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GAMIFICATION AND CLINICAL SIMULATION IN UNDERGRADUATE EMERGENCY MEDICAL EDUCATION: AN INTEGRATIVE REVIEW OF OUTCOMES

Geovanna de Castro Feitosa, Rodolfo de Oliveira Medeiros,
Viviane Canhizares Evangelista de Araújo, Cristiano Machado Galhardi,
Giovana Cortez Rodolpho, Isabela Greggio Ferreira, Fernanda Moerbeck Cardoso Mazzetto,
Maria José Sanches Marin, Beatriz Massagli Soeiro, Camila Menon Oliveros,
Julia Mel de Moraes Ximenes, Gabriela Modolin Arroteia, Camila Petersen de Carvalho,
Heloísa Ragda Lourenço, Giovana Pietronte Moreira, Maria Eduarda Brito Muniz de Oliveira,
Mariana Victor Tudisco, Kelly Cristina Encide de Vasconcelos Donadai, Lívia Faria Orso,
Sílvia Helena Soares Gianini, Gabriela Henrica Abu Kamel Gazetta, Adriana Porto Nunes Gazetta

geovannafeitosa10@hotmail.com, rodolfomedeiros@unimar.br, vi.evangelista@unimar.br,
drgalhardi@outlook.com, giovanacortezrodolpho@gmail.com, isabelagreggioferreira@gmail.com,
Fernandamazetto4@gmail.com, marnadia@terra.com.br, bea.msоеiro@gmail.com, cmo1406@gmail.com,
juliamelximens579@gmail.com, gabimodolin@gmail.com, camilapetersendecarvalho20@gmail.com,
ragdaheloisa@gmail.com, gipietronte@hotmail.com, mariaeduarda.britomed@gmail.com,
marianavictud@hotmail.com, kelly_encide@yahoo.com.br, liviaorso@unimar.br,
silgianini@hotmail.com, gabihenrica@gmail.com, apngazetta@gmail.com

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ABSTRACT

Introduction: Undergraduate Emergency Medicine education requires innovative methodologies that enhance the acquisition of clinical competencies and student engagement. Clinical simulation and gamification are emerging strategies with promising applications in this context. **Method:** This Integrative Literature Review was conducted through a systematic search in the PubMed, Scopus, Web of Science, ERIC, and SciELO databases, including publications from 2020 to 2025 in English, Portuguese, and Spanish. Empirical studies investigating the use of clinical simulation and gamification in Emergency Medicine education and evaluating their pedagogical and clinical impacts were selected. **Results:** A total of 20 studies were included, demonstrating the effectiveness of clinical simulation in promoting active learning, formative assessment, and the development of technical and interpersonal skills. Gamification was found to be effective in increasing motivation, personalizing learning, and facilitating the integration of complex content, although contextual implementation remains challenging. **Discussion:** Clinical simulation stands out as an essential tool for students' integral development by combining technical and ethical dimensions. Gamification, in turn, enhances the attractiveness and adaptability of the educational process but requires solid pedagogical grounding and curricular alignment. Methodological limitations and the need for longitudinal studies were identified. **Final considerations:** The findings highlight the transformative potential of these methodologies for medical education, emphasizing the importance of their reflective and structured incorporation into curricula. Investment in faculty development and further research is recommended to deepen the understanding of the real impact of these strategies on clinical practice.

Keywords: Clinical simulation. Gamification. Medical education. Emergency Medicine. Integrative review.

1 INTRODUCTION

Contemporary medical education has undergone curricular transformations that challenge traditional models centered on the vertical transmission of knowledge (Alharbi, 2024). The growing emphasis on competency-based education and active learning requires medical schools to adopt pedagogical strategies capable of promoting student agency, clinical reasoning, and decision-making in realistic and complex scenarios. In this context, Emergency Medicine education emerges as one of the greatest training challenges due to its practical, critical, and unpredictable nature (Lopes *et al.*, 2024; Cevik *et al.*, 2024).

The need to prepare medical students for high-complexity clinical situations, often under time pressure and with imminent risk of death, places upon educators and curriculum managers the task of developing instructional tools that go beyond theoretical frameworks and approximate real-world healthcare settings (Rafi, Habibi & Kalantarion, 2025). Within this scope, clinical simulation and gamification have emerged as innovative methodologies with strong potential for developing both technical and non-technical skills, as well as fostering engagement, autonomy, and critical thinking (Salafia & Perez-Ochoa, 2025; Gue, Ray & Ganti, 2022).

Simulation allows students to experience, in a controlled environment, scenarios that realistically replicate medical practice, enabling safe pedagogical errors, formative assessment, and the consolidation of problem-based learning (Elendu *et al.*, 2024). Gamification, in turn, incorporates game elements (challenges, scores, rankings, instant feedback) into the educational process, making it more dynamic, participatory, and aligned with the learning profiles of newer student generations (Van Galen *et al.*, 2021; Huang, Loid & Sung, 2024). Both strategies have been implemented in various medical schools worldwide, yet their results and methodological approaches still require critical systematization (Najafi *et al.*, 2025).

Given this context, the objective of the present study is to conduct an Integrative Literature Review on the use of gamification and clinical simulation in undergraduate Emergency Medicine education, focusing on their impact on clinical competence development and student engagement.

2 METHOD

This is an Integrative Literature Review (ILR), a methodological approach that allows the inclusion of various research designs in order to gather, synthesize, and critically analyze the scientific production on a given topic. Grounded in the principles of Evidence-Based Practice, this method aims to construct robust knowledge that is useful both for professional practice and for the formulation of educational policies (Lemes *et al.*, 2021; Ganong, 1987; Lockwood, Munn & Porritt, 2015).

To ensure methodological rigor, the review followed the systematic steps described in the literature, including: (1) identification of the research problem; (2) definition of inclusion and exclusion criteria; (3) database search; (4) evaluation of

selected studies; (5) analysis and synthesis of findings; and (6) presentation of results. The guiding research question was constructed using the PICO strategy (Stern, Jordan & McArthur, 2014), considering: P (medical students), I (gamification and clinical simulation strategies), and Co (Emergency Medicine education). The formulated question was: How do gamification and clinical simulation methodologies impact Emergency Medicine education in undergraduate medical training?

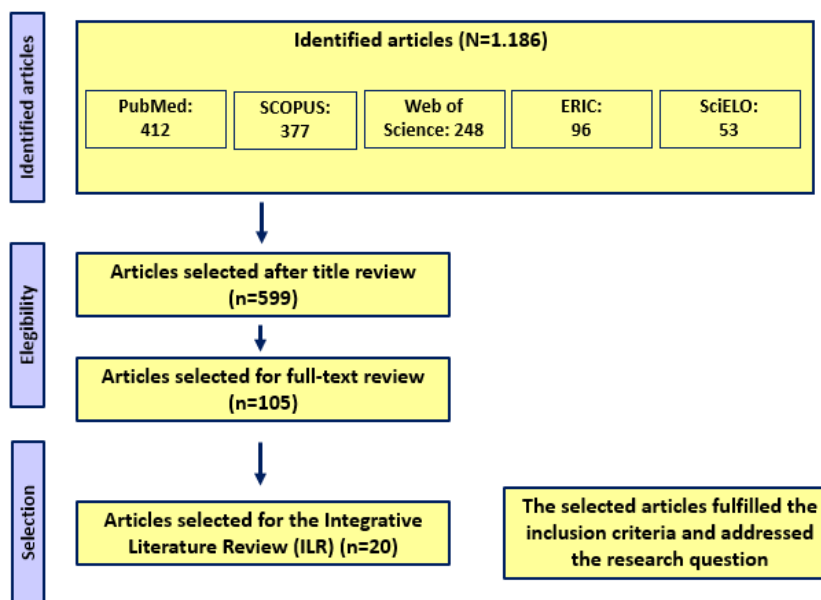
The search was conducted in the PubMed, Scopus, Web of Science, ERIC, and SciELO databases, using the descriptors “simulation-based learning,” “gamification,” “emergency education,” “medical education,” “clinical competence,” and “student engagement,” combined using Boolean operators. Studies published between 2020 and 2025 in English, Portuguese, or Spanish were included, provided they presented empirical research (quantitative, qualitative, or mixed methods). Opinion papers, editorials, and duplicated reviews were excluded. Data were extracted and organized in a synthesis table including: article title and author, journal and year, type of study and level of evidence, target population/context, and main findings and contributions to pedagogical practice.

The data collection stage was systematized through the construction of a synthesis table covering the following variables: article title and journal of publication, main author and year, country of origin and language, methodological design/level of evidence, and general objective of the study. The classification of levels of evidence followed the Joanna Briggs Institute (JBI) guidelines, as per the following hierarchy: Level I: evidence from meta-analyses, randomized controlled trials, and controlled studies; Level II: evidence from experimental studies; Level III: evidence from quasi-experimental studies; Level IV: evidence from descriptive studies; Level V: evidence from case reports or practical experiences; Level VI: evidence based on expert opinion (Lockwood *et al.*, 2020).

A systematic search in the selected databases resulted in the identification of 412 articles in PubMed, 377 in Scopus, 248 in Web of Science, 96 in ERIC, and 53 in SciELO, totaling 1,186 studies. All records were exported to the EndNote X9 reference manager, which was used for organizing and managing citations, as well as supporting the screening process and the exclusion of duplicate studies in subsequent steps.

Continuing the screening process, the titles of the 1,186 articles identified in the selected databases were reviewed based on the previously defined inclusion and exclusion criteria. This stage resulted in the selection of 599 studies, of which 105 were deemed eligible for full-text reading. After a thorough analysis of the full texts, 85 articles were excluded for not meeting the proposed methodological design, for being outside the thematic scope of the study, or for being secondary studies, editorials, or experience reports. At the end of the process, 20 studies fully met the established criteria and were included in the present Integrative Literature Review.

Figure 1. Flowchart of the selection process for studies included in this Integrative Review



Adapted from: Moher *et al.*, 2009

3 RESULTS

After applying the search and selection criteria, 20 studies published between 2020 and 2025 were included, retrieved from the PubMed, Scopus, Web of Science, ERIC, and SciELO databases. Regarding methodological design, the majority were primary quantitative studies (65%), followed by qualitative (5%) and mixed-method studies (5%). Systematic and scoping reviews accounted for 25% of the analyzed studies. The target population consisted mainly of undergraduate medical students (85%), with some studies including faculty members and residents (15%). The analyzed studies address various applications of gamification and clinical simulation in Emergency and Urgent Care education. Key research focuses include the impact of these strategies on the development of both technical and non-technical clinical competencies (Costa *et al.*, 2020; Mahling *et al.*, 2023), their influence on student engagement and motivation (Gue, Ray & Ganti, 2022; Van Gaalen *et al.*, 2021), and formative assessment mediated by these methodologies (Salafia & Perez-Ochoa, 2025). Furthermore, gaps were identified regarding methodological variability, a lack of longitudinal studies, and the challenge of measuring long-term impacts on real clinical practice (Najafi *et al.*, 2025; Suazo *et al.*, 2025). Below, the summary table presents the studies included in this review, outlining their main methodological characteristics and contributions to Emergency and Urgent Care education.

Table 1. Summary of the studies included in the integrative review on gamification and simulation in emergency and urgent care education

Article Title / Main Author	Journal / Country of Origin	Language / Year of Publication	Method / Level of Evidence	Main Findings / Contributions to the Topic
The impact of simulation-based training in medical education / Elendu, C.	Medicine / United States	English / 2024	Descriptive study / Level IV	There is evidence that simulation-based training significantly improves students' clinical competence and confidence in simulated medical environments.
Game-based educational experience in clinical simulation and academic achievement in medical students / Salafia, M. A.	BMC Medical Education / United Kingdom	English / 2025	Quantitative study / Level IV	Game-based educational experiences applied to clinical simulation were associated with better academic performance, suggesting a positive impact on engagement and learning among medical students.
Simulação clínica no desempenho cognitivo, satisfação e autoconfiança na aprendizagem: estudo quase-experimental / Costa, R. R. O.	Acta Paulista de Enfermagem / Brazil	Portuguese / 2020	Quasi-experimental study / Level III	Clinical simulation demonstrated that nursing students learn more effectively through this experience compared to traditional teaching methods. Cognitive performance and self-confidence showed significant improvement among students.
Virtual Reality for Emergency Medicine Training in Medical School: Prospective, Large-Cohort Implementation Study / Mahling, M.	Journal of Medical Internet Research / Canada	English / 2023	Quantitative study / Level IV	Virtual reality-based simulation was useful in identifying students' difficulties and insecurities. It was considered not only an alternative to mannequins, but also a facilitator in acquiring complex competencies.
Gamification of graduate medical education in an emergency medicine residency program / Gue, S.	International Journal of Emergency Medicine / United Kingdom	English / 2022	Descriptive study / Level IV	A significant increase in motivation, engagement, and student learning was observed when gamification was adopted, which may contribute to better performance in certification exams and patient care.

Gamification of health professions education: a systematic review / Van Gaalen, A. E. J.	Advances in Health Sciences Education / Germany	English / 2021	Systematic review / Level I	Gamification contributes to improved learning and behavior among healthcare professionals through the diverse attributes embedded in games.
Gamification in critical care education and practice / Bass, G. A.	Critical Care Explorations / United States	English / 2024	Descriptive study / Level IV	Gamification engages students both visually and cognitively, fostering new skills and knowledge in a simulated environment. Correct decision-making is practiced individually and in teams, with a focus on enhancing collaborative work.
Gamification in midwifery education: a systematic review / Najafi, T. F.	BMC Medical Education / United Kingdom	English / 2025	Systematic review / Level I	Gamification-based education supports the improvement of students' practical skills in obstetrics. The games include various scenarios and aspects of care, and are more accepted by students compared to traditional methods.
Caution with competitive gamification in medical education: unexpected results of a randomised cross-over study / Kirsch, J.	BMC Medical Education / United Kingdom	English / 2023	Randomized study / Level II	Clinical simulation games allowed students to recognize their skill-based difficulties during risk-related practices. Although considered challenging, in this group it did not foster long-term intrinsic motivation.
A targeted systematic review of cost analyses for implementation of simulation-based education in healthcare / Hippe, D. S.	SAGE Open Medicine / United States	English / 2020	Systematic review / Level I	Simulation-based education offers innovative, feasible, and responsive approaches by utilizing realistic emergency scenarios, which directly enhance the effectiveness of healthcare education.
Evolución de la aplicación del concepto de integración curricular en simulación clínica: una revisión centrada en pregrado de las profesiones de la salud / Suazo, F. T.	Revista Médica de Chile / Chile	Spanish / 2025	Systematic review / Level I	It is stated that integrating clinical simulation into the curriculum improves procedural competencies and fosters critical and clinical thinking, with increased engagement in interprofessional applications.

Assessment and evaluation of simulation-based learning in higher education and professional training: An introduction / Duchatelet, D.	Studies in Educational Evaluation / Netherlands	English / 2022	Expert opinion / Level VI	Teaching grounded in clinical simulations is considered effective for learning, as it contributes to the development of problem-solving skills, critical thinking, and self-efficacy.
The PIER framework for healthcare simulation integration in undergraduate physiotherapy education / Van der Merwe, A.	BMC Medical Education / United Kingdom	English / 2022	Descriptive study / Level IV	Simulation-based learning experiences can be applied to various healthcare scenarios and are considered essential for reinforcing complex skills.
Evidence-based, ethical decision-making: Using simulation to teach the application of evidence and ethics in practice / Opsahl, A.	Worldviews on Evidence-Based Nursing / United States	English / 2020	Qualitative study / Level IV	Practical simulation in learning suggests a positive impact by fostering group dynamics, interprofessional collaboration, and evidence-based ethical teaching.
Effectiveness of simulation-based interventions at improving empathy among healthcare students: a systematic review and meta-analysis / Chua, J. Y. X.	Nurse Education Today / United Kingdom	English / 2021	Systematic review / Level I	Healthcare students showed significant improvement in empathy after participating in realistic simulation-based interventions.
Escape box and puzzle design as educational methods for engagement and satisfaction of medical student learners in emergency medicine: survey study / Cantwell, C.	BMC Medical Education / United Kingdom	English / 2022	Descriptive study / Level IV	The use of gamification highlights how it stimulates student engagement, builds confidence in applying acquired knowledge in practice, and improves teamwork dynamics and communication.
The influence of gamification on medical students' diagnostic decision making and awareness of medical cost: a mixed-method study / Ishizuka, K.	BMC Medical Education / United Kingdom	English / 2023	Mixed-method study / Level III	Gamification through decision-making cards is a method with a positive impact on medical students' learning, as it stimulates clinical reasoning and enhances self-confidence in clinical decisions and diagnoses.

Emerging trends in gamification for clinical reasoning education: a scoping review / Lee, C. Y.	BMC Medical Education / United Kingdom	English / 2025	Scoping review / Level I	It affirms the potential of gamification as a tool to intensify clinical reasoning among healthcare students, as well as to improve individual diagnostic decision-making and team communication dynamics.
Gamification bolsters self-regulated learning, learning performance and reduces strategy decline in flipped classrooms: A longitudinal quasi-experiment / Maimaiti, G.	Computers & Education / Netherlands	English / 2025	Quasi-experimental study / Level III	English language learning improved significantly after the implementation of gamification in undergraduate education, with a focus on fostering self-directed learning.
Gamification in medical education: identifying and prioritizing key elements through Delphi method / Wang, Y. F.	Medical Education Online / United Kingdom	English / 2022	Expert opinion / Level V	In addition to providing a realistic learning environment, simulation also contributes to the development of competitiveness and teamwork in education.

Source: Own elaboration based on the analyzed studies. Classification of levels of evidence according to the Joanna Briggs Institute guidelines (Lockwood *et al.*, 2020).

4 DISCUSSION

This Integrative Review revealed that both clinical simulation and gamification represent innovative pedagogical strategies with significant potential for medical training, particularly in Emergency Medicine education (Elendu *et al.*, 2024; Salafia & Perez-Ochoa, 2025). The studies analyzed highlight positive impacts on the acquisition of technical and behavioral competencies (Costa *et al.*, 2020; Mahling *et al.*, 2023), student engagement (Gue, Ray & Ganti, 2022), and formative assessment (Van Gaalen *et al.*, 2021; Bass *et al.*, 2024).

However, methodological challenges and limitations were also identified, requiring further exploration in future research, along with the need for contextual adaptations to effectively incorporate these methodologies into medical curricula (Najafi *et al.*, 2025; Kirsch & Spreckelsen, 2023). The main findings are discussed below, organized into two analytical categories that reflect central dimensions of contemporary medical education.

4.1 Clinical Simulation as a Formative Assessment Tool

Clinical simulation emerges as a crucial tool for the development of clinical skills in a controlled environment, allowing students to engage in hands-on practice without posing risks to real patients (Costa *et al.*, 2020). The reviewed studies

indicate that this methodology fosters active learning, recognition of pedagogical errors, and critical self-assessment, essential for the formation of safe and competent professionals. Additionally, clinical simulation enables ongoing formative assessment, contributing to the early identification of performance gaps and the personalization of teaching processes (Gue, Ray & Ganti, 2022; Mahling *et al.*, 2023).

Nonetheless, the implementation of simulation faces challenges related to infrastructure, equipment costs, and faculty training to conduct activities effectively (Hippe *et al.*, 2020). There is also an urgent need for longitudinal studies to assess the transfer of skills acquired in simulation to real clinical practice (Suazo *et al.*, 2025). The literature emphasizes the potential of simulation in diverse contexts, but also highlights the importance of integrated curriculum planning and protocols that ensure standardization and quality in simulated activities (Duchatelet, Jossberger & Rausch, 2022; Van der Merwe, Barnes & Labuschagne, 2022).

Beyond technical aspects, clinical simulation also plays a key role in the development of interpersonal skills and the strengthening of ethical decision-making, preparing students for high-pressure situations with emotional complexity (Opsahl, Nelson, Madeiro & Wonder, 2020; Chua, Ang, Lau & Shorey, 2021). Thus, it becomes not only a technical training tool, but also an instrument for comprehensive and humanistic professional education.

4.2 Gamification and the Ecology of the Medical Classroom: Limits and Possibilities

Gamification has been presented as a strategy capable of increasing engagement and motivation among medical students by introducing playful and competitive elements that make the learning process more attractive (Van Gaalen *et al.*, 2021). The reviewed studies emphasize that the use of points, rankings, challenges, and instant feedback contributes to active student participation and the consolidation of complex content, such as that related to emergency protocols (Cantwell *et al.*, 2022; Ishizuka *et al.*, 2023).

However, gamification also presents limits, such as the risk of overvaluing competition to the detriment of collaboration, and the need to balance the playful component with pedagogical objectives (Lee *et al.*, 2025). Adapting to the specificities of the medical context requires sensitivity to avoid trivializing critical topics, and the success of such interventions depends on institutional culture, student profiles, and technological infrastructure, central elements in the ecology of the classroom (Kirsch & Spreckelsen, 2023; Bass *et al.*, 2024).

Moreover, gamification allows for personalized learning, respecting different learning styles and paces, which enhances students' autonomy and self-regulation (Maimaiti & Hew, 2025). For gamification to be effective and sustainable, it must be anchored in solid pedagogical foundations and strategically integrated into the curriculum, with faculty development and the involvement of multidisciplinary teams for its continuous development and evaluation (Wang *et al.*, 2024; Maimaiti & Hew, 2025).

5 FINAL CONSIDERATIONS

This Integrative Review aimed to map and analyze the current state of knowledge on the application of gamification and clinical simulation in Emergency Medicine education at the undergraduate level, emphasizing their impact on the development of clinical competencies and student engagement. From the synthesis of recent studies, it became evident that these innovative methodologies represent promising pathways for medical training, especially in contexts where preparation for critical situations is essential.

The results indicate that clinical simulation not only enhances active learning and formative assessment but also contributes to the holistic development of students by integrating technical, interpersonal, and ethical skills. Gamification, in turn, stands out as a strategy capable of making the educational process more attractive and personalized, promoting motivation and autonomy, provided it is thoughtfully incorporated into the curriculum and supported by solid pedagogical principles.

However, important gaps were identified, such as the need for longitudinal studies to evaluate the impact of these methodologies on real clinical practice, the standardization of simulation protocols, and faculty training for the effective use of gamification. Additionally, it is essential to consider the cultural, institutional, and technological specificities of educational contexts to ensure the effectiveness and sustainability of these interventions.

Therefore, future research should broaden methodological approaches, incorporating both qualitative and quantitative evaluations that can capture the complexity of learning in Emergency Medicine. It is also crucial that educational institutions invest in infrastructure and continuous faculty development to foster the integrated and reflective incorporation of these methodologies into medical curricula.

Finally, this study contributes to the advancement of medical education by highlighting the transformative potential of gamification and clinical simulation, pointing to pathways for educators, administrators, and researchers to build more effective, inclusive, and contextually aligned learning environments in health education.

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