

Simulation-Based Learning in Nursing Education: Current Evidence and Future Directions

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Abstract

Objectives

To synthesize current evidence on simulation-based learning in nursing through an outcomes-first lens—knowledge/skills, clinical judgment, communication/interprofessional skills, and affective outcomes—and to translate implications for design, assessment, implementation, equity, and policy.

Methods

Narrative review organizing evidence by learner outcomes and interpreting findings through experiential learning, NLN Jeffries Simulation Theory, and INACSL Standards; interprofessional studies included where mechanisms transfer.

Results

Simulation improves knowledge and psychomotor skills when fidelity is matched to objectives and scenarios are scaffolded; short, focused events with deliberate practice and structured debriefing yield measurable gains. Effects on clinical judgment vary unless simulation is coupled with inquiry-driven designs (e.g., PBL, self-directed approaches) and high-quality debriefing, supported by validated instruments (e.g., LCJR, CCEI, SET-M, DASH). Standardized patients strengthen communication and empathy; interprofessional simulation enhances teamwork and speaking-up. Affective outcomes (confidence, motivation, engagement) generally improve with clear prebriefs, psychological safety, and repetition. Policy-level evidence supports partial substitution of clinical hours when programs meet standards. Implementation requires capital, operations, faculty development, and rater calibration; equity demands culturally attuned, cost-sensitive approaches suitable for LMICs and digitally constrained settings.

Conclusions

Simulation is a core pedagogical strategy when objectives, design/fidelity, debriefing, and measurement are tightly aligned. Priorities include standardized core outcomes, longitudinal transfer and patient-level effects, cost-effectiveness, rigorous evaluation of gamification and adaptive/AI-enhanced approaches, and equity-focused deployment.

Keywords: nursing education, clinical judgment, debriefing, assessment instruments, simulation-based learning, VR/AR

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1. Introduction

Simulation-based learning is increasingly embedded within global nurse curricula, providing controlled, no-risk environments where students can practice clinical judgment, technical expertise, and professional communication (J. Kim et al., 2016). Placements from the past are limited because of safety issues, small capacity, and uneven case exposure; simulation reduces such constraints while making possible standardized, evidence-based practice (Shin et al., 2015). A landmark, national research agenda conducted on behalf of the National Council of State Boards of Nursing concluded that as much as 50% of traditional clinical time could be substituted with high-fidelity simulation without harm to licensure performance or practice preparedness (Hayden, Smiley, et al., 2014).

Recent syntheses highlight rapid expansion in immersive technologies (e.g., AR/VR, 360° video) with positive impacts on satisfaction, realism, and self-efficacy/knowledge (Park et al., 2024) and reliably enhanced engagement and performance in nursing and midwifery programs (Yahya et al., 2024). Recent small-scale course-level tests also suggest that the integration of immersive VR with problem-based learning can enhance academic self-efficacy and improve tangible clinical performance on targeted exams (e.g., neurologic exam), increasing impetus for blended simulation designs (J. S. Lee & Son, 2023). Simulation has evolved from an adjunct method to an axial pedagogic approach highly pertinent to policy, necessitating aligned outcomes-based design and assessment as a priority for programs and regulators.

Consequently, this review spotlights outcomes—first synthesis: rather than manikins, standardized patients, and VR/AR as ends, we examine the ways that these methodologies enable knowledge/skills, clinical judgment, communication, and motivation, and we map each to debriefing practices and validated measures (INACSL Standards Committee, 2016, 2021; Oermann et al., 2016; Rizzolo et al., 2015). We also illuminate program-level outcomes—regulatory substitution of clinical hours, cost profiles, and equity—so that program planners may align choices with policy and resources realities (AACN, 2021; Hayden, Smiley, et al., 2014).

The practice has ancient roots: initial applications include bronze teaching statues dating back to the Song Dynasty as well as the “Mrs. Chase” manikin brought forward in 1922 as part of task practice (Herrmann, 2008; Owen, 2012). Practice today ranges the gamut between low-, medium-, to high-fidelity practice, where fidelity—the degree to which the experience is authentic or believable—is comprised of engineering (look/feel) as well as psychological (authentic behaviors and necessary actions) aspects related to learner involvement (Bauchat et al., 2016; Loke et al., 2014; MacLean et al., 2019). As the pedagogy maturely advances, it is increasingly used, not just as a teaching modality, but also as part of formative, summative, as well as high-stakes assessment, as long as programs keep current with established best practices, as reflected through validated processes and instruments (INACSL Standards

Committee, 2016, 2021; Oermann et al., 2016; Rizzolo et al., 2015).

1.1. Review rationale and argument

It is instead argued here that the value of simulation be framed as an alignment issue: aligning objectives, design (including fidelity), debriefing, and measurement. Working through this framework, apparently unrelated outcomes, such as the variable ones on critical thinking, fall into place once scenario design as well as emotional states are specified. This review, then, is to contribute to that integration of evidence by mechanism and outcome, indicating where and why simulation produces lasting learning as well as where, within constraint, programs can best leverage it.

1.2. Objectives

This narrative review (a) charts the history and theory behind simulation in nurse education, (b) incorporates the evidence by outcomes, rather than modality, (c) incorporates manikins, standardized patients, and immersive/virtual technologies as delivery vehicles to those outcomes, (d) outlines difficulties of implementation (particular where resources are limited), and (e) suggests future directions and research agendas.

We start with the theory and history (Section 3). We then synthesize the evidence based on the outcomes of learners—psychomotor skills and knowledge; clinical judgment; communication/empathy/IPS; and affective outcomes (Section 4). Debriefing and evaluation, which function beyond all outcomes, then follow (Section 5). We then touch on implementation, equity, and policy translation (Section 6) and finish up with future directions and implications (Sections 7–8).

2. Methods

We undertook this review as a narrative synthesis, opting for conceptual integration and practice relevance rather than comprehensive listing of studies available. We drew on the peer-reviewed literature across nursing, health professional education, and medical informatics, preferring recent systematic reviews, experimental studies, and publications bearing policy or standards relevance. Interprofessional research was included if their mechanisms or design principles had transfer value to nursing education. We included undergraduate and initial postgraduate settings, as the review organized the evidence around learner outcomes, based on knowledge and psychomotor skills, clinical judgment, communication, empathy, and interprofessional skills, as also motivation and emotional domains. We interpreted findings through the frames of reference of experiential learning theory, the NLN Jeffries Simulation Theory (Jeffries, 2021), as also the INACSL Standards of Best Practice, thereby stressing the correspondence between the objectives of the instruction and the design of the simulation, including the fidelity, the debriefing strategy, as also the measurement of outcomes. Since the overarching goal was to provide an outcomes-based syn-

thesis that would inform practice and policy translation, the reporting accents the underlying mechanism as also the boundary conditions, while delineating the outcomes mapping to corresponding debriefing practice as also to instruments validated.

3. Historical Context and Conceptual Foundations

The history of simulation-based nursing education tracks a slow but consistent shift from rudimentary task trainers to complex, theory-based pedagogies. Initial constructs depended on low-fidelity task trainers and rudimentary mannequins, which were eventually supplanted by high-fidelity human patient simulators and role-playing exercises (Herrmann, 2008; Owen, 2012). This trajectory documents both technological advances as well as increasing acknowledgment that organized practice under safe, controlled conditions holds the potential to methodically construct competence where properly advised by pedagogic theory.

Several theories have outlined the basis for this progress. Jeffries' Simulation Framework—subsequently developed into the NLN Jeffries Simulation Theory—is focused on the importance of fidelity, scenario construction, the role of the facilitator, learner participation, and organized debriefing. It conceptualizes simulation as an interaction among dynamic context, background, design, educational approach, and outcomes (Jeffries, 2005; Jeffries et al., 2015). Supplementing this, the INACSL Standards of Best Practice institutionalize guidelines throughout design, facilitation, operations, outcomes, and debriefing (INACSL Standards Committee, 2016, 2021). In tandem, these theories have provided the discipline with a common language and standards, facilitating the transition beyond ad hoc use of simulation to planned infusion and quality assurance.

Simulation's theoretical foundations also draw on wider pedagogic traditions. Kolb's cycle of experiential learning, constructivist practice, and Schön's reflective practice offer the justification why active participation, reflection, and debriefing are integral component parts rather than optional enhancements (Bauchat et al., 2016; Kolb, 2014; Schön, 1983). Evidence based on the clinical skills laboratories also demonstrates small-group, hands-on settings building intrinsic motivation and proximate interaction over the large lecture group, confirming the utility of simulation as a psychologically safe, interactive learning environment (Haraldseid et al., 2015).

One key construct across these paradigms is fidelity, which is most usefully conceived as a multiple dimension rather than a unidimensional scale of realism. Fidelity subsumes both engineering dimensions, such as physical appearance, as well as psychological dimensions, such as authenticity of actions and necessary actions. Note that fidelity must be balanced to the objectives of instruction rather than optimized wilfully, as gratuitous complexity will incur cognitive overload without adding to the benefit of instruction (Bauchat et al., 2016; Loke et al., 2014; MacLean et al., 2019). This working definition underlies much of the evidence reviewed subsequently, where corre-

spondence between fidelity and instructionally defined purpose becomes a recurring factor influencing effectiveness.

4. Evidence by Learner Outcome (What Works, For Whom, Under What Conditions)

4.1. Knowledge Acquisition and Psychomotor Skills

Simulation reveals its most compelling base of evidence in the areas of knowledge acquisition and psychomotor skill acquisition, yielding one of the most compelling rationales for its universal integration into nursing curricula. Working across modalities, simulation invariably improves both knowledge and skills (Cant & Cooper, 2017). A meta-analysis yielded a cumulative SMD of 0.71 for patient simulation vs. control teaching (Shin et al., 2015). Manikin-based designs, where aligned to objectives, yield moderate-to-large effects overall (SMD = 0.70), wherein medium-fidelity (SMD = 1.03) and high-fidelity (SMD = 0.86) significantly surpass low-fidelity designs (J. Kim et al., 2016). High-fidelity simulators have been found to significantly benefit the cognitive (SMD = 0.50) and affective (SMD = 0.80) domains, with strong support for psychomotor acquisition based on advanced life support, airway management, recognition of deterioration, and crisis resource management where scenarios are scaffolded (J. Kim et al., 2016; Owen, 2012). Equivalent gains are also claimed based on immersive designs; e.g., a VR-based simulation embedded within problem-based learning enhanced performance on neurological exam compared to controls based on lecture combined with demonstration (J. S. Lee & Son, 2023). Meta-analysis based on the role of VR in nurse education also found improved outcomes based on knowledge vs. non-VR controls (Chen et al., 2020). Subject-specific research corroborates as follows: human patient simulator-based training improved diabetic ketoacidosis management based on knowledge and competence (Rumahorbo et al., 2018), and immersive technologies repeatedly surpassed traditional instruction based on acquisition of knowledge (Park et al., 2024). Course-based research also explored the role of virtual patient-based simulations within medical-surgical nursing (Musgrove, 2016).

Comparative studies still compare VR to traditional simulated practice of psychomotor skills (e.g., Rourke, 2020). A recurring theme throughout this evidence is that fidelity must not be viewed as a straightforward increase in realism, but rather as a variable aligned with learning goals. Engineering fidelity must be properly sized to task demands, as must psychological authenticity (Bauchat et al., 2016; Loke et al., 2014; MacLean et al., 2019). Moulage, properly applied, has been found to improve realism, immersion, and skills transfer (Stokes-Parish et al., 2019), as meticulously designed video-based simulations have indicated greater motivation and attainment than controls (Koçan et al., 2024). These results indicate that the genuine pedagogic power of simulation resides, not in the technologies themselves, but rather in the customization of design features to the skill and knowledge goals of each scenario.

Reflection and formalized feedback also play a critical role in cementing procedural skills. Directed debriefing

programs such as the Plus-Delta, the GAS, PEARLS, and the Debriefing for Meaningful Learning framework allow learners to identify errors and enhance transfer (American Heart Association, 2010; Cheng et al., 2016; Dreifuerst, 2012, 2015; Fanning & Gaba, 2007; Shinnick et al., 2011). Use of validated measures also ensures that the outcomes are measured adequately: the CCEI measures competency in such areas as those of communication, judgment, and safety (Hayden, Keegan, et al., 2014; Todd et al., 2023), the SDS measures perceptions of the quality of the designs (Adamson et al., 2012). Use of the former such measures bases conclusions about skills acquisition on psychometrically valid, rather than anecdotal, impressions.

Those processes correspond directly to experiential learning and cognitive load. Carefully controlled exposure to cues, error opportunity and recovery, and timely release of feedback facilitate encoding and recall of procedural and conceptual knowledge (Dreifuerst, 2012, 2015; Fanning & Gaba, 2007; Kolb, 2014). When fidelity is judiciously matched—for example, medium-fidelity mannequins to teach algorithmic skills, high-fidelity scenarios to teach crisis management—the learner processes attention to the right task demands without distraction from extraneous realism (Bauchat et al., 2016; Loke et al., 2014; MacLean et al., 2019). Moulage also increases cue salience through increasing the realism of signs and symptoms (Stokes-Parish et al., 2019). Comparison across varying levels of immersion of VR can inform pragmatic decisions among formats (Smith et al., 2018).

At the learner level, the strongest designs are those sequencing short, narrowly defined scenarios of 15–20 minutes, progressive scaffolding from deliberate-practice stations to longitudinally integrated high-fidelity experiences (J. Kim et al., 2016; Koçan et al., 2024; J. S. Lee & Son, 2023; Owen, 2012). When paired with structured debriefing and measured with competency-based instruments such as the CCEI or design-perception measures such as the SDS, these designs support reproducible improvements across cohorts (Adamson et al., 2012; Hayden, Keegan, et al., 2014; Hayden, Smiley, et al., 2014; Todd et al., 2023). On this basis, the pedagogic imperative is no longer keeping ahead of the next generation of complex technologies, but rather ensuring objectives, fidelity, debriefing, and measurement come together seamlessly to support sustainable learning outcomes.

4.2. Clinical Judgment and Critical Thinking

Where knowledge and psychomotor skills are the strongest base of support for simulation, critical thinking and clinical judgment are more contentious ground. Research here seems to be influenced as much by learner context, as designed, as the modality itself. While technical performance and knowledge always improve following simulation, the influence on critical thinking is variable. A meta-analysis, based on standardized patient-based programs, found no significant gains in critical thinking whilst other areas improved (Oh et al., 2015). Subsequent research suggests that the modality itself is less important than the use that is made of it. Stenseth et al. (2025), for in-

stance, found advances in computer-based platforms, immersive VR, blended synchronous–async modes, and those designs that improve realism, engagement, and access facilitating critical thinking. Concurrently, research points up the significance of the affective conditions under which the learner experiences the modality. Thus, stress negates the learner's access to the psychological state necessary to support flow, the latter being required for judgment building (Delvaux et al., 2025). Clinical judgment was, in specific situations (Lebanese nursing students, Fawaz & Hamdan-Mansour, 2016), improved following high-fidelity simulation. Personal (personal professional identity) as well as design-related (attitudes to simulation, stress, problem-solving focus) factors significantly influenced the results where maternal–child cases were used (Nuampa et al., 2025).

One reliable mechanism for developing judgment lies in blending simulation together with inquiry-based designs. Problem-based learning (PBL), when used together with simulation, has yielded gains in metacognition, team competency, learning orientations, motivation, and life skills in numerous studies (M. N. Lee et al., 2017; Roh & Kim, 2015). Likewise, self-guided designs such as MAES© have been associated with increased motivation—including self-efficacy, strategy, and self-management—and gains across several aspects of critical thinking (Arizo-Luque et al., 2022). In maternal–child nursing situations, designs that safeguard opportunities to make errors as well as recovery while strongly replicating natural practice have been qualitatively associated with gains in judgment, echoing learner-autonomy principles as well as scaffolding (Nuampa et al., 2025). Broadening this mechanism, VR-based PBL has yielded simultaneous gains in self-efficacy on academic tasks as well as performance on neurologic exams, substantiating the benefit of immersive, inquiry-based designs for higher-order skills (J. S. Lee & Son, 2023). These results collectively indicate that gains in critical thinking do not occur spontaneously based on exposure to simulation; they occur as experiences are designed to foster autonomy, inquiry, as well as reflection.

Variability of effect expressed in the literature may be traceable to misalignments between scenario construction and targeted processes of judgment, restricted learner freedom, or emotional obstacles such as stress (Delvaux et al., 2025; Oh et al., 2015). Designs that overtly include the noticing–interpreting–responding–reflecting cycle are apparently more effective, generating concurrent gains in metacognition, team functioning, and self-efficacy—even very short exposes to VR-PBL (Arizo-Luque et al., 2022; J. S. Lee & Son, 2023; M. N. Lee et al., 2017; Roh & Kim, 2015). This framing locates clinical judgment no longer as a passive incidental derivative of technical practice, but as an iterative competence that needs to be coached and scaffolding, aligned with the Debriefing for Meaningful Learning (DML) conception and operationalizations across the Lasater Clinical Judgment Rubric (LCJR) domains of judgment.

Instruments and structured debriefing strategies are important to measuring and achieving these outcomes. While

the DML approach specifically addresses the noticing–interpreting–responding–reflecting cycle (Dreifuerst, 2012, 2015), the LCJR provides a psychometrically validated framework on which to build the measurement of clinical judgment along those dimensions (Adamson et al., 2012). Instruments such as the CCEI and the DASH venture still further to standardize competency rating as well as quality of debriefing (Simon et al., 2010–2018; Todd et al., 2023). A recent systematic review also positively addresses the idea that students affirmatively identify debriefing as critical to confidence and learning, that a two-stage process of self-examination followed by group discussion becomes significantly effective (Glennie, 2025). Together, these findings corroborate that the acquisition of clinical judgment during simulation relies less on the modality itself than on explicit design, inquiry-based structure, as well as active debriefing and measurement.

4.3. Communication, Empathy, and Interprofessional Skills

Simulation contributes both to technical skills as well as to the attainment of relational skills such as communication, empathy, as well as collaboration. SPs are best suited to this role because they mimic real-world encounters, albeit in a predictable, controlled manner. Their scenarios allow learners to practice communication as well as empathy while being offered structured, instruction-supporting as well as evaluation-augmenting, feedback (Barrows, 1993; Ryan et al., 2010). Virtualized SPs have also been used to assess history-taking ability as well as predictors among nurse undergraduates (Du et al., 2022). Evidence based on meta-analyses demonstrates strong effects on communication ($d = 1.86$) as well as improvements related to self-efficacy, motivation, as well as overall competence (Oh et al., 2015). More recent summaries verify these findings, including broad gains on knowledge, confidence, as well as communication, when SPs are implemented as part of curricula (Ma et al., 2023). As SPs provide standardized affect as well as story consistency, they alone are best suited to allow students to practice empathy, agenda setting, as well as shared decision-making, skills that are difficult to administer with patients or mannequins.

Interprofessional simulation (IPS) has also been a worthwhile approach to advancing interdisciplinary collaboration and communication. It has been found that adequately designed IPS scenarios, such as those on acute events such as anaphylaxis, improve coordination, role clarity, and speaking-up behaviors (Hodgkins et al., 2020). Even where resources limit active engagement, observers in observer windows report equivalent learning outcomes, again attesting the value of formalized structured observation in team-based simulation (Johnson, 2019, 2020). At international levels, IPS has been used to improve broader care models. For instance, as part of the Democratic Republic of Congo midwifery programs, simulation exercises between academic sites and practice sites aided the rollout of person-centered care models through allowing the opportunity for students to rehearse the scenarios involved in cases and processes of care communication with the women them-

selves. Hierarchic practice culture, however, limited full transformation of those skills, again affirming the requirement for faculty professional growth and local-context adaptation where relational outcomes are the desired goal (Temple et al., 2025).

Illustrative scenarios illustrate how the modalities complement one another. In an anaphylaxis case, nursing and medical students synchronise epinephrine dosing, airway management, and rapid reassessment while experiencing closed-loop communication. Spotters monitor team roles and speaking-up actions using structured checklists, achieving similar results as those directly involved (Hodgkins et al., 2020; Johnson, 2019, 2020). SP encounters, on the other hand, excel themselves in the acquisition of empathic decision-making skills, where significant advances in self-efficacy, as well as outcomes, were observed (Barrows, 1993; Ma et al., 2023; Oh et al., 2015). This contrast points to the mechanism whereby SPs and IPSs can be used selectively, each tackling specific yet complementary dimensions of relational competence.

Effective relational objectives' implementation needs more than exposure; it necessitates structured facilitation and evaluation. Advocacy–inquiry– or PEARLS-based debriefing models engender psychologically safe spaces where gaps in communication as well as team functioning may be brought to the surface and explored (Cheng et al., 2016; INACSL Standards Committee, 2016, 2021; Rudolph et al., 2007). Tools such as the DASH standardize the assessment of debriefing quality further and assist with sustaining facilitator consistency (Simon et al., 2010–2018). When such techniques are implemented invariably, relational results, including empathy, communication, and teamwork, may be measured and enhanced commensurably with those of technical competencies. In aggregate, the evidence suggests that relational skills must be considered not afterthoughts of simulation, as incidental happenstances, but rather as deliberate results necessitating careful design, cultural awareness, and validated measurement.

4.4. Motivation, Engagement, and Desirable Outcomes

In addition to cognitive and technical skills, simulation has a specific impact on learners' affective spheres, including motivation, confidence, and engagement. In the aggregate, across modalities, research reliably demonstrates that simulation raises self-efficacy and intrinsic motivation (Nojima et al., 2025). Perceptions among students that they experience online simulation are similar, where learners point to the benefit of clear instructions, corrective feedback, and caring facilitation (Carmody et al., 2020; Egilsdottir et al., 2022; Scott et al., 2021). A systematic review of virtual simulation documents widespread improvement in knowledge and learner perceptions (e.g., confidence, satisfaction) regardless of the format (Foronda et al., 2020). Capability to contribute anonymously and safe reflection also significantly enhanced motivation and persistence (Johnsen et al., 2021; Rim & Shin, 2021; Verkuyl & Hughes, 2019). These features were associated with increased-confidence (Donovan et al., 2018; Egilsdottir et al., 2022; Rim & Shin,

2021; Saab et al., 2021) and satisfaction (Foronda et al., 2016; Jiménez-Rodríguez et al., 2020; Saab et al., 2022), where many students indicated they themselves were significantly prepared for practice (Spalla, 2012; Verkuyl & Hughes, 2019). Beyond self-efficacy, simulated exposure has been related to more positive attitudes about older adults and chosen care indicators (Eren & Şendir, 2025). Patient-based, standardized learning has specifically enhanced motivation and self-efficacy (Oh et al., 2015). In the immersive modality, VR-PBL interventions improved academic self-efficacy as well as clinical performance, although transfer motivation did not change, implying that self-efficacy is a more short-term-sensitive outcome than motivation among targeted exposures (J. S. Lee & Son, 2023). Reviews have also shown that clinical simulation underpins motivation as well as competencies, autonomy, reflection, as well as decreased anxiety (Henrique-Sanches et al., 2024). Systematic review of immersive technologies suggests increases in satisfaction, realism, knowledge, and confidence (Park et al., 2024), while a review specific to nursing and midwifery concentrated on increases in engagement and performance (Yahya et al., 2024). Experiences of VR in mental health nursing also demonstrated enhanced motivation to learn (Y. Lee et al., 2020). At the microdesign level, video-based simulation improved motivation and academic achievement compared to controls (Koçan et al., 2024). Aspects of games may also enhance engagement where designed expressly to complement outcomes (Sanz-Martos et al., 2024). Aspects of gamified simulation, where institutions support them, also improved engagement and confidence, albeit where faculty members also referred to persistent barriers such as limitation of IT support as well as gaps in policy (Kotp et al., 2025). Considered together, these studies confirm that emotional benefits are inevitably demonstrated but persistently dependent on rehearsal, scaffolding, and organizational support.

Learning environments themselves can be levers that motivate. Skills labs, for instance, are typically described by students as comfortable and conducive spaces that support persistence (Haraldseid et al., 2015). PBL-simulation blends have been shown to improve motivation and life skills while improving metacognition as well as team functionality (M. N. Lee et al., 2017; Roh & Kim, 2015). Such results underscore that motivation cannot be best conceived as an individual disposition, but rather as a product of the context, of the collaboration afforded by the peers, as well as the instruction's designs.

Equivalently, the emotional aspect of simulation is vulnerable to stress, particularly where stakes are high. If orientations, prebriefings, and facilitator support are insufficient, stress could undermine learners' confidence, dampen performance (Cordeau, 2010; Rutherford-Hemming et al., 2014). Proactive programs that address this threat explicitly are more likely to preserve the motivational benefit of simulation than turn evaluation into sources of constructive pressure.

Certain design features prove to be critical to the preservation of engagement and confidence. Clear guidance, supportive comment, and psychologically secure spaces are

ever-higher-order factors, as students report (Carmody et al., 2020; Egilsdottir et al., 2022; Haraldseid et al., 2015; Johnsen et al., 2021; Rim & Shin, 2021; Verkuyl & Hughes, 2019). These features may be designed into online or based-on-VR modalities via prebriefs, anonymous contribution, and timely corrective comment. Gamification features hold the potential to offer additional moments of engagement that require faculty professional development as well as evaluation instruments to convert positive perception into competency gains (Kotp et al., 2025). Investigation also uncovers short-term exposure to VR-PBL increases self-efficacy more consistently than motivation, indicating that reflection as well as repetition contribute to stabilizing long-term gains on the affective dimensions (J. S. Lee & Son, 2023). In this sense, the motivational potential of simulation lies less among the novel or the simulative accuracy than among the careful framing of spaces that define safety, autonomy, as well as sense of belonging.

Affective outcomes evaluation demands the same degree of rigor as do technical or cognitive areas. Simulation Effectiveness Tool–Modified (SET-M) is common to the measurement of learners' perceptions regarding effectiveness, confidence, and satisfaction, as are instruments like DASH to the satisfaction that debriefing preserves psychological safety as well as constructive feedback (INACSL Standards Committee, 2016, 2021; Simon et al., 2010–2018). By aligning structured debriefing models with validated instruments, programs can be assured that affective outcomes, often qualitatively described, are regularly measured, and included as part of wider program evaluation.

5. Cross-Cutting Mechanisms: Debriefing, Assessment, and Standards

If the stage is provided by simulation, then the screenplay is provided by debriefing: it is the required mechanism that transforms experience into learning and transfers into practice. Debriefing is the “heart” of simulation-based learning, connecting experience to transfer (Dreifuerst, 2009; Shinnick et al., 2011). Different evidenced-based methods—Plus-Delta, GAS, Advocacy–Inquiry, PEARLS, and DML—all share something common: structured, psychologically safe reflection moderated by trained facilitators (American Heart Association, 2010; Bradley, 2019; Cheng et al., 2016; Dreifuerst, 2012, 2015; Fanning & Gaba, 2007; INACSL Standards Committee, 2016, 2021; Rudolph et al., 2007). Supplemental strategies like faculty re-enactment videos may complement debriefing bringing to the surface moments critical to analysis (Dudas & Wheeler, 2020). Supplemental strategies like faculty re-enactment videos may complement debriefing bringing to the surface moments critical to analysis (Dudas & Wheeler, 2020).

Assessment, too, must also conform to the same principle of alignment. Measurement must be aligned either with the desired outcome: LCJR on the clinical judgment, CCEI on the competency areas, SDS and DMLES on the observed design and reflective dialogue, SET-M on the affective outcomes, and DASH on the quality of the debriefing (Adamson et al., 2012; Bradley & Dreifuerst, 2016; Simon et al., 2010–2018; Todd et al., 2023). Psychometric rigor,

Table 1. Instrument–Outcome Alignment

Intended outcome	Primary instrument(s)	Typical use notes
Clinical judgment / reasoning	LCJR (Lasater Clinical Judgment Rubric)	Tracks noticing–interpreting–responding–reflecting; pair with DML debrief.
Competency domains (assessment, communication, safety)	CCEI (v2.0)	Scenario-embedded competency ratings; ensure rater training (Todd et al., 2023).
Debriefing quality (facilitator behaviors)	DASH (rater version)	Calibrate faculty; use to improve debrief consistency (Simon et al., 2010–2018).
Design quality / learner perceptions	SDS; DMLES	SDS for scenario design features; DMLES for reflective dialogue quality.
Affective outcomes (confidence, satisfaction)	SET-M	Useful for program evaluation and affective tracking.

as well as rater expertise, becomes a requirement, particularly where high stakes are concerned (Kardong-Edgren et al., 2017; Rutherford-Hemming et al., 2014).

In summative contexts, treat rater calibration and periodic inter-/intra-rater checks as non-negotiable (Kardong-Edgren et al., 2017; Rutherford-Hemming et al., 2014).

6. Implementation, Equity, and Policy Translation

Although the evidence base for the educational value of simulation is robust, its conversion to sustainable practice hinges on institutional preparedness, budgeting, and regulatory affirmation. The NCSBN National Simulation Study provided definitive proof that substituting up to 50% of clinical hours with high-fidelity simulation does not harm NCLEX outcomes or readiness for practice (Hayden, Keegan, et al., 2014; Hayden, Smiley, et al., 2014), a conclusion that framed subsequent accreditation (AACN, 2021) and policy paradigms. Supplemental quasi-experimental research suggests that simulation-based instruction has the potential to prevent short-term postlicense learning loss among prelicensure groups (Alshammari et al., 2025). The NCSBN National Simulation Study changed the perception about simulation, transforming it from being considered an adjunct strategy to being recognized as a viable partial Clinical alternative that can be used with fidelity.

Achieving such integration, however, is resource-intensive. A national UK survey highlights that organizational readiness—including leadership support, faculty digital competence, and adequate resources—is decisive for successful adoption (Abdulmohdi et al., 2025). Programs require substantial capital investment in manikins, VR systems, audiovisual equipment, and physical lab space, as well as ongoing expenditures for maintenance, moulage, licensing, staffing, and time to support prebriefing–scenario–debriefing cycles (INACSL Standards Committee, 2016; Jeffries et al., 2015; Pauly-O’Neill et al., 2013). A national survey in the UK highlighted organizational readiness—encompassing leadership support, faculty digital competence, and adequate resources—as a decisive factor in successful adoption (Abdulmohdi et al., 2025). Faculty development is particularly critical: educators must be proficient not only in scenario design and facilitation but also

in debriefing and assessment literacy (Oermann et al., 2016; Rizzolo et al., 2015). Faculty-led action research in Oman illustrates how capacity can be systematically strengthened, with educators co-developing mental health nursing simulation frameworks that improved student confidence while simultaneously enhancing faculty readiness and innovation (Valsaraj et al., 2025).

Technological developments contribute additional complexity. Immersive VR/AR review studies report usability, realism, and learner satisfaction gains, early AR-inclusion designs showing viability in health-care practice applications (Carlson & Gagnon, 2016), yet also report anxiety, dizziness, and navigation problems, necessitating careful prebriefing and scaffolding to optimize benefit (Y. Lee et al., 2020; Park et al., 2024; Saab et al., 2021, 2022; Verkuyll & Hughes, 2019). Time-bound, structured formats, including two 60-minute VR-PBL sessions spread over two weeks, have been effective for specific competencies, indicating pragmatic dosage paradigms for time-limited lab-bound curricula (J. S. Lee & Son, 2023). Short-term VR-based knowledge gains are hinted at through trial evidence, authors citing cost-effectiveness, scalability trade-offs compared to other methodologies (Kiegaldie & Shaw, 2023). Gamification has also been trialed, high faculty and student perception, validated measures for assessment, and gains in confidence attributed to previous training, being reported through mixed-methods research. However, obstacles such as policy voids, inadequate IT support, and limited educator preparation persist (Kotp et al., 2025).

This sudden shift to online and distant simulation has brought to the fore its range of challenges. Students most commonly mention internet stability (Jiménez-Rodríguez et al., 2020; Yehle, 2011), technical and usability challenges (H. Y. Kim et al., 2021), and negative consequences like motion sickness (Saab et al., 2021, 2022). Others find online simulations unfriendly or unreal (Chang & Lai, 2021; Yehle, 2011) or necessitating exceptional self-discipline and specialized hardware (Egilsdottir et al., 2021; Foronda et al., 2016). Educators also report obstacles, such as restricted digital expertise, pressures of the working schedule, as well as problems remaining engaged within virtual worlds (Egilsdottir et al., 2022; Scott et al., 2021; Stanley et al., 2018). These results affirm the INACSL Standards’ plea for learner-focused, inclusive simulation designs that are mea-

sured with multiple stakeholder input (INACSL Standards Committee, 2021).

Equity considerations present an added dimension. In low- and middle-income countries (LMICs), high-fidelity technologies could be financially or logistically unaffordable. Lower-cost task trainers, standardized patients, regional simulation centers, and bandwidth-sensitive virtual sites are more affordable options (Robinson et al., 2024). In Bangladesh, simulation has been suggested as an attractive strategy to compensate for deficits in skilled faculty and infrastructure, but this hinges on capacity-building and policy-level investments (Islam, 2025). Even among high-income countries, disparities based on the availability of devices or internet access or digital proficiency persist (Stenseth et al., 2025; Umphrey et al., 2024). Cultural adaptation of scenarios, debriefing techniques, and fidelity expectations is also necessary to foster psychological safety and contextual appropriateness (Vincent et al., 2015). Equity, then, is also about culturally appropriate design as well as workforce building to make simulation inclusive in diverse settings.

Interprofessional integration also reveals the divide between potentiality and practice. Research evidences that interprofessional simulation enhances teamwork, communication, and role understanding (Collaborative, 2016; Hodgkins et al., 2020; Palaganas et al., 2013; Sezgin & Bektaş, 2023; Reeves et al., 2017; Miller et al., 2012). However, scheduling issues, entrenched hierarchies, and incompatible curricula often limit actualized practice. Achieving the promise of interprofessional learning through simulation necessitates intentioned coordination across discipline lines and organizational dedication to eliminating silos.

Finally, longitudinal and ethical dimensions are underexplored but increasingly recognized. It is possible to employ simulation to build ethical competence, although budget constraints more often than not relegate these objectives to afterthoughts. Qualitative findings released recently highlight the contribution that strategy augmented by simulation can make to substantially integrating curricula with meaningfully infused ethics, so professional values as well as technical, relational competence are developed (Rasesemola & Molabe, 2025). Longitudinal integration across the continua also comes into consideration: among postgraduate critical care as well as anesthesia nurses, embedded before, during, as well as after placements, a set of simulations enhanced readiness as well as reflective learning, although anonymous teams as well as technological limitations may hamper participation (Sjöberg et al., 2025). Evidence such as this implies that optimum outcomes result where simulation is implemented as iterative, vertically aligned experiences that occur longitudinally, rather than as stand-alone events.

Taken together, these results suggest that the transposition of simulation into sustainable pedagogic practice depends as much on demonstration of effectiveness as on realities about resources, faculty preparedness, digital infrastructure, cultural climate, and supportiveness of policies. Without these points of integration, simulation is at risk of remaining an attractive, if haphazardly available,

pedagogy, instead of a transformational, universal, pedagogy.

7. Future Directions and Research Gaps

Next generation simulation-based research in nursing must move beyond modality comparison to mechanism-sensitive, context-aware research that informs stronger practice as well as evidence. A promising path forward is the integration of adaptive and AI-augmented simulation platforms, that will be able to adapt difficulty to the learner, as well as build analytics-informed debriefing commensurate with competency-based designs. Such approaches would be able to push up personalization as they provide the faculty member with objective measures to inform assessment.

Another parallel frontier is in the designs that combine manikins, standardised patients, and immersive AR/VR environments as part of multimodal designs. Multimodal designs hold the potential to combine technical realism with relational authenticity, both being limitations of single-modality simulations (Y. Lee et al., 2020; Park et al., 2024). In order to interpret results across such heterogeneous designs, standardised core outcome sets in competencies like clinical judgement, teamwork, and patient safety are much needed. Based on anchors like Jeffries' theory on simulation (Jeffries et al., 2015) and Kirkpatrick's (2015) evaluation framework, the heterogeneity also would be minimised, making the studies more comparable. Recent revisions to the Healthcare Simulation Standards of Best Practice distill the best current evidence into actionable criteria ready for implementation, which also guide the faculty development as well as the programme improvement (Decker et al., 2025).

Cost-effectiveness and scalability are also under-investigated, most notably in low- and middle-income countries where faculty expansion must move in tandem with technological rollout. Longitudinal studies also are required to determine if gains in simulation generalize to Kirkpatrick Levels 3 and 4 patient outcomes, a gap consistently found in the literature (Oermann et al., 2016). Mechanism-based designs—the such as problem-based learning using simulation or self-paced designs such as MAES©—deserve more research to determine more clearly how these modalities support critical thinking, motivation, and professional identity (Arizo-Luque et al., 2022; M. N. Lee et al., 2017; Roh & Kim, 2015).

Ultimately, newer innovations like gamification need sophisticated evaluation paradigms and organizational policies that positive learner perception yields tangible competencies (Kotp et al., 2025; Sanz-Martos et al., 2024). No less important is context-aware roll-out. In LMICs, simulation needs to be aligned with country-level policy emphases and local workforce realities, frequently through low-cost, locally adapted designs. Dual-profile strategies—in this case, person-centered care paradigms augmented through simulation—demonstrate the balancing act that aligning pedagogy and environment simultaneously drives forward equity as well as instruction innovation (Islam, 2025; Temple et al., 2025).

8. Practice Implications (What Educators Can Do “Monday Morning”)

To the teacher, the first task is alignment of objectives, features, and assessment instruments. In practice, this is identification of the terminal point desired—a conclusion of judgment, a demonstration of technical competence, or statement about affective confidence—and then choosing the proper fidelity level, scenario setting, and vetted instrument best measuring this terminal point. Instruments like the LCJR for judgment, the CCEI for competency areas, or the SET-M for confidence and satisfaction must be aligned intentionally with scenario intentions rather than appended posthoc.

Equally important is scenario construction itself. Science indicates that short, narrowly framed sessions of 15–20 minutes, accompanied by specific goals, yield concrete improvements in knowledge and performance (Koçan et al., 2024; J. S. Lee & Son, 2023). Such outcomes are fortified where scenarios are embedded within formalized debriefing. Approaches such as PEARLS, the Debriefing for Meaningful Learning framework, or advocacy–inquiry provide the reflective facilitation required to enable learners to convert experience into practice, while tools such as DASH help instructors monitor and preserve facilitator quality (Dreifuerst, 2012; Simon et al., 2010–2018).

Designs of simulation also need to advance in complexity. Starting practice at low- or medium-fidelity gives learners the opportunity to practice core skills, then they may proceed to high-fidelity, integrated, or even interprofessional scenarios that require coordination as well as higher-order judgment. At each point, the measurement of affective outcomes needs careful consideration. Prebriefing, as well as structured orientation, may help alleviate anxiety, and safety psychologique, self-determination, as well as reflection opportunities, foster persistence as well as confidence. Tools like the SET-M enable educators to quantify these dimensions of affect programmatically.

Third, considerations of equity are necessary so that simulation is not restricted to the settings that are richly endowed. Pooled scenario banks, bandwidth-sensitive VR platforms, and low-cost standardized patients are pragmatic approaches to making wider access possible where the high-fidelity equipment is not affordable. By placing equity as equal to design rigor, educators will be able to spread the advantage of simulation across various institutional as well as cultural settings, making it a genuinely inclusive pedagogic approach.

Simulation-based education is a core part of nurse education with strong evidence to support improvement in knowledge, skills, and learner confidence. Best effects are achieved when modality–objective alignment, proper fidelity, effective debriefing, and validated tests are combined. Following the NCSBN research, policy and accreditation can be used to facilitate significant substitution of clinical hours under stringent quality constraints. Following steps are next required, including standardized framework measures, longitudinal studies of transfer, cost-effectiveness, and equity-influenced innovations—in particular,

where resources are constrained (Hayden, Keegan, et al., 2014; Hayden, Smiley, et al., 2014; INACSL Standards Committee, 2016, 2021; J. Kim et al., 2016; Ma et al., 2023; Shin et al., 2015).

Recent research also suggests the future potential of immersive technologies for knowledge, self-efficacy, motivation, and performance (Y. Lee et al., 2020; Park et al., 2024; Yahya et al., 2024) and PBL-aligned and self-directed simulation as effective ways to improve motivation and higher-order thinking (Arizo-Luque et al., 2022; M. N. Lee et al., 2017; Roh & Kim, 2015), answering previous conflicting outcomes for critical thinking. These advances suggest that simulation enters a newer era—not justified simply as a trade-off for equivalent clinical hours, but as a result of its potential to deliberately support higher-order competencies, professional identity, and resilience within complex care settings.

In the future, the challenge is twofold: to offer rigorous, standardized outcomes assessment across multiple modalities, and to conceive cost-effective, contextualized models that facilitate access to simulation around the world. If achieved, simulation would be not only an effective teaching tool, but also a policy instrument to enhance equity, safety, and workforce readiness in nurse programs.

Conflict of Interest / Competing Interests

The authors declare no competing or conflicting interests.

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