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Learning and Autonomy in Clinical Simulation: an Integrative Conceptual Framework

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Abstract

Clinical simulation can integrate knowledge, skills, communication, emotions, and decision-making within a protected environment. However, its educational value is not guaranteed by simulator fidelity or scenario complexity. This article analyzes and integrates theoretical frameworks that explain the transition from supported performance to progressively autonomous clinical action. A conceptual narrative review combined foundational works on the zone of proximal development, scaffolding, cognitive load, experiential learning, reflective practice, skill acquisition, deliberate practice, and social cognitive theory with contemporary evidence and best-practice standards in simulation. The synthesis indicates that learning depends on the calibration among challenge, prior knowledge, cognitive and emotional resources, faculty support, and opportunities for reflection and renewed practice. Based on this integration, a five-moment framework is proposed: diagnosis of the learner's developmental level; preparation and prebriefing; simulated experience with contingent scaffolding; reflection and conceptualization through debriefing; and renewed practice and transfer. The framework is neither a linear protocol nor a validated model, but a heuristic to guide instructional decisions and adapt support to learners' progression. Its main contribution is to shift attention from technology to instructional coherence. Clinical autonomy is more likely to develop when simulation design reduces extraneous load, maintains productive difficulty, protects psychological safety, links feedback to performance criteria, and provides repeated opportunities to apply learning.

Keywords (MeSH): Simulation Training; Learning; Self-Efficacy; Clinical Competence; Professional Education.

Key Ideas

- Technological fidelity and scenario complexity alone do not guarantee deep learning; their effect depends on alignment among learning outcomes, prior experience, cognitive demands, and instructional support.
- The article's contribution is a five-stage conceptual framework that integrates level assessment, prebriefing, simulation experience with contingent scaffolding, debriefing, and subsequent practice oriented toward transfer.
- Clinical autonomy is fostered when the challenge is productive, psychological safety is protected, feedback is linked to performance criteria, and support is gradually reduced.
- The proposal is derived from a conceptual narrative review, is supported predominantly by evidence obtained from students, and requires empirical evaluation before being used as a prescriptive model.

Introduction

The education of healthcare professionals requires the integration of disciplinary knowledge, technical skills, communication, clinical judgment, and emotional regulation. These capabilities must be mobilized in uncertain situations involving incomplete information and potentially consequential outcomes for other people. Clinical simulation provides a protected environment in which learners can practice, repeat procedures, analyze errors, and receive feedback without exposing patients to the risks associated with initial learning. Recent syntheses demonstrate favorable effects of simulation on knowledge, performance, and decision-making, although considerable heterogeneity exists across interventions, populations, and assessment methods [1,2]. This variability highlights that participation in a simulation does not, by itself, guarantee deep learning. A scenario may be technologically sophisticated while simultaneously being poorly aligned with learning outcomes, requiring actions for which the learner lacks sufficient prior knowledge, or generating an emotional burden that prevents meaningful analysis of performance.

Educational literature provides complementary explanations for these phenomena. The sociocultural perspective helps explain how assistance from instructors and peers expands what learners are able to accomplish. Cognitive load theory explains the limitations involved in processing new information. Experiential learning and reflective practice demonstrate how an experience can be transformed into knowledge. Skill acquisition models and deliberate practice describe conditions that support performance improvement. Social cognitive theory provides a framework for examining modeling, self-efficacy, and self-regulation. In simulation, these frameworks are often cited separately, making it difficult to translate them into coherent decisions regarding instructional design and facilitation.

In this article, clinical autonomy is understood as the progressive capacity to mobilize knowledge and skills, make informed decisions, monitor and adjust one's own performance, recognize the limits of competence, and seek support when appropriate. It does not mean acting without supervision or dispensing with interprofessional collaboration; rather, it represents graduated autonomy that is consistent with the learner's level of competence and the risk associated with the activity [3].

The objective of this article is to analyze and integrate these theoretical foundations and propose a conceptual framework to guide the transition from dependent performance toward progressively autonomous clinical practice. The central thesis is that the educational quality of a simulation depends more on the calibration among challenge, support, cognitive load, psychological safety, reflection, and subsequent practice than on the amount of technology incorporated.

Methods

This work is an analysis article based on a conceptual narrative review rather than a systematic review. Foundational works in learning psychology and adult education were intentionally selected and complemented with contemporary literature on clinical simulation, cognitive load, psychological safety, debriefing, skill acquisition, self-efficacy, and graduated autonomy.

The contemporary search was updated on July 31, 2026, using PubMed/MEDLINE, Scopus, ERIC, and Google Scholar. For recent evidence, publications from January 2020 to July 2026, in Spanish or English, were prioritized. The terms clinical simulation, simulation-based education, cognitive load, zone of proximal development, scaffolding, instruction, guidance, deliberate practice, self-efficacy, graded autonomy, psychological safety, prebriefing, and debriefing, together with their Spanish equivalents, were combined. The Healthcare Simulation Standards of Best Practice from the International Nursing Association for Clinical Simulation and Learning were also consulted. Systematic reviews, meta-analyses, scoping reviews, empirical studies directly related to the mechanisms analysed, and normative documents from specialized organizations were prioritized.

Selection was based on conceptual relevance and the ability to explain design or facilitation decisions. RA conducted the search and initial selection; JC and JMA contributed to assessing conceptual relevance and the correspondence between citations and references. No exhaustive screening, formal risk-of-bias assessment, or quantitative synthesis was performed. Therefore, the purpose was not to estimate causal effects or exhaust the available literature, but rather to construct an integrative and explicitly provisional interpretation.

Achievable Challenge, Scaffolding, and Cognitive Load

The zone of proximal development describes the distance between what a person can perform independently and what they can achieve with guidance from someone more experienced or through collaboration with competent peers [4]. Applied to simulation, this perspective requires starting from the learner's actual level: prior knowledge, clinical experience, ability to prioritize, and type of support required. The objective is not to design the most difficult scenario, but to position the activity at a level of challenge that cannot yet be fully resolved independently but remains achievable with mediation.

Scaffolding refers to temporary and appropriately adjusted support that enables progress within this zone [5]. It may take the form of a demonstration, a visible algorithm, a guiding question, role clarification, a pause, a clinical cue, or modeling of reasoning. Its defining characteristic is contingency: support is related to the difficulty observed and is withdrawn as competence increases. A scoping review of 90 studies showed that support during simulation can come from human or computer-based tutors and may include verbal guidance, checklists, modeling, step-by-step guides, pauses, and deliberate practice strategies; it also demonstrated that the reasons, timing, and methods for providing such support are frequently not made explicit [6]. If scaffolding is insufficient, the learner may become stuck in the task; if it is excessive, the learner may follow instructions without understanding or assuming responsibility for decisions.

A common example occurs when a student knows the initial actions required during an obstetric emergency but is unable to prioritize them, coordinate the team, and communicate under pressure. Such integration may lie beyond the student's independent performance while remaining within their capabilities when timely cues are provided. Groot and colleagues showed that scenarios positioned at the boundary of the zone of proximal development can generate intense emotional and cognitive responses in inexperienced participants; their educational value depends on the availability of support and a subsequent opportunity to understand and reconstruct the experience [7].

Cognitive load theory provides a second criterion for calibration. Working memory has a limited capacity for processing new information; when demands exceed this capacity, learners may lose priorities, omit basic actions, or fail to retrieve knowledge they actually possess [8,9]. Intrinsic load depends on the complexity of the elements involved and the learner's prior schemas. Extraneous load arises from unclear instructions, irrelevant distractors, unintuitive interfaces, or redundant information. Contemporary developments no longer regard effort directed toward schema construction as a separate third type of load; rather, the focus is on reducing unnecessary demands so that resources can be directed toward relevant learning [9].

Complexity, therefore, is not a fixed property of a scenario. An experienced professional organizes data into meaningful patterns; for a novice, each cue may constitute an independent element. The review by Lapierre and colleagues linked design characteristics, repetition, briefing, instructor presence, and feedback with the cognitive load experienced by novice participants [10]. A trial by Tremblay and colleagues showed that task and environmental complexity must be carefully regulated, although students can also develop strategies to manage it [11]. A systematic review of 21 studies published in 2025 found that varying complexity can modify educational outcomes, but rated the certainty of the evidence as very low because of heterogeneity, imprecision, and risk of bias [12]. Evidence on stress during simulation further suggests that neither insufficient activation nor overstimulation uniformly promotes learning [13].

Design should not eliminate all difficulty. An excessively simple task limits development, whereas an unattainable task may result in disorganization and avoidance. Productive difficulty preserves the clinical problem that learners are expected to master while removing obstacles that consume cognitive resources without contributing to the learning objective. This involves segmenting procedures when necessary, familiarizing learners with the environment in advance, gradually introducing distractors, using worked examples, and progressively increasing uncertainty. The facilitator should intervene with the minimum level of assistance necessary to enable the learner to resume thinking and acting independently.
Experience, Reflection, and Deliberate Practice.

Experience does not automatically transform into learning. Kolb's experiential learning cycle integrates concrete experience, reflective observation, abstract conceptualization, and active experimentation [14]. In simulation, the scenario provides the experience; reflection reconstructs decisions, emotions, and consequences; conceptualization connects what occurred with physiology, protocols, evidence, and ethical principles; and subsequent practice allows learners to determine whether their understanding has changed their performance. The cycle serves as a guide rather than a rigid sequence, but it prevents simulation from being reduced to a memorable event without subsequent processing.

Schön distinguished reflection-in-action, which occurs when individuals adjust their behavior while facing an unexpected situation, from reflection-on-action, which subsequently reconstructs the assumptions that guided performance [15]. Debriefing is the primary setting for this second form of reflection. Its purpose is not to recite a list of errors, but to explore which data were noticed, how they were interpreted, what alternatives were considered, and how emotions influenced action.

The systematic review by Duff and colleagues found considerable heterogeneity in debriefing methods and does not support assuming that a single technique is superior across all contexts [16]. The updated INACSL standards emphasize that the process should be planned, linked to learning objectives, and facilitated by a competent individual [17]. Specific and respectful feedback helps make mental models visible; punitive feedback or feedback focused on personal traits may shift attention away from the clinical problem toward protecting one's self-image.

Deliberate practice completes this process. Improvement depends not simply on accumulating hours, but on practicing tasks with specific goals, appropriately adjusted difficulty, conscious effort, feedback, and opportunities for correction [18]. Simulation makes it possible to pause, repeat, and vary a situation without compromising patient safety. Repetition should not be mechanical; it can focus on a difficult component, alternate performance with feedback, and subsequently reintegrate individual components into a complete scenario. Spaced practice and variation across contexts support retention and transfer.

Progressive Competence, Self-Efficacy, and Psychological Safety

Skill acquisition models remind us that educational needs change with experience. Dreyfus and Dreyfus described a progression from a rule-dependent novice toward more situated and integrated forms of performance [19]. Fitts and Posner proposed cognitive, associative, and autonomous phases in motor skill learning [20]. These models are useful as heuristics but should not be interpreted as universal, linear stages or as sufficient to explain all aspects of clinical judgment. An individual may demonstrate fluency in a familiar task and yet require explicit analysis again when faced with a novel situation.

Partial automation of basic components frees attentional resources for communication, monitoring clinical changes, and team coordination. However, fluency should not become mechanical behavior. Safe performance combines automation with the ability to recognize exceptions, review assumptions, and seek assistance. Therefore, learning objectives and assessment criteria should be differentiated according to the learner's level, without expecting a novice to demonstrate the same speed and integration as an advanced participant.

Social cognitive theory adds the reciprocal relationship among person, behavior, and environment. Learning also occurs through observation, modeling, and anticipation of consequences [21]. Instructor demonstrations are more useful when they not only show what to do but also make the reasoning visible: which data are prioritized, what risk is being avoided, and why one intervention is preferable to another. Peers can also serve as models; observing another student ask for help, acknowledge an error, and correct their performance can normalize safe professional behaviors.

Self-efficacy is the specific belief in one's capacity to organize and execute actions in a given situation [22]. It influences goal selection, persistence, and the interpretation of errors. Its sources include mastery experiences, observation of others, verbal persuasion, and interpretation of physiological and emotional states. Simulation can influence all of these sources, but increased self-reported confidence does not necessarily equate to improved performance. The review by Brocker and Scafide showed that the relationship between self-efficacy and skill performance is not uniform [23]. The educational objective is calibrated confidence: recognizing strengths, limitations, and situations in which support is needed.

Psychological safety allows learners to express doubts, take interpersonal risks, and analyze errors without fear of humiliation. It does not imply an absence of challenge or accountability. Prebriefing helps establish objectives, roles, participation rules, confidentiality boundaries, and characteristics of the learning environment. Recommendations from Somerville and colleagues, the meta-analysis by Tong and colleagues, and the INACSL standards highlight its contribution to preparation and participation [24–26]. It may also reduce extraneous cognitive load by resolving logistical uncertainties in advance. However, it should not reveal the cues that constitute the learning problem.

Safety should be maintained throughout both the scenario and the debriefing. Facilitation standards emphasize adapting to the participant, observing performance, and deliberately selecting interventions [27]. Within this environment, self-regulation is strengthened when learners understand the criteria, establish goals, observe their own performance, and adjust their strategies [28]. Autonomy does not mean acting without assistance at any cost; rather, it involves using judgment to decide, monitor, correct, and seek support when appropriate.

Five-Stage Conceptual Framework

The frameworks examined operate at different levels and are not equivalent. Their integration is not intended to construct a new causal theory, but rather to provide a heuristic for organizing instructional decisions. The zone of proximal development helps estimate the level of challenge; scaffolding defines the support; cognitive load theory guides the organization of information; experience and reflection enable meaning-making; deliberate practice supports improvement; and social cognitive theory explains modeling, self-efficacy, and self-regulation.

Based on this synthesis, five interdependent stages are proposed. They do not constitute a fixed protocol: observed performance may require returning to a previous stage, temporarily reducing complexity, or increasing support. Figure 1 represents the cyclical nature of the process, while Table 1 translates each stage into a design question.

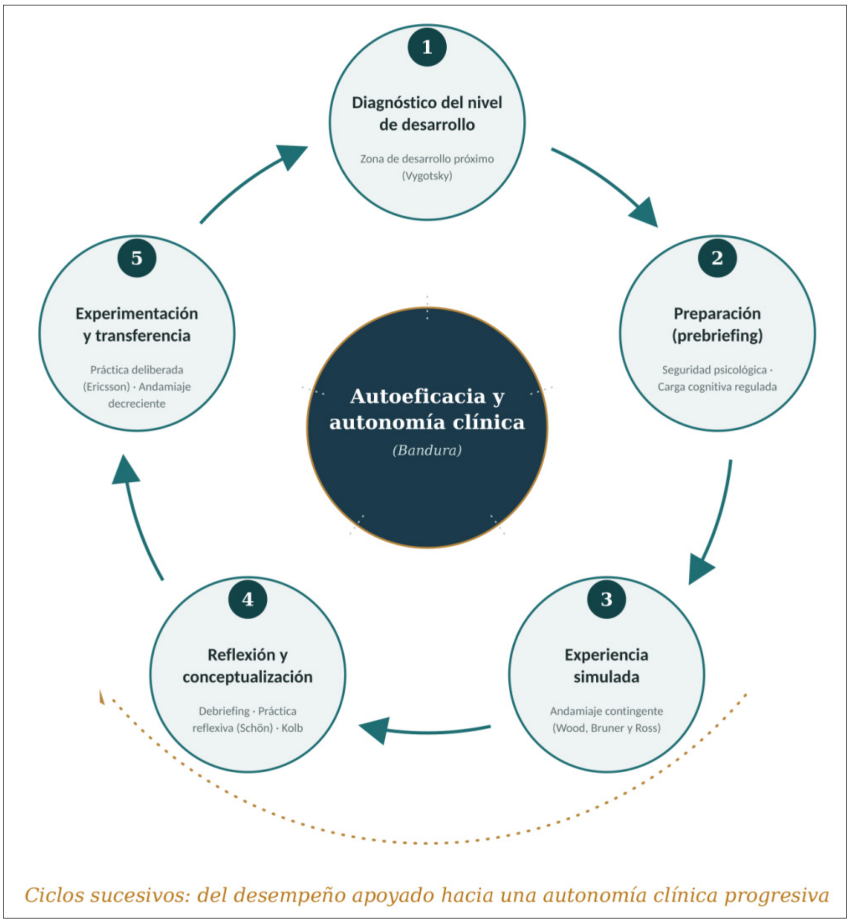

Figure 1: Five-stage conceptual framework for learning in clinical simulation. The central circle represents self-efficacy, self-regulation, and progressive clinical autonomy as educational outcomes; the outer arrow represents successive cycles of practice and adjustment. Source: Developed by the authors.

Table 1: Instructional Questions and Decisions within the Five-Stage Conceptual Framework. Source: Developed by the authors.

Stage	Design Question	Main Instructional Action	Risk to Avoid
1. Level Assessment	What can the learner perform independently and with assistance?	Assess prior knowledge, experience, and initial performance.	A scenario that is too simple or unattainable.
2. Preparation and Prebriefing	What does the learner need to understand before acting?	Clarify objectives, roles, resources, rules, and the fiction contract.	Avoidable anxiety and context-related extraneous cognitive load.
3. Simulation Experience	What level of challenge and support will be productive?	Adjust complexity, observe performance, and intervene with contingent scaffolding.	Cognitive overload, disorganization, or excessive direction.
4. Reflection and Conceptualization	How will decisions and their consequences be interpreted?	Facilitate a structured debriefing and connect the experience with evidence.	Superficial or punitive feedback.
5. New Practice and Transfer	How will learning be verified and generalized?	Repeat the practice, vary the case, space practice sessions, and progressively withdraw support.	An isolated experience without consolidation or transfer.

The first stage is the assessment of the learner's developmental level. It includes determining prior learning, clinical exposure, the ability to perform basic components, and common difficulties. This assessment may be supported by a brief activity, a demonstration, retrieval questions, or evidence of previous performance. Without this assessment, complexity is determined by intuition or by the availability of technology.

The second stage involves preparation and prebriefing. Its purpose is to reduce uncertainties that are not part of the learning objective, establish psychological safety, and focus the learner's attention. The learner should understand what is expected, what resources are available, and how the activity will be conducted, without being given the solution to the clinical problem.

The third stage is the simulation experience. The challenge should be meaningful and achievable. The facilitator observes indicators of reasoning, coordination, and cognitive load and intervenes only when the situation ceases to be productive or when process safety requires it. Support may be planned in advance, but its use should depend on actual performance.

The fourth stage is reflection and conceptualization. Debriefing reconstructs what occurred, explores the frameworks that guided decisions, and connects the experience with clinical knowledge and performance criteria. It also allows learners to interpret stress without automatically equating it with inability.

The fifth stage is new practice and transfer. The learner repeats a component, encounters a variation of the case, or applies the learning in another context. Support is gradually reduced. This stage is essential because a convincing explanation during debriefing does not, by itself, demonstrate that performance has changed.

Discussion and Implications for Educational Practice

The proposed integration shifts the discussion from technological fidelity toward instructional coherence. A simulation with low technological complexity can be pedagogically robust when its objectives, learner level, support, reflection, and assessment are aligned. Conversely, a high-fidelity scenario may produce superficial learning if it adds stimuli without an educational purpose or uses error as a form of public exposure.

The proposal does not seek to replace established frameworks for simulation design and quality. The NLN Jeffries Simulation Theory organizes components such as context, background, design, experience, facilitation, participants, and outcomes [29], while the INACSL standards operationalize requirements for prebriefing, facilitation, and debriefing [17,26,27]. Kolb's cycle explains the transformation of experience into learning [14]. The specific contribution of the five-stage framework is to articulate these components around a dynamic question: how much challenge and how much support does a learner require in each cycle, how should that support be withdrawn, and how can change be verified through subsequent practice? It therefore functions as a complementary heuristic rather than as an alternative protocol or a reformulation of these established models.

The framework makes four tensions visible. The first lies between challenge and overload: learning requires effort, but not all effort contributes to learning. The second concerns support and autonomy: intervening too early may inhibit reasoning, whereas intervening too late may transform difficulty into frustration. The third arises between confidence and competence: self-efficacy is relevant, but it must be calibrated against objective evidence of performance. The fourth occurs between standardization and adaptation: objectives and criteria should be explicit, while support needs to be adjusted to specific individuals and moments.

These tensions reinforce the role of the educator as designer, mediator, and facilitator. Clinical experience is necessary for constructing authentic situations, but it is not sufficient to guide learning. Training in instructional design, cognitive load, observation, feedback, psychological safety, and debriefing is also required. The educator also models a professional culture: the way uncertainty is acknowledged, errors are addressed, and explanations are requested communicates what is understood as safe practice.

Six recommendations emerge from the proposal. First, assess the learner before determining complexity. Second, define observable learning outcomes and eliminate components that do not contribute to them. Third, anticipate possible forms of support and criteria for withdrawing them without turning the scenario into a directed sequence. Fourth, establish psychological safety during the prebriefing and maintain it throughout the experience. Fifth, design the debriefing to examine reasoning, emotions, and alternatives rather than simply correcting actions. Sixth, include subsequent practice and assess knowledge, performance, and self-efficacy separately.

The proposal has limitations. The selection of sources was narrative and may reflect availability and interpretive biases. The integrated frameworks originate from different traditions, and their articulation has not been empirically validated as a whole. A substantial proportion of the contemporary evidence comes from nursing students and undergraduate programs; therefore, transferability to other professions, postgraduate education, or continuing education requires caution. In addition, evidence regarding scenario complexity is heterogeneous and has very low certainty [12], and the framework does not comprehensively incorporate organizational and cultural factors, summative assessment, or interprofessional practice. Future research should examine its feasibility, content validity, relationship with cognitive load and performance, and usefulness for facilitator training.

Conclusions

Learning in clinical simulation emerges from the interaction among knowledge, emotion, action, and context. Autonomy does not result from exposure to increasingly complex scenarios, but from cycles in which the challenge is adjusted to the learner's level, support is provided contingently, the experience is interpreted, and performance is tested again.

The proposed five-stage framework organizes this process into assessment, preparation, simulation experience, reflection, and new practice. Its value lies in guiding design questions rather than prescribing a rigid sequence. The quality of a simulation depends on the coherence among learning objectives, cognitive load, psychological safety, instructional mediation, feedback, and opportunities for transfer. The ultimate goal is not simply to complete an isolated scenario successfully, but to develop clinical judgment, self-regulation, and calibrated confidence to act progressively and autonomously, reflectively, and safely with real people.

Notes

Author Contributions: RA: conceptualization, methodology, investigation, literature curation, writing of the original draft, review and editing, supervision, and project administration. JC: investigation, validation, and critical review of the manuscript. JMA: investigation, validation, and critical review of the manuscript. All three authors approved the final version and assume responsibility for its content.

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Protocol Registration

Not applicable, as this is an analysis article based on a narrative review.

Ethical Considerations

Ethics committee approval was not required because the article did not involve participants, interventions, or individual-level data.

Data Availability Statement

Not applicable; the article did not generate or analyze original datasets.

Artificial Intelligence Use Statement

ChatGPT (OpenAI; GPT-5.6 Thinking model) was used during the manuscript revision stage to support structural reorganization, stylistic editing, translation of the abstract into English, and formal standardization of the references. The scientific content and references were fully reviewed and verified by the authors, who assume full responsibility for the final version.

Preprint

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