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REVIEW ARTICLE

Gamification in Emergency Medicine Residency Education: A Scoping Review

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Abstract: **Introduction:** In emergency medicine (EM) residency education, gamification has increasingly been incorporated into educational activities. This scoping review aimed to map the current literature on gamification in EM residency education and summarize the characteristics and reported outcomes of existing interventions. **Methods:** This scoping review was conducted in accordance with the PRISMA-ScR guidelines. A comprehensive search was performed in PubMed, Scopus, Web of Science, IEEE, SID, Irandoc, and Google Scholar for studies published up to March 2026. A total of 1,002 records were initially identified, of which 23 studies met the inclusion criteria and were included in the final review. Original studies investigating gamification in emergency medicine residency education were included without restriction on study design. Data were extracted using a structured charting form and analyzed descriptively through narrative synthesis. **Results:** A total of 23 studies on gamification in emergency medicine residency training were included. The studies were published between 2016 and 2026, with most originating from the United States. Gamification interventions were predominantly delivered in face-to-face settings, with increasing use of blended and online formats. Most interventions were multi-component, commonly integrating simulation with gamified strategies such as escape rooms, quizzes, and competitive activities. Feedback, task-based missions, and team competition were the most frequently used gamification elements. Affective outcomes (e.g., motivation, engagement, and satisfaction) were most commonly reported, followed by cognitive outcomes, which showed heterogeneous effects. Social and behavioral outcomes were less frequently assessed but generally positive. Reported implementation outcomes generally indicated favorable feasibility and acceptability, although some studies reported mixed findings or lacked formal implementation measurements. **Conclusion:** Our review suggests that gamification is a promising supplementary educational strategy in emergency medicine residency training, particularly in interactive and team-based formats such as escape rooms. While current evidence indicates improvements in engagement, motivation, and perceived learning, most findings remain focused on short-term and subjective outcomes. Therefore, gamification should be considered a complementary rather than a replacement approach for traditional educational methods. Future research should focus on stronger study designs, objective outcome measures, and long-term evaluations to better establish its educational and clinical impact.

Keywords: Gamification; Emergency Medicine; Internship and Residency; Education; Medical; Graduate

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1. Introduction

Emergency medicine (EM) is a critical specialty within healthcare systems that focuses on the rapid assessment and management of life-threatening conditions. Due to the high-pressure and time-sensitive nature of emergency care, EM residency training must be dynamic, practical, and based on real or simulated clinical experiences. Residents are required to develop competencies in rapid decision-making, critical thinking, and managing complex clinical scenarios. Therefore, structured educational programs are designed to simultaneously enhance knowledge, clinical skills, and professional attitudes (1). Evidence also suggests that a combination of scientific, professional, and communication skills can better predict resident performance in emergency settings (2).

Gamification, defined as the use of game elements such as competition, points, levels, and feedback in non-game contexts, has emerged as an innovative approach in education. This strategy aims to increase motivation, engagement, and active participation in the learning process. Core components of gamification, including challenges, clear goals, immediate feedback, and reward systems, can enhance problem-solving skills, critical thinking, and social interaction among learners (3).

The effectiveness of gamification is supported by several well-established psychological and learning theories, including self-determination theory, flow theory, experiential and constructivist learning theories. These frameworks explain how gamification can enhance motivation and learning by providing immediate feedback, manageable challenges, and opportunities for social interaction (4). More recent theoretical models have attempted to integrate these perspectives, highlighting how gamification can reshape learning environments to promote active, meaningful, and learner-centered experiences (5).

In medical education, particularly at the residency level, gamification has shown potential to improve engagement, motivation, and interactive learning. It allows residents to participate in game-based challenges that simulate real clinical scenarios and support decision-making skills in a safe environment. Additionally, gamification facilitates timely and constructive

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feedback, which can accelerate learning and promote continuous improvement. However, the successful implementation of this approach requires careful design and integration with traditional teaching methods (6).

Despite the growing interest in gamification, there are still uncertainties regarding its effectiveness, optimal design, and application in advanced levels of medical education (7). Existing studies have reported inconsistent findings regarding its impact on educational outcomes, particularly in specialized training programs such as residency (8). Unlike gamification in undergraduate medical education, gamification in EM residency faces unique constraints: shift-based schedules, Accreditation Council for Graduate Medical Education (ACGME) milestone assessments, and high-stakes clinical environments. No prior scoping review has specifically mapped gamification design elements and outcome domains in this population. These gaps highlight the need for a comprehensive mapping of the literature to better understand the scope, characteristics, and evidence base of gamification in this specific training context.

2. Methods

2.1. *Protocol and registration*

This scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (9). The study protocol was developed prior to the review process to ensure methodological transparency and consistency. Ethical approval for this study was obtained from the institutional ethics committee (Code: IR.SBMU.SME.REC.1403.006).

2.2. *Eligibility criteria*

Studies were included based on the following criteria:

- Articles published in English or Persian;
- Studies focusing on gamification in emergency medicine residency education;
- Original research articles published in peer-reviewed journals;
- Availability of full-text articles.

No restriction was applied regarding study design to ensure comprehensive coverage of available evidence. Therefore, descriptive, quasi-experimental, interventional, and randomized controlled studies were included. However, secondary studies such as systematic reviews and meta-analyses were excluded to avoid duplication of data, although their reference lists were screened for additional relevant studies.

Studies conducted in non-formal educational settings (e.g., public health education or social interventions) were excluded. Additionally, conference abstracts, posters, dissertations, books, and non-scientific publications (e.g., blogs or websites) were not considered.

No geographical or time restrictions were applied, and all studies published up to March 2026 were included.

2.3. *Information sources*

A comprehensive search was conducted in both national and international databases. Persian-language articles were retrieved from SID, Irandoc, and Google Scholar. International databases included PubMed (MEDLINE), Scopus, Web of Science, IEEE, and Google Scholar to ensure broad coverage of the literature.

2.4. *Search strategy*

The search strategy was developed using a combination of keywords and their synonyms related to gamification, residency training, and emergency medicine. Controlled vocabulary and free-text terms were combined using Boolean operators (AND, OR) to maximize the retrieval of relevant studies.

Key terms for gamification included: “gamification,” “gamified,” “game-based learning,” “game design elements,” and related expressions. Residency-related terms included “resident,” “clinical resident,” and “postgraduate.” Training-related terms included “education,” “training,” and “educational methods.” Emergency medicine-related terms included “emergency medicine,” “emergency care,” and “acute care.”

Equivalent Persian keywords were also used in national databases. The full search strategy for each database is provided in Appendix 1.

2.5. *Data charting process*

Data extraction was performed using a structured data charting form developed by the researchers. This form was consistently applied to all included studies to ensure uniformity and comparability.

Extracted data included: Bibliographic information (authors, year, journal); Study characteristics and design; Field and educational context; Theoretical frameworks used; Gamification elements (e.g., points, badges, levels, feedback); Data collection tools (e.g., questionnaires, tests, interviews); and outcome types. The complete dataset of all included studies is presented in table 1.

2.6. *Publication bias and sensitivity analysis*

Given the scoping review design, the heterogeneity of the included study designs, interventions, outcome measures, and reported outcomes, and the absence of quantitative synthesis or pooled effect estimates, publication bias was not assessed using formal statistical methods such as funnel plots or regression-based tests. Instead, the potential for publication bias was considered qualitatively during interpretation of the evidence. Particular attention was paid to the distribution of study designs, settings, geographic locations, and reported findings, including the presence of null, non-significant, or mixed results. The search strategy incorporated multiple bibliographic databases and both international and national information sources to maximize the identification of relevant evidence. Sensitivity analysis was not performed because no quantitative effect estimates were pooled and findings were synthesized narratively.

2.7. *Quality assessment*

To provide further insight into the methodological quality of the available evidence, a structured quality assessment was undertaken for studies with sufficient methodological information and an eligible study design. Quantitative descriptive studies were appraised using the Mixed Methods Appraisal Tool (MMAT), applying its five quantitative descriptive criteria (Q1–Q5) (10). Quasi-experimental studies were assessed using the Revised Joanna Briggs Institute (JBI) Critical Appraisal Tool for Quasi-Experimental Studies (2024), comprising nine appraisal questions (Q1–Q9) (11). Each criterion/question was assessed individually based solely on information explicitly reported in the corresponding article and was classified according to the response categories of the respective tool: Yes,

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No, or Can't tell for MMAT, and Yes, No, Unclear, or N/A for JBI. No numerical scores or overall quality categories were assigned, and quality assessment was not used as a criterion for excluding studies from the review. Two studies that were educational or technical innovation reports without sufficient methodological information for application of a formal appraisal tool were not subjected to formal critical appraisal (12) (13).

2.8. *Synthesis of results*

The extracted data were analyzed using descriptive methods. Findings were summarized in tables and charts, and recurring patterns across studies were identified. A narrative synthesis was conducted to describe the characteristics of included studies, types of gamification interventions, and reported educational outcomes.

3. Results

3.1. *Study characteristics*

A total of 1002 records were initially identified through database searching. After removing 112 duplicates, 890 records were screened based on title and abstract.

During the screening phase, 803 records were excluded for various reasons. These included ineligible population (n=256), lack of gamification-based intervention (n=79), non-English or non-Persian language publications (n=12), non-peer-reviewed formats such as letters and conference abstracts (n=76), review articles (n=67), and studies deemed irrelevant to the scope of the review (n=313).

Following the screening process, 87 full-text articles were assessed for eligibility. Of these, 64 studies were excluded after full-text review. The main reasons for exclusion were the unavailability of full-text articles and population heterogeneity. In several studies, mixed participant groups were included (e.g., nurses, faculty members, or residents from other specialties), and results specific to emergency medicine residents were not reported separately. Ultimately, 23 studies met the inclusion criteria and were included in the final synthesis. The PRISMA flow diagram for this scoping review is presented in Figure 1.

The temporal distribution of the included studies indicates that research activity in this field has predominantly developed over the past decade (2016–2026), with an increasing trend observed in more recent years.

Geographically, the majority of studies were conducted in countries with well-established medical education infrastructures and a strong emphasis on educational innovation, particularly the United States, which accounted for more than 70% of the included studies. Other contributing countries included Iran, India, UK, and Pakistan.

Regarding study design, 11 quasi-experimental studies and 10 quantitative descriptive studies constituted the majority of the included literature, while two studies were educational innovation or technical reports that did not provide sufficient methodological information for formal critical appraisal.

Sample sizes varied considerably across studies, although small to moderate sample sizes were most frequently reported. The most common group sizes were 10–20 participants (n=6) and 30–40 participants (n=5), whereas only one study included a sample size larger than 50 participants. This pattern of relatively small sample sizes is expected given the limited number of residents in emergency medicine training programs and the logistical constraints of educational interventions in this setting.

More than half of the included studies (n=12) did not report the use of an explicit theoretical framework. Among studies that applied a theoretical basis, the Kirkpatrick model, Kolb's experiential learning theory, and self-determination theory were the most frequently used frameworks.

Other theoretical approaches were less commonly reported and included adult learning theory, deliberate practice, and constructivism. Overall, the findings indicate variability in the use of educational theories across gamification interventions in emergency medicine residency training.

All included studies were conducted in the context of emergency medicine residency training, and gamification-based interventions were designed in alignment with the educational needs of this specialty. However, a proportion of studies focused on more specific and subspecialty-level topics within emergency medicine. These topics included obstetric and gynecologic emergencies (n=2), toxicology (n=2), cost-effective care (n=2), as well as urogenital emergencies, infectious diseases, evidence-based medicine (EBM), research training, palliative care, point-of-care ultrasound (POCUS), electrocardiogram (ECG) interpretation, and procedural skills training in emergency medicine.

3.2. *Intervention characteristics and gamification design*

Gamification interventions were implemented in a variety of formats across the included studies. Mixed-format interventions represented the most frequently used approach (n=9), in which multiple gamification strategies or educational game mechanisms were combined within a single intervention. In several cases, gamification elements were integrated with simulation-based education. In these studies, simulation functioned as the learning environment, while gamified elements such as escape rooms, quizzes, or competitive tasks were embedded within this setting.

Other commonly reported standalone formats included educational escape rooms, which were implemented as an independent instructional strategy in multiple studies. In addition, gamified question-and-answer activities and competition-based formats (e.g., game-like contests) were frequently used. Less commonly, longitudinal or curriculum-level gamification approaches, as well as role-playing or system-based games, were reported.

Across the included studies, gamification was generally applied as a multi-layered and flexible educational approach rather than a single standardized format, with interventions combining elements such as simulation, competition, problem-solving, role-play, and narrative-based learning. A detailed classification of gamification intervention formats and their corresponding studies is presented in Table 2.

3.3. *Gamification elements*

Feedback was the most frequently reported gamification element and was present in nearly all included studies. Task-based missions and team-based competition were also commonly used. Additional elements such as point systems, leaderboards, and level progression were reported in several studies; however, these were less frequent compared with feedback and competition.

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Overall, gamification design was predominantly based on the combined use of interactive, competitive, and feedback-oriented elements. These components were typically integrated rather than applied in isolation and were used to enhance learner engagement, motivation, and learning experience. A detailed summary of gamification elements and their frequency across included studies is presented in Table 2.

3.4. *Delivery modalities*

Interventions were categorized into four delivery modalities: face-to-face, fully online, synchronous blended, and asynchronous blended formats. The majority of interventions were delivered in face-to-face settings (n=12), where all learning activities were conducted in-person without the use of online platforms.

Asynchronous blended interventions (n=6) were the second most common format, combining in-person and online components delivered at different time points. Fully online interventions were reported in three studies and were mainly delivered through digital platforms or online classrooms. Synchronous blended formats, in which in-person and online learning occurred simultaneously, were the least frequently used.

The predominance of face-to-face delivery may be related to the interactive and team-based nature of many gamification interventions, such as escape rooms and simulation-based games, which rely on real-time interaction, group coordination, and immediate feedback. However, the presence of blended and online formats indicates an increasing trend toward flexibility in instructional design, particularly in recent years, reflecting the adaptability of gamification across different educational environments. The distribution of delivery modalities is illustrated in Figure 2.

3.5. *Outcome measures and data collection tools*

Data collection tools across the included studies primarily consisted of post-intervention questionnaires, Likert-scale surveys, written feedback forms, interviews, pre- and post-intervention assessments, and, in some cases, observational data or learning management system log data. Most instruments were self-reported, indicating that a substantial proportion of the evidence was based on learners' perceptions of the educational experience. However, a number of studies also incorporated performance-based or cognitive assessments, allowing for a more objective evaluation of intervention effects.

3.6. *Outcomes classification*

Outcomes were categorized into five main domains: cognitive, affective/attitudinal, behavioral, social, and implementation-related outcomes. The distribution of outcome domains across the included studies is presented in Table 2.

Affective outcomes were the most frequently reported domain across studies. These included motivation, satisfaction, learner engagement, and perceived educational experience, which were consistently documented. Increased learner engagement and satisfaction were commonly reported findings. In addition, improvements in learning enjoyment and perceived value, particularly in relation to clinical applicability and board examination preparedness, were frequently noted.

Cognitive outcomes, including knowledge acquisition, skill development, and clinical reasoning, were reported in a substantial proportion of studies; however, the magnitude and statistical significance of these outcomes varied across studies, indicating heterogeneity in cognitive effects.

Behavioral outcomes were reported less frequently but were generally positive. These included increased completion rates, participation levels, and adoption of interventions. In addition, self-reported transfer of learning to clinical practice was documented in several studies.

Social outcomes included improvements in teamwork and communication, which were reported across multiple studies. Enhancements in collaboration and team dynamics were also observed. In some cases, a reduction in disruptive or inappropriate behaviors compared with e-learning approaches was reported, suggesting broader effects on the learning environment.

Implementation-related outcomes included feasibility, acceptability, usability, and cost. Overall, studies reported high feasibility and acceptability of gamification interventions. Usability was generally rated positively, and supportive educational conditions were frequently highlighted. In a few studies, low implementation cost (e.g., less than 100 USD) was identified as a practical advantage.

3.7. *Non-significant and heterogeneous findings*

A subset of studies reported non-significant or no-change findings, particularly in comparison with traditional educational approaches such as lectures or e-learning. For example, no significant differences in standardized examination scores were observed in some studies, despite improvements in motivational outcomes. Similarly, heterogeneous effects on motivation were reported across different study sites.

In some cases, improvements in knowledge or other educational outcomes were observed but did not reach statistical significance. Likewise, variables such as confidence and feasibility showed limited or no meaningful change from baseline in certain studies.

These findings indicate that the effects of gamification-based interventions are not uniform across contexts and may depend on factors such as intervention design, implementation quality, educational setting, and learner characteristics. From a methodological perspective, the inclusion of non-significant and null findings provides a more balanced representation of the reported evidence; however, the possibility of publication bias cannot be excluded because formal statistical assessment was not feasible.

3.8. *Methodological quality assessment*

Methodological quality was assessed at the criterion level for 21 studies, including 10 quantitative descriptive studies using the MMAT and 11 quasi-experimental studies using the revised JBI tool.

Among the 10 quantitative descriptive studies assessed using the MMAT, sampling strategy and measurement appropriateness were rated positively in 5/10 and 6/10 studies, respectively, while sample representativeness was not established in any study. Risk of nonresponse bias was considered adequately addressed in 5 studies, and statistical analysis was rated as appropriate in 8 studies.

Among the 11 quasi-experimental studies assessed using the revised JBI tool, the intervention preceded outcome measurement in all studies, while a control group was present in only 3

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studies. Most studies included multiple pre- and post-intervention measurements (9/11), adequate follow-up (9/11), and consistent outcome measurement (9/11). However, the reliability of outcome measurement was unclear in 6 studies, and statistical analysis was considered appropriate in 7 studies. Detailed criterion-level findings are presented in Tables 3 and 4 and graphically summarized in Figures 3 and 4.

4. Discussion

4.1. *Summary of main findings*

This scoping review indicates that gamification has been increasingly adopted as an innovative educational approach in emergency medicine residency training. The increasing number of publications over the past decade suggests a growing interest in gamification within emergency medicine education. The predominance of US-based studies may reflect differences in research infrastructure, educational research capacity, and publication practices, and may limit the generalizability of findings to other healthcare and training contexts. Gamification-based interventions have been applied across a wide range of educational domains, including clinical decision-making, emergency patient management, teamwork, and communication skills. The predominance of quasi-experimental and descriptive study designs suggests that the field remains in an early developmental stage, with a focus on exploratory and implementation-based research. The relatively small sample sizes observed across studies are likely related to the limited number of residents in emergency medicine training programs and logistical constraints of educational interventions.

These interventions were commonly designed in formats such as escape rooms, team-based games, and competitive simulation activities, incorporating elements such as competition, scoring systems, feedback, and collaborative learning.

Overall, the included studies consistently suggested that gamification is associated with increased learner engagement, improved educational satisfaction, and enhanced perceived learning. Some studies also reported improvements in knowledge acquisition, clinical skills, and learner confidence. However, most reported outcomes were situated at the levels of reaction and perceived learning, while evidence regarding behavioral or clinical outcomes remained limited.

4.2. *Interpretation of findings*

The findings of this review suggest that gamification in emergency medicine residency education primarily functions as a tool to enhance learner engagement and motivation. This is consistent with the broader medical education literature, where systematic reviews have shown that gamification generally improves learning experience and learner interaction (14). This effect can be explained through active learning and motivational theories, in which gamification elements such as competition, immediate feedback, and structured progression enhance cognitive engagement and participation.

However, a key finding of this review is the predominance of perceived outcomes over objective outcomes. Similar patterns have been reported in previous studies, indicating that gamification tends to have a stronger impact on engagement and perceived learning than on measurable clinical performance (15). This may be attributed to methodological limitations, measurement tools relying on self-report, and the short duration of most interventions.

Another important finding is the feasibility and acceptability of gamification interventions. The results showed that these interventions are generally feasible in practice, as reported in the previous studies (16,13). In some cases (17), the low cost of implementing the intervention was even mentioned as a key advantage. These findings suggest that gamification can be used not only from an educational but also from an implementation perspective in clinical settings.

A notable proportion of studies reported non-significant or mixed findings. While most evidence supported positive effects on affective and some cognitive outcomes, some studies showed that these effects were not consistent. For example, in a study, no significant difference was observed in ITE test scores (18), and in another study, a motivational effect was observed in one center but not in another (19). Also, in the study by Stephanie Cohen, an increase in knowledge was reported, but this increase was not statistically significant (20).

From a methodological perspective, the inclusion of non-significant and null findings provides a more balanced representation of the reported evidence; however, the possibility of publication bias cannot be excluded because formal statistical assessment was not feasible. Furthermore, the considerable diversity observed in intervention design, gamification elements, and implementation contexts is another prominent feature of the field. This heterogeneity has also been highlighted in previous literature as a key challenge in synthesizing evidence and drawing generalizable conclusions (21). While such diversity reflects the flexibility of gamification, it also limits comparability across studies.

The methodological appraisal provides important context for interpreting the predominantly positive findings identified in this review. Among the quantitative descriptive studies, sample representativeness emerged as a notable concern, with no study rated “Yes” for this criterion. Similarly, among quasi-experimental studies, the absence of a control group was common, with eight of 11 studies rated “No” for this criterion. In addition, the reliability of outcome measurement was unclear in seven of 11 quasi-experimental studies. These findings suggest that, although the reported results generally support the potential value of gamification for learner engagement and selected educational outcomes, the methodological characteristics of the available evidence limit the strength of conclusions regarding effectiveness and causal inference. Importantly, the appraisal was conducted at the criterion level and was not used to assign an overall quality grade; therefore, these findings are best interpreted as highlighting specific methodological strengths and limitations across the evidence base rather than defining the studies as globally high- or low-quality.

Overall, gamification in emergency medicine residency education appears to be more than a simple entertainment tool; rather, it represents a potentially effective educational strategy for enhancing engagement and learning experience. In particular, gamified interventions such as escape rooms have shown positive effects on learning, satisfaction, teamwork, and leadership development, suggesting their alignment with core educational objectives in emergency medicine training.

From a practical perspective, the effectiveness of gamification depends on the appropriate alignment of game elements with educational context and learner needs. Therefore, balancing competition, feedback, collaboration, and learning objectives is essential in designing effective interventions.

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4.3. *Recommendations for future research*

Future research in this field should prioritize stronger methodological designs, particularly randomized controlled trials with adequate sample sizes, to enhance internal validity and generalizability. The use of standardized and objective assessment tools, alongside self-reported measures, is recommended to provide a more accurate evaluation of educational effectiveness.

In addition, the application of clear theoretical frameworks in the design of gamification interventions is essential to systematically link educational design with learning outcomes and improve comparability across studies.

Long-term outcomes, particularly in higher levels of learning such as clinical performance, decision-making, and skill transfer to real clinical settings, should be explored through studies with extended follow-up periods.

Finally, comparative studies evaluating different gamification formats (e.g., escape rooms, competitive games, simulation-based interventions) are needed, as current evidence is insufficient to determine the superiority of any specific approach.

4.4. *Limitations*

This review has several limitations. Considerable heterogeneity in study designs, sample sizes, and measurement tools limited direct comparison across studies. Most included studies involved small sample sizes, which may affect generalizability. In addition, the lack of theoretical frameworks in more than half of the studies reduced conceptual consistency within this field. Geographic concentration of studies may also introduce contextual bias. Furthermore, most studies focused on self-reported outcomes such as satisfaction and engagement, with limited assessment of behavioral or long-term clinical outcomes.

Another important limitation was the widespread use of convenience sampling across the included studies, with no reported power calculations or participant randomization in most cases, increasing the risk of selection bias. Although methodological quality was assessed at the criterion level, the heterogeneity of study designs and the absence of an overall quality score limited the extent to which appraisal findings could be used to compare studies directly. Gamified interventions generally improved motivation and engagement; however, evidence of their superiority over traditional teaching methods remains inconclusive.

5. Conclusions

This scoping review suggests that gamification is a promising supplementary educational strategy in emergency medicine residency training, particularly in interactive and team-based formats such as escape rooms. While current evidence indicates improvements in engagement, motivation, and perceived learning, most findings remain focused on short-term and subjective outcomes. Accordingly, current evidence supports gamification primarily as a complementary strategy for engagement, motivation, and learning experience rather than as a standalone approach for high-stakes knowledge assessment.

6. Declarations

6.1. *Acknowledgments*

No specific acknowledgments.

6.2. *Conflict of interests*

The authors declare that they have no conflict of interest.

6.3. *Funding and supports*

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6.4. *Authors' contributions*

Mahsa Soleimani: Investigation, data collection, and writing the original draft. Mehrnoosh Khoshnoodifar and Masomeh Kalantarion: Conceptualization, study design, critical review, and editorial revision. All authors have read and agreed to the published version of the manuscript.

6.5. *Ethical statement*

Al procedures performed in this study were in accordance with the ethical standards of the institutional research committee. The study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences IR.SBMU.SME.REC.1403.006)

6.6. *Informed consent*

Not applicable.

6.7. *Availability of supporting data*

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

6.8. *Using artificial intelligence chatbots statement*

The authors also acknowledge that artificial intelligence tools were used solely for language editing and translation purposes. These tools were not involved in data analysis, interpretation of results, or scientific decision-making.

6.9. *Other declarations*

None None None

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Table 1: The complete dataset of all included studies

Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Joseph Ray et al., 2024 (22)	USA	Quasi-experimental	Emergency Medicine Residency Training	Cost awareness + estimation skill	Kirkpatrick model (Level 2 learning mentioned)	Game based on The Price is Right (interactive competitive session)	*Quests *Feedback *team competition	In-person (during didactic session)	Pre-session survey Post-session survey Cost estimation test (10 items)	Learning performance ↑ Cost estimation accuracy ↑ Awareness ↑ Engagement ↑
Burke et al., 2023 (23)	USA	Educational curriculum evaluation (quasi-experimental)	Emergency Medicine Residency Training (OB/GYN emergencies)	Clinical knowledge + decision-making + confidence	Kirkpatrick Level 1 (and mention of Level 2 in discussion)	Kahoot-based quiz (game-based questions within case-based lectures)	*Quests *Feedback *team competition *Leaderboard *point	Mostly in-person + one session via Zoom	Pre-curriculum survey (Likert scale confidence) Post-curriculum survey (Likert scale confidence)	Confidence ↑ Engagement ↑ Self-perceived learning↑
Shayne Gue et al, 2022 (18)	USA	Quasi-experimental (single-group pre–post mixed-methods study)	Emergency Medicine Residency Training	Motivation+ Engagement+ Perceived learning experience+ Educational performance (ITE scores)	SDT	Longitudinal gamified curriculum (East EMWars), implemented over 10 months (August 2020–June 2021).	*Feedback *team competition *Leaderboard *point	In-person (conference-based curriculum) longitudinal program over 10 months	Pre- and post-intervention structured surveys (Likert scale) Open-ended qualitative responses (thematic analysis) In-training examination percentile scores (self-reported)	↑Motivation ↑ Engagement ↑ Challenge → / ≈ No significant change in ITE exam scores
Timothy S Fallon et al, 2022 (24)	USA	Descriptive study	Research education + EBM in Graduate Medical Education	Research methodology+ Statistical reasoning+ Study design+ interpretation+ EBM skills+ Critical appraisal	Kolb's Experiential Learning Theory +Kirkpatrick evaluation model (for assessment framework)	Escape room–scavenger hunt (team-based, multi-station game)	*Feedback *team competition *point *Quests	In-person + virtual (Zoom breakout rooms)	Post-activity Likert-scale survey Self-reported satisfaction, engagement, learning Open-ended qualitative feedback Knowledge self-assessment across domains Behavioral reflection questions	Engagement ↑ Satisfaction ↑ Comfort with EBM concepts ↑ Knowledge acquisition ↑ Behavior (application in practice) ↑ (self-reported)
Adam Heilmann et al, 2023 (12)	USA	Technical report (pre-evaluation)	Emergency medicine education (simulation-based learning, gamification)	Clinical reasoning + task prioritization+task switching+decision-making under uncertainty	Not reported	Hybrid simulation + TRPG	*Points *Levels *Feedback	In-person Virtual (Zoom)	Not yet collected	Feasibility (planned), engagement (hypothesized), learning (not measured)

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Jessica Stanich et al, 2023 (25)	USA	Observational study	palliative care, end-of-life care in emergency medicine	end-of-life communication, palliative care management, clinical decision-making, assessment skills, prioritization of care, communication with patients and healthcare team	LDR + Kolb experiential learning model + Deliberate practice	In person	*Feedback *Quests *level	In-person simulation (high-fidelity)	SET-M survey	Confidence ↑ ; learning ↑ ; skills ↑ ; communication ↑
Sara P Dimeo et al, 2022 (19)	USA 2-site study	Quasi-experimental study	Infectious disease education in EM residency	Knowledge acquisition + motivation/enjoyment	SDT(mentioned)	Virtual escape room (compared with lecture)	*Quests *Team Competition *Feedback	Virtual (Zoom + Google Forms)	Pre-quiz (9-item MCQ) Post-quiz (18-item MCQ) IMI	Knowledge: ↑ (escape room group) Lecture comparison: → (no significant change) Motivation: ↑ (escape room higher in one site) → (no difference in other site)
Jon Smart et al, 2018 (26)	USA	Quasi-experimental study	Emergency Medicine residency asynchronous curriculum	Knowledge acquisition (via learning points/trivia) Engagement / motivation Board exam preparation readiness (self-reported)	Not reported	Gamified asynchronous curriculum + team-based trivia competition	*Quests *Team Competition *points	Blended (online + in-person conference)	Survey (Likert scale)	Completion rate: ↑ Enjoyment: ↑ Perceived value (clinical/board preparation ↑
Viveta Lobo et al, 2017 (27)	USA	Prospective pilot educational study	POCUS training	Knowledge Technical skills Image interpretation Clinical decision-making	Not reported	Competitive team-based game (“Sound Games”) Orientation-integrated gamified competition Mixed format: Question rounds Simulation round	*Points — *Feedback — (post-test + survey feedback + instructor review implied in sessions) *Team Competition —	Blended	Pre-test (MCQ) Post-test (MCQ) Self-assessment survey (Likert scale)	Knowledge ↑ Perception (satisfaction, perceived learning) ↑ Teamwork↑

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Asjad Mallick et al. 2024 (28)	Pakistan	Descriptive	Urogenital emergencies Emergency medicine clinical education	Knowledge acquisition Teamwork Leadership Problem-solving Time management Strategic decision-making	Not reported	Team Competition + Feedback	*Points — Not explicitly stated (but token movement based on correct answers implies scoring mechanism) *Feedback — Present (immediate facilitator feedback + debriefing + Likert scale evaluation) *Team Competition —	In-person facilitated board game	Questionnaire with Likert scales (faculty evaluation of performance) Resident evaluation form (end of session feedback) Mini-interviews (educator evaluation) 360-degree feedback strategy Debriefing session feedback Not standardized validated test reported	Skills (non-technical) ⬆Affective (motivation, engagement, satisfaction) ⬆Teamwork/communication
Alexis L Cates et al, 2020 (29)	USA	Comparative Descriptive educational intervention study	Toxicology education in Emergency Medicine residency	Recognition of toxicologic ingestion and antidote selection / toxidrome management	Not reported	Virtual Escape Room	*Quests *Team Competition:*Feedback: *Leaderboard *points	Virtual (Zoom + Google Forms)	Google Forms (embedded anonymous 3-item Likert-scale evaluation survey)	Perception / satisfaction: ↑ in Program 1 / ↓ in Program 2 Knowledge correctness (final puzzle accuracy): ↑ in both programs (high overall correctness reported)
Susan Owens et al, 2025 (16)	India	Descriptive program evaluation study	EM procedural training (laceration repair)	Procedural competency+ laceration repair techniques	Adult learning theory+self-determination theory+peyton model	Competitive procedural showcase+virtual workshop	Leaderboard+ level+feedback +Quests	Hybrid(asynchronous submission+ synchronous Zoom workshop)	Photo submission+blinded rubric scoring+peer voting	Engagement ↑ Participation ↑ Motivation ↑ (qualitative) Skill performance ↑ (by PGY level, not pre-post) Feasibility ✔ Acceptability ✔

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Jodi DeJohn et al, 2024 (17)	India	Descriptive educational intervention / simulation-based program evaluation	Emergency Medicine residency education	HIV management Emergency procedural skills Pericardiocentesis Clinical reasoning (HIV complications)	Kolb's Experiential Learning Cycle/Gamification principles (autonomy, competitiveness, relatedness)Simulation-based education theory	Escape room + simulation + procedural station	* Quests * Team Competition * Feedback	In-person simulation Small group team-based escape room Multi-site implementation (different hospital settings)	Pre- and post-surveys (Likert scale) Self-reported knowledge assessment Completion time tracking (escape time) Participation metrics	↑ self-reported knowledge /↑ engagement and positive feedback / improved collaboration (qualitative) / ↑Satisfaction /↓ cost (< $100 = very low cost intervention)
Alanna O'Connell et al, 2020 (30)	USA	Descriptive study (educational innovation with post-session survey)	OB/GYN core curriculum in Emergency Medicine	Knowledge review (OB/GYN topics, clinical decision-making in EM context)	Not reported	Virtual gamified competition modeled after TV show ("So You Think You Can Dance")	* Points *Team Competition *Leaderboard * Feedback * Quests	Virtual (Zoom + breakout rooms + Kahoot + Google Forms)	Post-session anonymous survey (Likert scale + free text)	Reaction (satisfaction, engagement) Self-reported learning
Mary G McGoldrick et al, 2024 (31)	USA	educational intervention (flipped classroom, pre–post quasi-experimental design)	Emergency Medicine (Environmental/toxicology: bites & envenomation)	Identification of envenomation/bite sources; clinical reasoning; management (antibiotics/antivenom/supportive care)	Flipped classroom; experiential learning	Small-group "Whodunit" case-based gamified flipped classroom with scenario matching and presentations		Small-group in-person or facilitated didactic session (virtual not stated in text)	Pre- and post-activity electronic MCQs + anonymous post-activity survey	↑ Knowledge (MCQ scores); ↑ engagement/acceptability
Peter J Tomaselli et al, 2018 (32)	USA	Descriptive educational feasibility study)	Cost-conscious care / Value-based healthcare	Cost awareness in clinical decision making Cost-effective ordering / resource utilization	Constructivism + Behaviorism	Game-show based interactive session ("The Price is Right" model)	*Points *feedback *quests *Team Competition	In-person didactic session (60-minute interactive conference)	22-item questionnaire (5-point Likert scale) + qualitative feedback	Knowledge outcome ↑ Attitude/Perception outcome ↑ Engagement/acceptability ↑

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Haris Shoaib et al, 2026 (33)	UK	Analytical pre–post interventional simulation study	Emergency medicine procedural skills (orbital compartment syndrome management)	Recognition and management of orbital compartment syndrome Lateral canthotomy and cantholysis procedural competence	Not reported	Multimodal simulation training package with gamified quiz component (Kahoot-style)	* Feedback * Quests / Challenges	Simulation-based training (multimodal: lecture + video + quiz + hands-on low-fidelity model)	Pre- and post-intervention 10-point Likert scale (confidence and competence) Qualitative free-text feedback	Theoretical knowledge score ↑ Procedural confidence ↑ Procedural competence ↑ Learner-rated usefulness of all components ↑ Acceptance of annual implementation ↑ Qualitative satisfaction ↑
L. PoSaw et al, 2021 (34)	USA	Quasi-experimental Educational intervention study	Emergency Medicine residency education (POCUS training)	POCUS image acquisition POCUS interpretation Integration of multiple POCUS applications Clinical integration for differential diagnoses	Adult learning theory	Escape room games (POCUS-based) Team-based gamified simulation sessions	*Feedback *Quests *Team Competition	In-person simulation / team-based escape room sessions	Pre-session survey Post-session survey Focus group Learner and trainer surveys Formative assessment by facilitators	POCUS performance (skills) → ↑ Confidence (self-reported) → Not changed Team dynamics → ↑ Feasibility / time completion → Not changed

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Meysam Heydari et al, 2024 (35)	Iran	Quasi-experimental study	Emergency Medicine residency education	Knowledge + procedural skills + clinical reasoning + judgment + exam performance	Not reported	Game-based learning + gamification curriculum vs e-learning (podcasts + videos) Formats included: face-to-face sessions virtual classes skill labs hospital-based sessions interactive game sessions (multi-format)	*Feedback *Quests *Team Competition	Hybrid: Face-to-face Virtual platforms Skill labs Hospital setting	Data Collection Tool MCQ written exam OSCE (10 stations) PMP + KF clinical reasoning exam MEEGA questionnaire (first group only) PHEEM questionnaire (first group only)	Knowledge ↑, skills ↑, clinical reasoning ↑, judgment ↑; usability ↑, player experience ↑; teacher support ↑, work conditions/time ↑, harassment ↓ (compared with e-learning group; no baseline/pre-test reported).
Kharmen e Sunga et al, 2016 (36)	USA	Descriptive	Emergency medicine simulation-based education (pulmonary emergency management)	Critical management of emergent pulmonary conditions; decision-making; performance of critical actions	Deliberate Practice; Kirkpatrick Model (Level 1 evaluation reported)	Simulation-based hybrid gamified intervention (Recursive Objective-Based Gameplay "LIVE. DIE. REPEAT." with level progression and repeated cycles)	*Feedback *Quests *level	In-person high-fidelity simulation (simulation center), small group sessions + live video observation	MSET + free-text learner feedback	Engagement ↑; Satisfaction ↑; perceived effectiveness ↑ (Kirkpatrick Level 1 only)
Stephanie Cohen et al, 2026 (20)	USA	Analytical (Quasi-experimental / Pilot pre–post + comparative groups)	Emergency medicine simulation education	Medical knowledge acquisition + clinical decision-making in simulation (sports medicine topics within EM simulation scenarios)	Not reported	Themed gamified simulation ("Star Wars"-themed simulation event) Competitive team-based simulation Procedural obstacle course with themed clues	*Leaderboard* Feedback *Quests *level	Simulation-based in-person educational event Team simulation + procedural stations + obstacle course	Pre-test and post-test knowledge assessment (10 MCQs) Anonymous electronic survey (Likert scale + demographics + attitudes)	Knowledge acquisition: ↑ (but NOT significant) Engagement/enjoyment: ↑ (subjective)

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Authors/ Year	Country	Study Type	Educational Domain	Target Skill	Theory/Model	Gamification Type / Intervention Format	Gamification Elements	Delivery mode	Data Collection Tool	Outcome Type
Cooper Benjamin, et al 2019 (13)	USA	Educational innovation)	ECG interpretation and triage in Emergency Medicine	Rapid ECG interpretation ECG-based triage (acuity classification) Identification of life-threatening ECG patterns Management of ECG-related emergencies	Not reported	Video-based curriculum + engaging game Mobile + web-based gamified ECG triage system Assignment of ECGs into 4 acuity categories (game mechanic)	*Feedback *Status	Video-based asynchronous learning Mobile application (iOS/Android) Web-based game Didactic conference integration	Survey data (learner feedback)	Engagement ↑ Adoption ↑ Feasibility ↑ Acceptability ↑
Mehrad Aghili et al, 2022 (37)	IRAN	Descriptive cross-sectional	Emergency Medicine Residency Training	not reported	Not reported	Game-based learning using scenario design across >10 sessions	*Quests *Team Competition	In-person (implied; not explicitly stated)	DREEM	Learner perception ↑

Abbreviations: OB/GYN: Obstetrics and Gynecology; ITE: In-Training Examination; SDT: Self-Determination Theory; EBM: Evidence-Based Medicine; TRPG: Tabletop Role-Playing Game; LDR: LIVE. DIE. REPEAT; SET-M: Simulation Effectiveness Tool–Modified; MCQ: Multiple-Choice Question; IMI: Intrinsic Motivation Inventory; POCUS: Point-of-Care Ultrasound; EM: Emergency Medicine; PGY: Postgraduate Year; HIV: Human Immunodeficiency Virus; OSCE: Objective Structured Clinical Examination; PMP: Patient Management Problems; KF: Key Feature; MEEGA: Model for the Evaluation of Educational Games; PHEEM: Postgraduate Hospital Educational Environment Measure; MSET: Modified Simulation Effectiveness Tool; ECG: Electrocardiogram; DREEM: Dundee Ready Education Environment Measure.

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Table 2: Classification of gamification intervention formats, elements, and outcomes

Type/Intervention	References	Number
Game-show/TV-style gamification	(22), (30), (32)	3
Escape room/Mystery-based	(24), (19), (29), (34)	4
Role-play/System-based serious game	(36)	1
Curriculum-level (longitudinal/blended programs)	(18), (26)	2
Quiz-based gamification	(28), (31), (35), (13)	4
Mixed	(23) (Case-based curriculum + Quiz) (12) (simulation + tabletop role-playing) (25) (Simulation-based gamified learning "serious game") (27) (quiz + simulation) (16) (showcase + simulation) (17) (Escape room + Simulation elements) (33) (simulation + gamified quiz) (20) (Themed simulation +Narrative gamification (with some competitive elements)) (37) (Role-play elements + Escape room+ Simulation)	9
Gamification Elements		
Quests	(22), (23), (24), (25), (19), (26), (29), (16), (17), (30), (32), (33), (34), (35), (36), (20), (37)	17
Feedback	(22), (23), (18) ,(24), (12), (25), (19), (27), (28), (29), (16), (17), (30), (32), (33), (35), (36), (20), (13)	20
Team competition	(22), (23), (18), (24), (19), (26), (27), (28), (29), (17), (30), (32), (34), (35), (37)	15
Leaderboard	(23), (18), (29), (16), (30), (20)	6
Point	(23), (18), (24), (12), (26), (27), (28), (29), (30) , (32)	10
Level	(12), (25), (16), (36), (20)	5
Outcomes		
Cognitive	(22), (24), (25), (19), (27), (28), (29), (16), (17), (30), (31), (32), (33), (34), (35)	15
Affective	(22), (23) ,(18), (24), (25), (19), (26), (27), (28), (29), (16), (17), (30), (31), (32), (33), (35), (36), (20), (13), (37)	21
Behavioral	(24), (26), (16), (13)	4
Social	(25), (27), (28), (17), (34), (35) (harassment ↓)	6
Implementation	(12), (16), (17), (35), (13)	5
No change / null	(18) (ITE exam scores (no significant change)) (19) (Lecture comparison) (34) (Feasibility / time completion) (20) (Knowledge (not statistically significant))	4

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Table 3: Methodological quality assessment of quantitative descriptive studies using the Mixed Methods Appraisal Tool (MMAT)

Study	Q1	Q2	Q3	Q4	Q5
(24)	Can't tell	Can't tell	Can't tell	Yes	Yes
(25)	Yes	No	Yes	Yes	Yes
(28)	Can't tell	Can't tell	Can't tell	Can't tell	Yes
(29)	Yes	No	Yes	Yes	No
(16)	Can't tell	No	Yes	Can't tell	Yes
(17)	Can't tell	Can't tell	Yes	Yes	Yes
(30)	Yes	No	Yes	Can't tell	Yes
(32)	Yes	No	Yes	Yes	Yes
(36)	Yes	No	Can't tell	Can't tell	Yes
(37)	Can't tell	Can't tell	Can't tell	Can't tell	Can't tell

Note: Q1–Q5 denote sampling strategy, sample representativeness, measurement appropriateness, nonresponse bias, and statistical analysis, respectively. Yes = criterion met; No = criterion not met; Can't tell = insufficient information.

Table 4: Methodological quality assessment of quasi-experimental studies using the Revised Joanna Briggs Institute (JBI) Critical Appraisal Tool (2024)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
(22)	Yes	No	N/A	N/A	No	Yes	Yes	Unclear	Yes
(23)	Yes	No	N/A	N/A	Yes	No	Yes	Unclear	Yes
(18)	Yes	No	N/A	N/A	Yes	N/A	Unclear	Yes	Yes
(19)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No
(26)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(27)	Yes	Yes	N/A	No	Yes	Yes	Yes	Unclear	Yes
(31)	Yes	No	N/A	N/A	Yes	Yes	Yes	Unclear	Unclear
(33)	Yes	No	N/A	N/A	Yes	Yes	Yes	Unclear	Yes
(34)	Yes	No	N/A	N/A	Yes	Yes	Yes	Unclear	Unclear
(35)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
(20)	Yes	No	Unclear	No	Yes	Yes	Unclear	Yes	Unclear

Note: Q1–Q9 denote temporal precedence, presence of a control group, comparability of participants, similarity of treatment/care, multiple pre- and post-intervention measurements, completeness and adequacy of follow-up, consistency of outcome measurement, reliability of outcome measurement, and appropriateness of statistical analysis, respectively. Yes: met; No: not met; Unclear: insufficient information to determine whether the criterion was met; N/A: not applicable.

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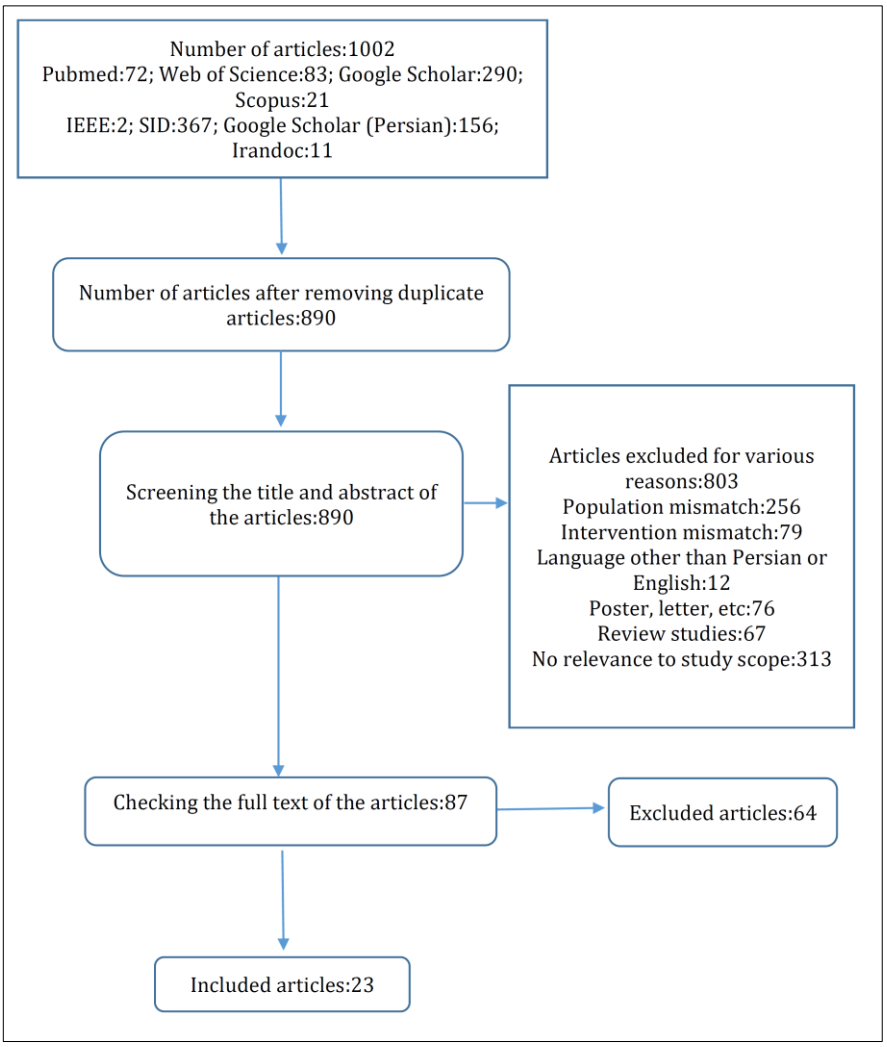


Figure 1: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram illustrating the study selection process.

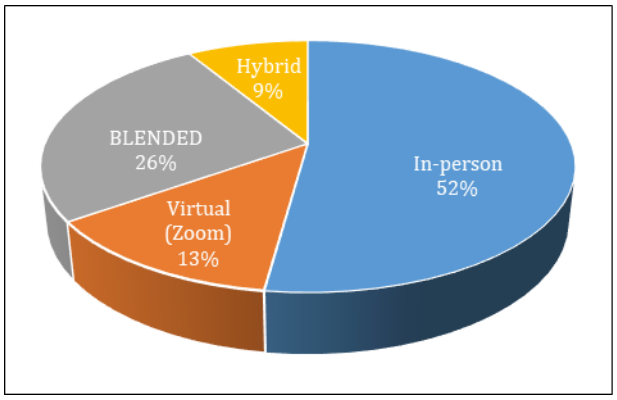


Figure 2: Distribution of delivery modalities used in gamification interventions in emergency medicine residency training.

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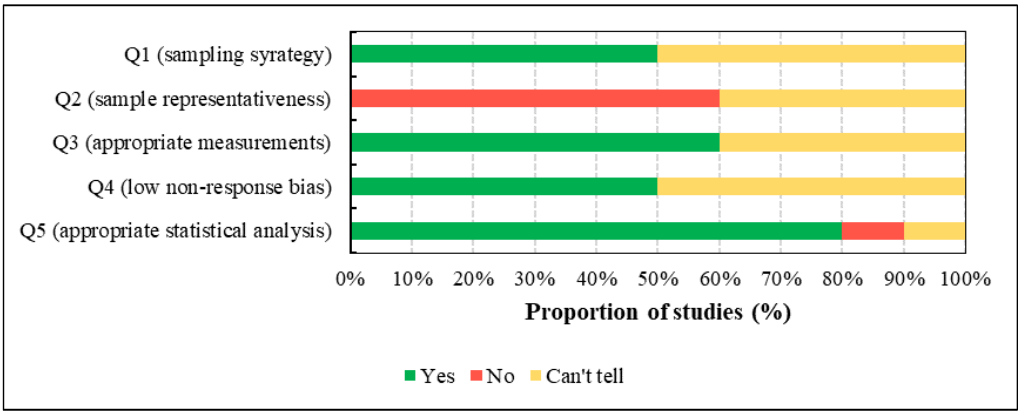


Figure 3: Methodological quality of quantitative descriptive studies was assessed using the relevant Mixed Methods Appraisal Tool (MMAT) criteria and assessment was performed at the item level. The figure presents the distribution of responses for each appraisal criterion.

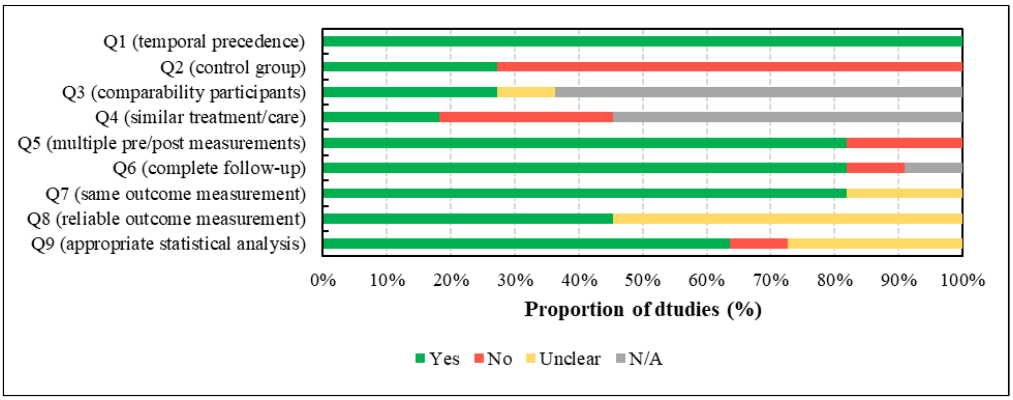


Figure 4: Methodological quality of quasi-experimental studies was assessed using the Revised Joanna Briggs Institute (JBI) Critical Appraisal Tool. Assessment was performed at the item level and the figure presents the distribution of responses for each appraisal criterion. N/A: Not Applicable.

Supplementary Table 1: Search strategy in different databases

PubMed
(gamification[Title/Abstract] OR gamif*[Title/Abstract] OR "game-based learning"[Title/Abstract] OR "serious game*"[Title/Abstract] OR "educational game*"[Title/Abstract] OR "simulation game*"[Title/Abstract] OR "escape room"[Title/Abstract] OR "game design"[Title/Abstract] OR "game-based"[Title/Abstract] OR "game mechanics"[Title/Abstract] OR "game elements"[Title/Abstract] OR "Gamification"[MeSH Terms] OR "Games, Experimental"[MeSH Terms]) AND (resident*[Title/Abstract] OR internship[Title/Abstract] OR residency[Title/Abstract] OR "medical trainee*"[Title/Abstract] OR intern*[Title/Abstract] OR "graduate medical education"[Title/Abstract] OR "Internship and Residency"[MeSH Terms]) AND ("emergency medicine"[Title/Abstract] OR "emergency department"[Title/Abstract] OR "emergency care"[Title/Abstract] OR "acute care"[Title/Abstract] OR "Emergency Medicine"[MeSH Terms])
Google scholar in English and Persian
2.1 ("gamification" OR "game-based learning" OR "serious game") "emergency medicine residency"
2.2. ("بازی‌وارسازی" OR "مبتنی بر بازی" OR "گیمیفیکیشن") (پزشکی)
Web of Science
("gamification" OR "game-based learning")
AND
("emergency medicine" OR "emergency department")
AND
("medical resident" OR "residency" OR "postgraduate medical education")
Scopus
TITLE-ABS-KEY(gamification OR gamified OR "game-based learning" OR "game design elements" OR "game design")
AND
TITLE-ABS-KEY("emergency medicine" OR "emergency medical services" OR "emergency care" OR "acute care")
AND
TITLE-ABS-KEY(resident OR residency OR "clinical resident" OR postgraduate)
AND
TITLE-ABS-KEY(education OR training OR "clinical training" OR "educational methods")
IEEE
gamification "emergency medicine" education

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