strengthen preparation for clinical practice.

This scoping review was designed to examine how psychological safety is defined and conceptualized within virtual reality nursing simulations and to identify challenges associated with its implementation. The central review question guiding this review was: How is psychological safety defined and conceptualized in virtual reality nursing simulations, and what challenges impede its implementation? Implications for fostering psychologically safe virtual learning environments were derived from the synthesis of findings related to definitions, conceptualizations, and reported challenges.

Methods

This scoping review was designed to explore how psychological safety is defined and conceptualized in virtual reality nursing simulations and to identify challenges associated with its implementation. The

central review question was: What challenges impede the implementation of psychological safety in virtual reality nursing simulations?

Virtual reality simulation in this review was operationally defined as immersive, computer-generated environments in which learners interact through avatars or virtual representations for structured educational purposes (Liaw et al., 2021; Azim et al., 2022). This definition includes scenario-based patient simulations as well as facilitated VR group simulations and discussions designed to support clinical reasoning, communication, reflection, or professional development (Tyerman et al., 2021; Funao et al., 2025).

Studies examining PS within immersive VR–based group learning or discussion formats were included when these activities were facilitated, structured, and designed to support learning outcomes consistent with simulation-based education. Virtual reality group discussions were included when they required interpersonal risk-taking, collaborative problem-solving, or reflective dialogue analogous to simulation processes known to influence PS (Edmondson, 1999; Kostovich et al., 2020; Ziegler et al., 2025). These environments share core simulation features, including immersion, role enactment, facilitation, and debriefing, and therefore present comparable PS demands (Liaw et al., 2021; Dale-Tam et al., 2021). Studies involving conventional videoconferencing or non-immersive online learning platforms were excluded.

Scoping Review Framework

This review followed the methodological framework by Arksey and O'Malley (2005), later refined by Levac, Colquhoun, and O'Brien (2010). The six stages included: (1) defining the research question, (2) identifying relevant studies, (3) applying inclusion and exclusion criteria, (4) charting data, (5) synthesizing findings, and (6) stakeholder consultation. The review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) to support transparent and complete reporting of scoping review methods and findings (Tricco et al., 2018). This process aligns with contemporary standards of transparency and reproducibility (Institute, 2017). The multidisciplinary research team brought expertise in simulation pedagogy, healthcare education, and organizational psychology. The review question was defined through consensus to capture diverse conceptualizations of PS in VR (Kostovich, O'Rourke, & Stephen, 2020; Eller, 2023).

A librarian-assisted search was conducted across seven databases including PubMed, CINAHL, Scopus, Web of Science, PsycINFO, MEDLINE, and Google Scholar to capture literature across nursing education and psychological safety. Search terms were developed iteratively and organized into four concept groups: psychological safety, virtual reality simulation, nursing education, and implementation challenges. Within each concept group, synonyms and related terms were combined using the Boolean operator OR. Core concepts were then combined using the operator AND.

For psychological safety, search terms included psychological safety, safe learning environment, learner safety, and emotional safety. Virtual reality terms included virtual reality, VR simulation, immersive simulation, and virtual simulation. Nursing education terms included nursing education, nursing students, nurse training, and simulation-based learning. Implementation and challenge-related terms included barriers, challenges, limitations, and implementation.

Controlled vocabulary terms such as MeSH headings were used when available and adapted for each database. Searches were limited to studies published between 2015 and 2025 to reflect contemporary virtual reality applications in nursing education.

Eligibility required peer-reviewed, English-language original research (qualitative, quantitative, or mixed-methods) focusing on VR simulations in nursing education and reporting perspectives of students, faculty, or educators. Excluded were non-English works, studies outside the timeframe, non-peer-reviewed materials (e.g., abstracts, theses, blogs, social media), and secondary sources (reviews, commentaries, opinion pieces). Studies broadly addressing simulation without virtual reality specificity were also excluded. For the purposes of this review, virtual reality simulation was defined as immersive, computer-generated learning environments in which participants interact through avatars or virtual representations within structured educational scenarios. These criteria ensured inclusion of empirical studies offering direct insights into how psychological safety is defined, experienced, and challenged within virtual reality nursing simulations.

Data Extraction and Quality Assessment

Data extraction was conducted systematically by the principal investigators to capture key study characteristics, including aim, design, participant demographics, setting, VR simulation features, outcomes related to PS, limitations, and implications for nursing education. Extracted data were organized into a structured evidence matrix to ensure consistency (Braun & Clarke, 2006). Quality appraisal was undertaken independently by two reviewers (M.Q. and M.A.) using design-specific Joanna Briggs Institute

(JBI) critical appraisal checklists. The JBI Checklist for Qualitative Research was applied to qualitative studies (Ziegler et al., 2025; Azim et al., 2022; Loizou et al., 2024; Liaw et al., 2021; Tyerman et al., 2021; Zhang et al., 2024). The JBI Checklist for Randomized Controlled Trials was used for the randomized controlled trial (Ko & Choi, 2024). The JBI Checklist for Quasi-Experimental Studies was applied to the one-group pretest–posttest study (Kang, Hong, & Lee, 2020). The JBI Checklist for Analytical Cross-Sectional Studies was used for the cross-sectional study (Funao et al., 2025). The JBI Checklist for Mixed Methods Studies was applied to the mixed-methods study (Kostovich et al., 2020). All checklists were sourced from the Joanna Briggs Institute critical appraisal tools (Joanna Briggs Institute, 2017).

Each criterion was rated as Yes, No, or Unclear. Studies were scored descriptively out of 20 and categorized as high (>14), medium (10–14), or low quality (<10) to summarize methodological strengths and limitations across the included literature. Consistent with scoping review methodology, no studies were excluded based on quality appraisal results; rather, appraisal findings were used to inform interpretation of the evidence and to contextualize identified gaps and limitations (Arksey & O'Malley, 2005; Levac et al., 2010).

Study Selection and PRISMA-ScR Flow

The database search yielded 391 records. After removal of duplicates, 213 records were screened by title and abstract against the predefined inclusion and exclusion criteria. Title and abstract screening was conducted independently by two reviewers. Full-text articles were then retrieved and assessed for eligibility by the same reviewers. Discrepancies at both screening stages were resolved through discussion, with consultation of a third reviewer when consensus was not reached.

A total of 117 full-text articles were assessed for eligibility. Of these, 10 studies met the inclusion criteria and were included in the final review. Reasons for full-text exclusion included absence of virtual reality as the simulation modality, lack of a nursing education context or nursing participants, failure to address psychological safety as a concept or outcome, non-empirical publication type, and failure to meet language or date limits.

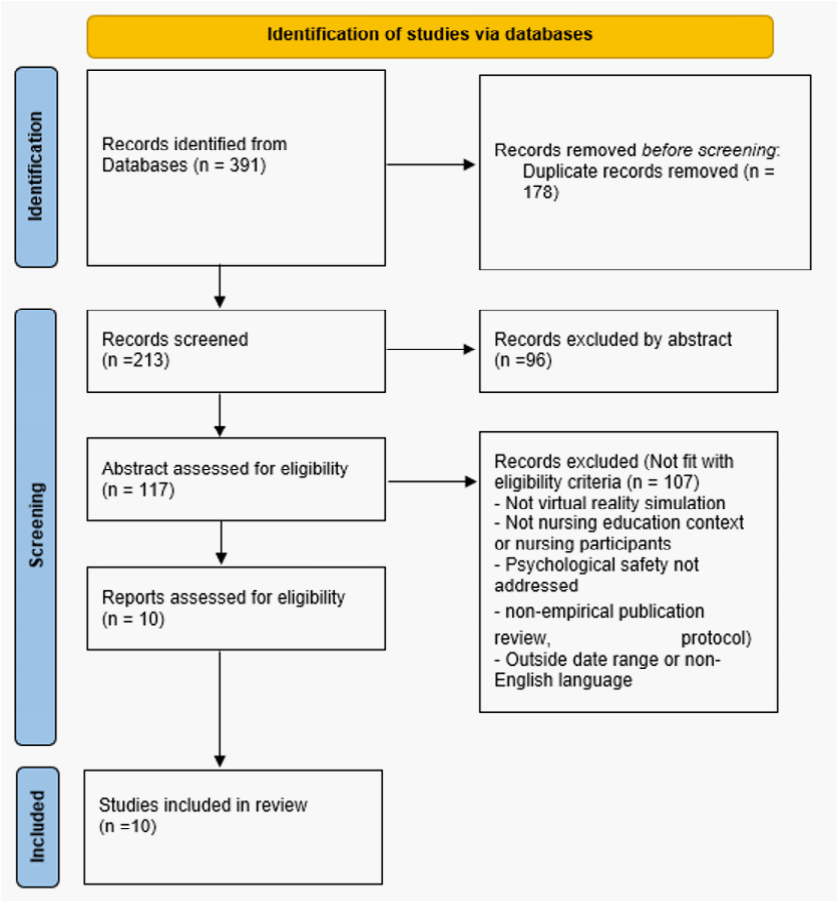

Figure 1. *PRISMA-ScR guidelines*

The screening and selection process is summarized in Figure 1 and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) reporting guidance (Tricco et al., 2018). Characteristics of the included studies, including author(s), year of publication, study design, sample, and key aims, are summarized in Table 1.

Quality Assessment of Included Studies

The quality evaluation ratings of the different studies varied from 15 to 20 out of a possible 20. The products possess high quality, shown by an average score of 16.6 in the quality evaluation. Each study explicitly articulated its objectives, used suitable methodologies, and yielded well-recorded findings; nonetheless, these investigations must acknowledge or address biases and confounding factors, which would have diminished the quality of evidence ratings. Consequently, while the research aimed to assess the present level of knowledge, all activities remained ongoing due to quality assessment.

Results

Table 1 provides a comprehensive overview of 10 studies published between 2015 and 2025 investigating the challenges of implementing PS in VR nursing simulation, showcasing a variety of research designs including six qualitative studies (60%), one pretest posttest quantitative study (10%), one randomized control study (10%), one cross sectional study (10%), and one mixed method study (10%), with the studies originating from Canada (3, 30%), South Korea (2, 20%), the United Kingdom (1, 10%), Singapore (1, 10%), the USA (1, 10%), Japan (1, 10%), and China (1, 10%). The major thematic aim across these studies is to explore and enhance the use of virtual simulation in nursing education, particularly to measure the PS of using VR. This includes investigating various aspects of virtual simulation delivery, learner experiences, and the development of effective virtual learning environments.

Table 1. *Characteristic of Study Included*

#	Authors	Design	Sample	Study Aim	Limitation	Recommendation
1	Ziegler et al., 2025	Qualitative study	n=12	To explore nurse educators' experiences with debriefing virtual simulations related to the SOGI nursing toolkit in nursing education.	Small sample size and limited generalizability.	Foster psychological safety, assess learners' knowledge and comfort before simulation, and provide ongoing professional development for educators.
2	Ko & Choi, 2024	Randomized controlled trial	n=93	To evaluate a virtual simulation-based education program designed to increase nurses' perceived competence in providing psychological support to patients affected by infectious disease disasters.	Reliance on self-reported measures and lack of evidence linking the intervention to changes in clinical practice or patient outcomes.	Conduct follow-up studies examining effects on clinical practice and patient outcomes, using both subjective and objective measures.
3	Azim et al., 2022	Qualitative study	n=17	To explore virtual interprofessional education using theoretical frameworks to develop new understandings and identify assumptions, gaps, and barriers.	Small sample and voluntary participation limit transferability and generalizability.	Examine the role of sociological fidelity in interprofessional learning and identify effective practices for virtual interprofessional education.
4	Loizou et al., 2024	Qualitative study	9 third-year mental health nursing students, 7 female and 2 male	To describe the design process for affective intelligent agents and test a prototype digital intervention incorporating these agents.	Small sample size and potential self-report bias.	Conduct research with larger and more diverse samples and examine the intervention across a wider range of clinical scenarios.
5	Kang, Hong, & Lee, 2020	One-group pretest-posttest study	n=47 Korean nursing students	To investigate the effects of virtual simulation on nursing students' critical thinking and self-directed learning abilities.	Small sample size, single-institution setting, and contextual or language-related limitations.	Replicate the study with larger, multisite samples and adapt virtual simulation content to local language and clinical contexts.

6	Liaw et al., 2021	Qualitative study	30 healthcare students and 12 facilitators	To explore healthcare students' and facilitators' experiences using a 3D virtual world for interprofessional team-based virtual simulation.	Self-report bias and restriction to specific healthcare courses and educational contexts.	Strengthen facilitator preparation and provide adequate technical support for virtual interprofessional simulation.
7	Kostovich et al., 2020	Mixed-methods study	n=37 nursing faculty	To explore nursing faculty perceptions of psychological safety in simulation learning environments.	Purposive sampling and limited follow-up exploration of participants' responses.	Conduct further research involving novice faculty and students to examine psychological safety from multiple perspectives.
8	Funao et al., 2025	Cross-sectional study	n=36 third-year nursing students	To assess the feasibility and safety of VR conferencing in nursing education.	Non-random assignment, low reliability of the teamwork self-assessment measure, and small sample size.	Refine discussion themes and measurement scales and examine the effects of different avatar conditions in larger studies.
9	Tyerman et al., 2021	Qualitative study	Actors from the LGBTQI2S community	To address gaps in nursing education related to cultural humility and the healthcare needs of the LGBTQI2S community through virtual simulation games involving community actors.	Potential challenges associated with involving members of a historically marginalized community in simulation activities and the need to ensure psychologically and culturally safe interactions.	Integrate cultural humility principles into interactions with actors and develop safeguards to support respectful, psychologically safe participation.
10	Zhang et al., 2024	Qualitative study	n=30 disaster rescue nurses	To explore disaster rescue nurses' perspectives on strategies for advancing nurses' disaster literacy.	Need for further evidence on effective disaster literacy interventions and limited evidence across different geographical and healthcare contexts.	Develop detailed, feasible disaster literacy intervention programs and conduct research across diverse countries and healthcare systems.

Thematic Analysis

Thematic analysis (Braun & Clarke, 2006) was used to synthesize findings from the ten included studies, focusing on barriers to implementing PS in VR nursing simulations. A systematic coding process was undertaken by two reviewers, with peer debriefing and independent coding audits ensuring rigor and trustworthiness. The analysis revealed nine interrelated challenges spanning technological, pedagogical, cultural, and institutional domains (See Table 2).

Table 2.*Challenges facing the implementation of PS within the VR in nursing simulation*

	Challenges	Study
1	Ensuring Psychological Safety in Learning Environments	(Azim et al., 2022; Funao et al., 2025; Ko &Choi, 2024; Kostovich et al., 2020; Liaw et al., 2021; Loizou et al., 2024; Ziegler et al.)
2	Overcoming Barriers to Effective Virtual Simulation as an Educational Tool	(Azim et al., 2022; Funao et al., 2025; Kang et al., 2020; Ko & Choi, 2024; Kostovich et al.,2020; Liaw et al., 2021; Tyerman et al., 2021)
3	Addressing Cultural Humility and Inclusivity Challenges	(Azim et al., 2022; Funao et al., 2025; Kang etal., 2020; Ko & Choi, 2024; Kostovich et al.,2020; Liaw et al., 2021; Loizou et al., 2024; Zhang et al., 2024; Ziegler et al.)

4	Developing and Supporting Professional Development and Facilitation Skills	(Azim et al., 2022; Funao et al., 2025; Kang et al., 2020; Ko & Choi, 2024; Liaw et al., 2021; Tyerman et al., 2021)
5	Managing Impact on Practice Readiness and Patient Outcome	(Azim et al., 2022; Funao et al., 2025; Ko & Choi, 2024; Kostovich et al., 2020; Liaw et al., 2021; Loizou et al., 2024; Zhang et al., 2024)
6	Institutional and Logistical Barriers	(Azim et al., 2022; Funao et al., 2025; Liaw et al., 2021; Tyerman et al., 2021; Ziegler et al.)
7	Participant Readiness and Engagement	(Azim et al., 2022; Funao et al., 2025; Kostovich et al., 2020; Liaw et al., 2021; Loizou et al., 2024; Ziegler et al.)
8	Realism and Fidelity of Virtual Scenarios	(Azim et al., 2022; Funao et al., 2025; Kang et al., 2020; Ko & Choi, 2024; Tyerman et al., 2021; Ziegler et al.)
9	Cultural and Attitudinal Factors	(Azim et al., 2022; Funao et al., 2025; Loizou et al., 2024; Zhang et al., 2024; Ziegler et al.)

Challenges to Implementing PS in VR Nursing Simulation

Ensuring PS in Virtual Learning Environments: The absence of physical presence and non-verbal cues often reduces trust and openness, leaving learners hesitant to ask questions or admit mistakes (Ko & Choi, 2024; Azim et al., 2022; Liaw et al., 2021). Structured prebriefing, empathetic facilitation, and reflective debriefings are essential to counteract these barriers (Funao et al., 2025; Ziegler et al., 2025).

Technical and Logistical Barriers: Connectivity issues, software glitches, and limited digital fluency undermine immersion, heighten stress, and discourage participation (Azim et al., 2022; Kang et al., 2020; Liaw et al., 2021). Learners' apprehension about unfamiliar platforms further restricts risk-taking (Funao et al., 2025; Tyerman et al., 2021).

Cultural Humility and Inclusivity: Failure to represent diverse identities or apply culturally sensitive communication risks alienating minority learners and reducing authentic engagement (Funao et al., 2025; Liaw et al., 2021; Ziegler et al., 2025). Training in cultural humility is vital to prevent exclusion and bias (Ko & Choi, 2024; Zhang et al., 2024).

Facilitation Skills: Many educators lack training in VR-specific pedagogy, such as managing avatars, interpreting digital cues, and conducting remote debriefings. This deficit may reduce learner confidence and overall PS (Azim et al., 2022; Tyerman et al., 2021). Faculty development in digital facilitation is urgently required (Kang et al., 2020; Ko & Choi, 2024).

Practice Readiness and Patient Outcomes: Learners may doubt the realism or transferability of VR-based skills, limiting confidence in clinical application (Funao et al., 2025; Loizou et al., 2024). Low PS may further inhibit engagement, with potential downstream effects on patient care (Ko & Choi, 2024; Liaw et al., 2021).

Institutional and Logistical Barriers: Lack of institutional investment, outdated infrastructure, and restrictive policies create stress and diminish trust in VR platforms (Azim et al., 2022; Funao et al., 2025). Institutional commitment is needed to embed PS structurally rather than treat it as optional (Tyerman et al., 2021; Ziegler et al., 2025).

Participant Readiness and Engagement: Variability in digital literacy and psychological preparedness affects comfort levels in VR environments. Learners unaccustomed to technology may experience stress or resistance, undermining PS (Kostovich et al., 2020; Liaw et al., 2021; Ziegler et al., 2025). Orientation and readiness assessments can mitigate these risks.

Realism and Fidelity: Poorly designed or low-fidelity scenarios reduce engagement, while overly complex or hyper-realistic simulations can provoke anxiety. Calibrated fidelity, aligned with learner readiness, is essential to balance immersion with PS (Azim et al., 2022; Kang et al., 2020; Tyerman et al., 2021).

Cultural and Attitudinal Factors: Cultural norms discouraging error-admission or authority-questioning can inhibit open communication. Fear of judgment is particularly pronounced in sensitive simulations (Funao et al., 2025; Loizou et al., 2024). Deliberate inclusion of diverse scenarios and culturally humble facilitation is required to mitigate these barriers (Azim et al., 2022; Ziegler et al., 2025).

Discussion

This scoping review provides critical insights into evolving definitions, conceptualizations, and barriers to implementing PS in VR nursing simulations. Across ten diverse studies, a clear consensus emerged that PS is essential for effective learning, yet its enactment in digitally mediated environments remains complex, under-theorized, and context dependent. The discussion expands on these findings by proposing conceptual, pedagogical, and structural shifts necessary to advance this field.

Edmondson's (1999, 2018) original framework describes PS as a shared belief that individuals can take interpersonal risks without fear of negative consequences. While highly influential, this definition does not fully account for VR-based simulations, where learners are disembodied,

communication is avatar-mediated, and nonverbal cues are reduced. Several studies (Ko & Choi, 2024; Liaw et al., 2021; Ziegler et al., 2025) reveal how digital embodiment creates novel vulnerabilities, reshaping how students interpret safety and risk. Kostovich et al. (2020) and Ziegler et al. (2025) suggest reframing PS as a cyber-embodied construct, influenced by avatars, affective agents, and digital facilitation. Future conceptualizations should incorporate constructs such as presence, authenticity, and emotional resonance in VR, reflecting the impact of affective computing and artificial intelligence on learner experiences.

Psychological safety in VR extends beyond reduced nonverbal cues or physical distance. In immersive environments, learners experience interaction through avatars, altered sensory feedback, and digitally constructed presence. These features shape how learners assess social risk, visibility, and belonging. Unlike traditional simulation, where safety is negotiated through physical co-presence and observable behaviors, VR requires learners to interpret intent, authority, and feedback through mediated signals. This shifts PS from a purely interpersonal construct to a cyber-embodied experience shaped by avatar representation, platform design, and facilitation practices (Liaw et al., 2021; Azim et al., 2022; Kostovich et al., 2020).

This framing positions PS as a function of digital embodiment rather than absence of presence. Learners remain socially exposed, though exposure occurs through virtual identity rather than physical self. As a result, perceived safety depends on how avatars communicate status, inclusivity, and role legitimacy within the virtual environment (Ziegler et al., 2025; Funao et al., 2025).

Avatar characteristics influence learner behavior and self-perception in virtual environments. This phenomenon, known as the Proteus effect, describes how an avatar's appearance shapes confidence, assertiveness, and social engagement independent of the user's offline identity (Yee & Bailenson, 2007; Yee et al., 2009). In VR nursing simulations, avatar traits such as professional attire, perceived authority, gender expression, and cultural markers can influence participation, willingness to speak, and tolerance for error.

These effects have direct implications for PS. Learners represented by avatars aligned with dominant professional norms may experience greater confidence and social permission to engage, while others may experience constraint or heightened self-monitoring. This dynamic can amplify existing power hierarchies or mitigate them depending on avatar design and facilitation strategies (Tyerman et al., 2021; Ziegler et al., 2025).

Addressing PS in VR therefore requires attention to avatar design choices and explicit facilitation practices that normalize participation across diverse representations. Without such intentional design, virtual environments risk reproducing inequities present in physical learning spaces rather than reducing them.

A paradox emerges in the relationship between immersion and safety. On one hand, high-fidelity VR enhances engagement, realism, and clinical transferability (Kang et al., 2020; Funao et al., 2025). On the other hand, the intensity of immersive environments can heighten anxiety, particularly for learners with low digital fluency or inadequate preparation (Azim et al., 2022). Conversely, low-fidelity or gamified VR risks disengagement and superficial learning (Tyerman et al., 2021).

Loizou et al. (2024) emphasize the importance of calibrated immersion, aligning fidelity with learner readiness and objectives. Designing emotionally responsive but non-threatening avatars may help balance realism with psychological security, mitigating the risks of both overstimulation and under-engagement.

The role of facilitators remains pivotal, though fundamentally reshaped in VR environments. Traditional approaches to reading nonverbal cues or managing group dynamics may not apply in avatar-mediated settings (Liaw et al., 2021). Studies highlight that educators require competencies in digital empathy, avatar-based communication, and trauma-informed online debriefing (Azim et al., 2022; Tyerman et al., 2021). Without such skills, facilitators may unintentionally replicate hierarchical or exclusionary dynamics, undermining learner confidence (Kostovich et al., 2020; Eller, 2023). Thus, formal training in Virtual Simulation Pedagogy is essential, equipping educators to function as "digital emotional architects" who actively design for inclusion and psychological security.

Findings from Tyerman et al. (2021) and Ziegler et al. (2025) underscore that PS is fragile when simulations involve marginalized identities or sensitive issues such as sexual orientation, trauma, or mental health. Learners from underrepresented groups may experience heightened vulnerability if their identities are misrepresented or silenced. This review suggests reframing PS as an equity-oriented practice, requiring intentional design of culturally inclusive avatars, culturally humble facilitation (Funao et al., 2025), and space for safe dialogue across differences. Similarly, Zhang et al. (2024) highlight the need for culturally adaptable PS strategies in global disaster preparedness contexts. Although PS is often positioned as a prerequisite for learning, findings suggest it should also be viewed as a platform for transformational discomfort. Ko & Choi (2024) and Loizou et al. (2024) show that well-

designed VR simulations can challenge moral reasoning, resilience, and cultural assumptions. When PS is secured, learners can tolerate ambiguity and engage with difficult emotions, producing deeper critical reflection. This reframing aligns with Mezirow's (1991) transformative learning theory: growth is catalyzed by disorienting dilemmas, provided learners are supported within a psychologically safe framework. PS should therefore not be equated with comfort, but rather with the structured safety necessary to explore discomfort productively.

Despite its potential, multiple barriers hinder the systemic implementation of PS in VR simulations. These include limited access to advanced technology (Funao et al., 2025), inadequate institutional support (Azim et al., 2022), and rigid curricula that leave little space for innovation (Tyerman et al., 2021). Educators often face heavy workloads, insufficient training, and scarce technical support (Kang et al., 2020; Liaw et al., 2021), constraining their ability to prioritize PS. Institutional commitment is therefore critical. As Harder et al. (2021) argue, trauma-informed debriefing and inclusive simulation design require cross-functional collaboration across IT, education, and clinical leadership. Without systemic investment, PS risks remaining aspirational rather than operational.

This review reveals PS in VR nursing simulations as a dynamic, contextual, and evolving construct shaped by the interplay of technological design, facilitation practices, cultural inclusivity, and institutional support. While the existing literature establishes groundwork, advancing this field demands a paradigm shift: from viewing PS as an incidental byproduct of "good teaching" to intentionally engineering it as a systemic and justice-oriented feature of immersive nursing education.

Implications for Practice

This review underscores that PS is not an optional feature of VR nursing simulation, but a foundational condition for meaningful learning. The implications span pedagogy, clinical practice, design, institutional policy, and future research.

Educators play a pivotal role as "digital emotional architects" in VR environments. Traditional facilitation strategies, such as reading body language or using in-person rapport, must be adapted to virtual contexts. Faculty require training in digital facilitation skills, including interpreting avatar cues, managing silence in virtual spaces, and conducting trauma-informed online debriefings (Liaw et al., 2021; Ziegler et al., 2025; Eller, 2023). Faculty development initiatives should embed VR-specific competencies as core teaching skills, rather than optional add-ons.

Psychologically safe VR simulations prepare nursing students for real-world complexity by fostering confidence, supporting open communication, and reducing anxiety when navigating uncertainty (Ko & Choi, 2024; Kostovich et al., 2020). Learners who practice in safe yet challenging VR environments are more likely to carry forward skills in critical thinking, interprofessional collaboration, and cultural humility into clinical settings (Tyerman et al., 2021; Funao et al., 2025). This highlights PS as a professional competency with direct clinical relevance.

VR simulation designers must navigate the immersion–safety paradox, balancing fidelity with learner readiness (Kang et al., 2020; Loizou et al., 2024). Designing calibrated immersion involves creating emotionally resonant but psychologically safe scenarios, integrating diverse avatars, and ensuring interfaces are intuitive and accessible to learners of varying digital fluency. The integration of affective intelligent agents holds promise but must be tested carefully to avoid overwhelming or alienating learners (Loizou et al., 2024).

Institutions must recognize PS as an ethical and systemic responsibility, embedding it in simulation standards, policies, and assessment frameworks. This includes providing adequate infrastructure, dedicated technical support, and protected faculty time to deliver high-quality VR simulations (Azim et al., 2022; Kang et al., 2020). Leadership commitment is essential for ensuring PS becomes a sustained institutional priority rather than a discretionary practice.

Future research should explore longitudinal outcomes of psychologically safe VR simulations, including their impact on learner performance, resilience, and patient care. Mixed-methods approaches are particularly needed to capture both subjective learner experiences and objective performance data (Braun & Clarke, 2006). Cross-cultural research should examine how PS is interpreted and enacted across diverse student populations, with special attention to equity and access for marginalized learners (Tyerman et al., 2021; Zhang et al., 2024).

Advancing PS in VR nursing simulation requires a holistic, values-driven approach that integrates pedagogy, technology, and institutional support. By embedding PS into every layer of design and delivery, educators and institutions can ensure that VR simulations are not only innovative but also ethical, equitable, and transformative for nursing education.

Limitations and Recommendations

This scoping review offers important insights into PS in VR nursing simulations; however, several limitations must be acknowledged. First, the overall number of included

studies was relatively small, and many were conducted within single institutions or limited geographic contexts, which restricts generalizability (Ziegler et al., 2025; Azim et al., 2022; Funao et al., 2025). Second, the majority of studies relied heavily on self-reported measures, introducing potential recall and social desirability biases and limiting the strength of conclusions regarding actual learning outcomes (Liaw et al., 2021; Loizou et al., 2024). Third, language barriers and insufficient localization of VR content were identified as obstacles to learner engagement, raising concerns about cultural applicability (Kang et al., 2020). Finally, the heterogeneity of study designs, spanning qualitative, quantitative, and mixed methods, posed challenges for synthesis and limited opportunities for direct comparison.

To strengthen the evidence base, future research should prioritize large-scale, multicenter studies that capture diverse cultural, linguistic, and institutional contexts. Longitudinal and mixed-methods designs are particularly important to evaluate both immediate and sustained effects of VR simulations on clinical performance, communication, and learner well-being (Braun & Clarke, 2006; Ko & Choi, 2024). The development of validated assessment tools that combine subjective experiences with objective performance data will enhance methodological rigor and comparability across studies (Institute, 2017). Additionally, research should explore the role of faculty preparation and institutional support in shaping psychologically safe VR environments, given the central role of facilitation identified in this review (Kostovich et al., 2020; Liaw et al., 2021). Importantly, equity-focused research is essential to examine how learners from marginalized or underrepresented groups experience PS in VR and how simulation design can advance inclusivity and justice in nursing education (Tyerman et al., 2021; Zhang et al., 2024).

The inclusion of immersive VR group discussions alongside scenario-based simulations reflects an intentional conceptual boundary; however, this decision may limit direct comparability with studies focused exclusively on patient-centered simulation scenarios.

Conclusion

PS remains a vital yet underdeveloped dimension of VR nursing simulation. As this review demonstrates, PS enables learners to take interpersonal risks, voice uncertainties, and engage authentically in ways that strengthen clinical reasoning, communication, and professional identity (Edmondson, 1999, 2018; Kostovich et al., 2020). However, challenges such as inconsistent facilitation, variable learner readiness, technological barriers, and limited cultural responsiveness continue to impede its consistent enactment (Kang et al., 2020; Liaw et al., 2021; Ziegler et al., 2025).

Despite these barriers, VR holds considerable promise for advancing nursing education when PS is deliberately embedded into simulation design, facilitation practices, and institutional policies (Ko & Choi, 2024; Loizou et al., 2024). Prioritizing PS not only enhances engagement and learning but also contributes to more inclusive and equitable educational environments, preparing graduates to meet the complexities of diverse healthcare contexts (Tyerman et al., 2021; Zhang et al., 2024).

Advancing this agenda will require ongoing research, innovative design approaches, and policy-level commitment to ensure VR simulations evolve into psychologically safe, empowering, and transformative spaces for nursing learners. By positioning PS as both a pedagogical necessity and structural standard, nursing education can harness VR not only as a technological innovation but as a platform for cultivating resilience, empathy, and professional excellence.

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