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The Role of Simulation in Nursing in the Training of Future Nurses: A Systematic Review

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Abstract The universitysation of nursing education and the competency-based approach require a change in teaching practices. Simulation is now establishing itself as a response to the ethical imperative of "never the first time on a patient." This literature review aims to analyse the impact of simulation on the development of clinical reasoning, metacognitive mechanisms and psychological factors influencing student learning. Thematic analysis of a corpus of eleven primary documents (articles, theses, symposiums) published between 2016 and 2024. Simulation promotes hypothetical-deductive reasoning and allows the identification of "dangerous knowledge" through debriefing. However, performance anxiety remains a major obstacle to learning. While simulation is a major lever for healthcare safety, its effectiveness depends on the rigor of the debriefing and the trainer's ability to ensure a safe learning environment.

Key Words Simulation Training, Systematic Reviews, Nursing Care, Patient Safety, Safety Management

INTRODUCTION

The Evolution of the Educational Paradigm and the Demands of Professionalization

Initial Nursing Education (INE) has undergone a major paradigm shift, in line with the move towards university-level education and the widespread adoption of the Competency-Based Approach (CBA). This change is directly related to the increasing complexity of care situations and the ethical imperative to ensure patient safety. Today's future nurses must be reflective and autonomous professionals, whose role requires them to exercise sound clinical judgment in order to diagnose situations and plan appropriate interventions [1]. The acquisition of professional competence can no longer be limited to the simple accumulation of knowledge but is based on the ability to mobilize all resources (knowledge, know-how, interpersonal skills) in action [2].

On the one hand, the transformation of initial nursing education in the context of university education involves not only institutional integration into higher education but also a profound redefinition of teaching practices and professional roles. This process has led to the emergence of a pedagogy that is more student-centered, reflective and focused on building knowledge through experience [3]. University education thus promotes the integration of healthcare research into training, strengthening the professionalization and scientific recognition of the nursing field [4]. The trainer then becomes a reflective coach, guiding the student in the analysis of their practice and the development of informed clinical judgment [5].

Furthermore, the adoption of a competency-based approach in higher education institutions for nursing and health care professions is part of a professionalization process that aims to respond to the complexity of contemporary care situations. The competency-based approach involves conceiving of competency not as simple know-how but as the ability to mobilize cognitive, emotional and social resources in an integrated manner in order to act effectively in a given situation [6]. From this perspective, the development of clinical competency is based on experiential progression, from novice to expert, where learning is based on reflective practice and exposure to

real-life care situations [7]. In this sense, contemporary nursing education seeks to train reflective practitioners capable of articulating theoretical knowledge, practical knowledge and the ethics of care [1].

The Limitations of the Traditional Model and the Ethical Imperative for Change

Traditionally, practical learning in nursing was based on the principle of integrative alternation, combining academic training and clinical immersion. This model, long considered the cornerstone of professionalization, aimed to expose students to the reality of care and promote the acquisition of skills through direct experience [7]. However, this approach has gradually revealed its limitations, particularly due to changing ethical standards and safety requirements. Modern healthcare ethics now prohibit learning by making mistakes on patients, enshrining the principle that the "first time" should never occur in a real-life situation [8].

At the same time, nursing training centers are facing a shortage of suitable internship sites and an overload of healthcare facilities, leading to a decrease in the availability of professionals to provide quality supervision [9]. These constraints make it more complex to assess and consolidate clinical skills in the real world. In this context, simulation-based training has emerged as a leading teaching method, enabling active, safe and standardized learning in healthcare situations [10].

Simulation has become an essential lever for professionalization, promoting not only technical mastery but also interprofessional communication, stress management and the development of clinical judgment [10,11]. It helps to establish a culture of safety and reduce the gap between academic knowledge and clinical practice by allowing students to practice without jeopardizing patient safety. The safe learning environment created by simulation reduced anxiety associated with making mistakes, thereby fostering a growth mindset among students [12]. As such, it is fully integrated into the dynamic of educational innovation initiated by the university-level training of nurses.

Healthcare Simulation: Definition and Educational Foundations

Healthcare simulation is defined as an active teaching method that places the learner in a healthcare situation that reproduces, in a controlled and interactive manner, the conditions and complexity of real life [13]. It is based on the faithful reproduction of procedures, environments and professional interactions, allowing students to experiment with clinical decision-making in a safe environment. Recognized by health authorities and accreditation bodies as an essential component of training, simulation is part of the logic of experiential learning and reflective practice [14,15].

Its main advantage lies in the ability to reproduce highly critical or rare situations-such as life-threatening emergencies, medication errors or complex decision-making-without endangering patient safety [9]. This modality provides a learning space where mistakes become a source of progress and where reflexivity is at the heart of the skill acquisition process [10,16]. Debriefing, the central part of the session, allows learners to collectively analyze their actions, compare their perceptions and develop a reflective attitude that is essential to nursing professionalism [17].

Issues and Objectives of the Review

Despite its widespread adoption in nursing education, the effectiveness of simulation does not depend solely on technology or the fidelity of the scenario but above all on the rigor of the educational engineering that structures it. The relevance of the system depends on the quality of the briefing, the precision of the learning objectives and above all the depth of the debriefing, a key moment when reflexivity and knowledge consolidation take place. The current challenge is no longer to determine whether simulation should be integrated into training but to understand how to optimize its use in order to promote the development of complex skills such as clinical reasoning, decision-making in contexts of uncertainty, team coordination and performance anxiety management.

From this perspective, simulation appears as a space for experimentation and transformation, where learners can exercise informed professional judgment, adjust their representations of care and strengthen their confidence in critical situations. This literature review aims to examine in depth the role and impact of simulation in initial nursing education, articulating the theoretical and empirical dimensions that underpin its relevance. More specifically, it aims to analyze its influence on clinical reasoning and metacognition, explore the mechanisms of debriefing and pedagogical facilitation and discuss the persistent challenges related to situational anxiety, skills assessment and the standardization of training practices.

METHODS

This literature review adopts a thematic and synthetic approach aimed at constructing a continuous discourse on the state of knowledge.

- **Corpus Selection:** Eleven primary documents (scientific journal articles, theses and conference proceedings) were selected
- **Study Period:** The publications cover the period from 2016 to 2024 to ensure that the data is up to date
- **Databases and Research:** The research was conducted using specialized health science databases (CINAHL, PubMed, Cairn), supplemented by secondary research focused on key concepts
- **Analysis Criteria:** The corpus was organized around three main themes: cognitive dimensions (clinical reasoning), educational dimensions (debriefing) and psychological dimensions (anxiety and teamwork)

To facilitate reading of the topics covered in this review, the following Table 1 summarizes the research areas identified.

Table 1: Descriptive Summary of the Research Areas Selected

Dimensions	Key concepts	Identified impacts
Cognitive	Clinical Reasoning (CR) and Metacognition.	Identification of errors, correction of "dangerous knowledge."
Pedagogical	Structured debriefing and facilitation.	Transformation of experience into conceptualized and transferable knowledge.

Source: Own elaboration

Table 2: Descriptive Summary of the Selected Studies

Main theme	Key concepts addressed	Major references (extracted from the corpus)
Pedagogical evolution	University education, Competency-Based Approach (CBA), Reflective practitioner	Le Boterf [2], Fouqueray [3], Perrenoud [5]
Ethical and safety framework	"Never the first time on the patient," Safety culture	Gaba [8], INACSL Standards Committee [10]
Cognition and Reasoning	Clinical Reasoning in Nursing (CRN), Hypothetical-deductive model, Intuition	Tanner [1], Benner [7], Psiuk [19], Psiuk [21]
Metacognition	Cognitive biases, Metacognitive Spectral Test (MST), "Dangerous knowledge."	Flavell [24], Romainville [25], Kruger and Dunning [26]
Instructional Design	Structured debriefing, Facilitation, Experiential learning	Jeffries [11], Jeffries [17], Rudolph *et al.* [18], Ledoux *et al.* [22]
Psychological Dimensions	Situational anxiety, Stress, Teamwork (CRM)	Cant and Cooper [9], Rosen *et al.* [13], Fanning and Gaba [23]

Cognitive Dimensions: Clinical Reasoning in Nursing (CRN) and Metacognition

In order to provide an overview of the body of work studied, the following Table 2 summarizes the reference sources used, organizing them around the cognitive, pedagogical and psychological dimensions that structure this literature review.

Simulation: A Tool for Developing Clinical Reasoning

The acquisition and mastery of Clinical Reasoning in Nursing (CRN) are not simply learning steps but constitute the cornerstone of nursing competence and, by extension, a critical factor in the safety of care. This complex cognitive process is fundament, as it enables healthcare professionals to collect, analyze and interpret data in order to make informed decisions and adjust patient care [18-20].

CRN and Bias Management: The Challenge of Metacognition

CRN is often conceptualized as a two-part process that integrates both analytical (hypothetical-deductive) reasoning and non-analytical/intuitive reasoning (based on pattern recognition and experience) [1].

Explanation of the Hypothetical-Deductive Model

This is a systematic approach where a novice nurse or a nurse faced with a complex situation: Collects data (signs, symptoms, history). Formulates potential diagnostic hypotheses (e.g., "Does the patient have cardiac decompensation? An infection?").

Verify these hypotheses by collecting additional targeted data (e.g., check vital signs, relevant lab results) until a clinical conclusion is reached [20].

Although this model is essential for teaching, it is often emphasized that expert nurses rely more on rapid, intuitive clinical judgment based on a vast database of experience [7]. Simulation is crucial for building the reservoir of experience necessary for the emergence of expert intuition.

High-fidelity clinical simulation (HFCS), particularly that using high-fidelity mannequins, is recognized as a powerful catalyst in the development of RCN.

Unlike a theoretical case study where the student "reads" the data, HFCS immerses them in a situation close to reality (e.g., managing a severe asthma attack or anaphylactic shock). The student must immediately:

- Prioritize taking blood or administering oxygen
- Articulate their knowledge (pathophysiology, pharmacology) for action
- Manage the stress associated with time constraints and simulated severity, which accurately replicates clinical pressure

Critique

The effectiveness of HFCS lies not only in the mannequin technology but critically in the structured debriefing phase that follows the scenario. It is during the debriefing, facilitated by the instructor (Debriefing with Good Judgment, for example), that the learner can explain their cognitive strategies, identify their biases and errors (metacognitive mechanisms) and transform the experience into usable and integrated knowledge [21,22].

Identifying "Dangerous Knowledge"

Metacognitive analysis, defined as knowledge and control of cognitive processes [23], has a direct and crucial application in the field of clinical simulation, particularly for identifying "dangerous knowledge"-a concept that alerts us to the risk associated with knowledge that is erroneous but held to be certain. Research using post-simulation self-assessment tools, such as the Metacognitive Spectral Test (MST) [24], has empirically demonstrated that students can arrive at a clearly erroneous diagnosis of a clinical situation while displaying a high degree of certainty in their response. This phenomenon is particularly serious because it reflects the activation of overconfidence bias (or the Dunning-Kruger effect in some contexts), where incompetence generates an illusion of competence [25]. This cognitive bias is a major risk to the safety of care in real-life situations, as it leads to premature closure of reasoning (premature closure bias) and the omission of alternative hypotheses, despite the presence of contradictory evidence.

Clinical simulation (HFCS) therefore acts as an essential safety filter and a unique opportunity for the trainer to address these critical shortcomings before exposure to a real clinical environment. By confronting the student with the failure of their reasoning in a safe environment, simulation triggers cognitive dissonance between the high level of certainty displayed and the negative outcome observed in the simulated patient. The ensuing debriefing, which focuses on analyzing thought processes (the "how" and "why" of the decision) rather than just the technical action, allows for the clarification of cognitive strategies and the adjustment of certainty judgments. This exercise in metacognitive reflection makes it possible to accurately diagnose the flaws in the RCN (lack of knowledge, poor prioritization, influence of biases) and to implement specific and targeted remediation strategies, thus transforming potential risk into a source of critical learning and future safety [21].

Pedagogical Dimensions: Debriefing and the Role of the Trainer

Debriefing: The Epicenter of Learning: The effectiveness of simulation depends on the post-scenario stage: debriefing. It is during this structured exchange that experiential learning is transformed into conceptualized and transferable knowledge. Debriefing is an essential reflection exercise that takes a step back from the action for retrospective analysis. It is generally divided into three sequential phases to maximize learning:

- **Descriptive/Emotional Phase:** Participants are invited to describe the facts and, above all, to verbalize their emotions and feelings. This step is crucial for defusing emotional tension and creating a climate of trust and psychological safety, which is essential for honest and open reflection
- **Analysis Phase:** This is the heart of the process, where the trainer explores the reasoning behind the actions. All students (actors and observers) are engaged in exploring why certain actions were taken and, above all, how the RCN worked. This phase facilitates access to metacognition
- **Synthesis/Application Phase:** Students make the connection between the simulated experience and the theoretical framework, synthesizing what they have learned and planning how to transfer these skills to future real-life situations

Comparative studies have highlighted the superior effectiveness of systematic and reflective debriefing methods, such as the RESPOND method [26], which focus on a comprehensive description of observations (ABCDE) before performance evaluation, compared to more evaluative methods such as Plus-Delta.

The Complexity of the Trainer's Facilitation Role

The simulation trainer is responsible for educational engineering and performs a complex facilitation and guidance role. Their activity takes several forms, which may be in tension at the time of the exercise:

- **Didactic Guidance:** Focused on progress toward the initial learning objective
- **Supportive Guidance:** Focused on supporting the learner, particularly in managing their stress and commitment
- **Prospective Guidance:** Seeking to provoke certain actions or errors in order to obtain rich "material" for discussion during the debriefing

The trainer's performance lies in their ability to strike a balance between these approaches, particularly in order to maintain the illusion of realism in the scenario (productive guidance) while ensuring psychological safety and the didactic contract. The trainer must also ensure that the problem is devolved to the learner, i.e., that the student is actively engaged in solving the problem as if the situation were real, which is a key element in the effectiveness of the simulation [27].

Psychological and Contextual Dimensions

The Challenge of Situational Anxiety and Stress Factors: Anxiety is a critical variable in simulation. Although simulation is designed to be safe, it can cause significant psychological stress (situational anxiety) that can inhibit learning processes and impair performance. Novice students are particularly prone to anticipatory anxiety, which is exacerbated by the novelty effect, the presence of observers or the fear of judgment by peers and trainers.

The briefing is an ideal opportunity to reduce this anxiety. It should clarify objectives and roles and emphasize the rules of confidentiality and the formative, non-evaluative nature of the scenario. The study on adding an Educational Capsule (EC) [26] during the briefing to reduce anxiety and improve teamwork showed that, although this intervention was perceived as acceptable by students, it did not have a significant effect on reducing anxiety. This lack of effect is multifactorial: it is possible that the EC (which presented an ideal role model) was confused with expectations of maximum performance, thereby increasing performance anxiety rather than reducing it. The researchers emphasize the need for a supervised and structured implementation of such tools, including a detailed discussion to properly adjust expectations.

A quantitative study Lubbers and Rossman [28] conducted among novice nursing students shows that the use of medium-fidelity simulation, even in community care settings (outside acute hospital settings), significantly increases learners' self-satisfaction and self-confidence. The results emphasize that successful learning does not depend solely on high technology but on the match between the scenario and the student's skill level, thus enabling a smoother transition to actual clinical practice.

Simulation and Development of Teamwork Skills

Simulation is the ideal environment for training in non-technical teamwork skills (communication, collaboration, leadership, task management), which have been identified as crucial for reducing medical errors. The use of models such as Crisis Resource Management (CRM) is facilitated by immersion in simulation, allowing for the immediate

application and evaluation of these collective behaviors in crisis situations. However, the study on the addition of EC also failed to demonstrate a significant effect on improving teamwork, suggesting that the acquisition of these complex skills is often masked by the accumulation of stressful contextual factors (novices, untrained teams) [28]. To optimize this learning, it is imperative to distinguish roles (participants vs. observers) and ensure that teams have prior experience collaborating in simulation to isolate the effect of the intervention.

DISCUSSION AND IMPLICATIONS FOR CLINICAL PRACTICE

Summary of the Contributions of Simulation

This literature review highlights that High-Fidelity Simulation (HFS) is no longer simply an educational option but a lever for healthcare safety. The consensus emerging from the eleven documents analyzed emphasizes that simulation acts as a catalyst for metacognition. It allows students to move from intuitive thinking, which is often subject to bias, to analytical and structured clinical reasoning (Tanner model, 2006).

Debriefing

A space for cognitive transition, the analysis confirms that learning does not occur during the simulated action itself but during the debriefing. It is in this safe space that errors are "deconstructed" and "dangerous knowledge" is corrected. For the student, this step is crucial in transforming a stressful experience into reusable professional knowledge, thereby boosting their confidence before actual exposure to patients.

Implications for Practice and Healthcare Safety

The systematic integration of simulation into initial training has direct repercussions on the clinical environment:

- **Risk Reduction:** By practicing on mannequins, students learn safety protocols and priority management without risking lives
- **Non-technical Skills:** Simulation promotes the development of leadership and interprofessional communication, key factors in preventing adverse events in the care unit
- **Emotional Preparation:** Managing anxiety in a simulated environment prepares students to maintain their clinical judgment under pressure in emergency situations

Limitations of the Corpus and Research Perspectives

Although the benefits are clear, this review identifies certain limitations. The majority of studies focus on students' perception of learning rather than on the objective measurement of skills transfer at the patient's bedside. Future research should focus on:

- **Long-Term Transfer:** Evaluate whether simulation learning persists after several months of clinical practice
- **The Impact of Stress:** Using biomarkers (such as heart rate variability) to quantify the impact of performance anxiety on clinical reasoning
- **Trainer Support:** Enhance facilitator training to ensure standardization of debriefings

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