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Review Article

The Role of Gamification in Fostering Problem-Solving Skills Based on Connectivism Theory: A Narrative Review

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Abstract

Background: In the digital era, connectivism theory—which emphasizes knowledge networks and distributed interactions—offers a framework to address the limitations of traditional educational models. As soft skills, particularly problem-solving, become increasingly vital in medical education, gamification has emerged as a potential strategy to foster motivation and cognitive engagement. However, the conceptual synergy between connectivism and gamification in developing these skills remains underexplored.

Objectives: This narrative review aimed to synthesize current evidence on the role of gamification in fostering problem-solving skills within a connectivist framework in medical education.

Methods: A narrative review was conducted through a targeted search of PubMed, Google Scholar, and ScienceDirect for articles published between 2015 and 2025. The search focused on the intersection of connectivism, gamification, and soft skills. After screening based on predefined inclusion criteria, 28 relevant articles were selected for thematic synthesis.

Results: The synthesis indicates that gamification and multimedia technologies may support student motivation, active participation, and cognitive development. When grounded in connectivism, self-directed learning and networked interactions appear to facilitate a deeper understanding of complex clinical concepts. While challenges such as infrastructural limitations and suboptimal instructional design persist, the integration of these technologies shows potential for enhancing the quality of medical training.

Conclusion: Gamification, when aligned with connectivism theory, effectively fosters distributed problem-solving and clinical reasoning by leveraging network participation, immediate feedback, and collaborative digital environments. Future research should prioritize longitudinal evaluations and standardized effectiveness metrics.

Keywords: Connectivism; Gamification; Problem-Solving; Clinical Competence; Medical Education; Educational Technology

Background

In recent decades, medical education has required reconsideration of teaching and learning approaches due to transformations in healthcare, increasing clinical complexity, and technological advancements (1). With the digital era and widespread information access, traditional models are considered less sufficient, and classical theories such as behaviorism and cognitivism show limitations in addressing dynamic information networks (2). Connectivism has emerged as a novel paradigm proposed for the digital context (3), viewing learning as occurring within networks of human connections, technologies, and resources, where creating and leveraging these networks is considered an important competency (4). In medical education, amid complex environments and the demands of rapid decision-making, connectivism has been suggested to support lifelong learning through interdisciplinary interaction and active participation (5).

Given clinical complexity, developing higher-order outcomes—especially problem-solving—is important (6). Problem-solving, represented by the IDEAL model (Identify, Define, Explore, Act, Look back), involves five stages and is considered an active learning approach in

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clinical and outpatient contexts (7). Problem-based learning has been reported to support the development of problem-solving skills and related competencies, such as creativity, stress and time management, critical thinking, teamwork, and communication (8, 9). Educational technologies may contribute to clinical judgment and problem-solving by supporting patient assessment, problem identification, and decision-making in complex scenarios (10). Gamification has been introduced as an approach that may enhance motivation, engagement, and cognitive performance (11, 12), transforming learning into more engaging, learner-centered experiences and potentially supporting higher-order skills including problem-solving and decision-making (13, 14).

Game-based learning may deepen participation and understanding, making it relevant for networked learning environments. Integrating connectivism with gamification may enable medical students to practice complex skills such as problem-solving in interactive settings (15, 16). This approach may allow students to explore the consequences of their decisions in lower-risk environments and may support the development of clinical competencies in controlled settings (17, 18). However, challenges such as limited technological infrastructure, need for digital design expertise, and resistance to traditional methods may hinder implementation (19).

Despite advances in educational technologies, fostering problem-solving skills in complex clinical environments remains a challenge. While previous literature has explored gamification and connectivism separately, there is a lack of conceptual synthesis explaining how their integration specifically facilitates the iterative and networked nature of problem-solving in medical education. Grounded in connectivism theory, this study addresses this gap by providing a narrative synthesis of how gamification can serve as an approach for supporting problem-solving competencies, enhancing engagement, and contributing to the development of essential clinical skills in medical students.

Objectives

This narrative review aimed to synthesize current evidence on the role of gamification in fostering problem-solving skills within a connectivist framework in medical education.

Methods

This study was conducted as a narrative review, aiming to examine how connectivism theory is linked to the development of problem-solving skills through gamification within medical education. This type of review emphasizes selective and targeted analysis of scholarly sources and, rather than following the formal structure of systematic reviews, focuses on conceptual and interpretive synthesis of the literature (20).

To identify relevant studies, a targeted search was conducted in three databases: PubMed, Google Scholar, and ScienceDirect. The search strategy included keywords such as connectivism, problem-solving, gamification, soft skills, clinical education, and educational technology. These terms were combined in different combinations according to the search functions of each database. The publication period was limited to 2015-2025 to ensure the inclusion of recent and relevant studies reflecting contemporary developments in educational technology. Because this was a narrative review, the search strategy was targeted rather than exhaustive.

A total of 703 records were initially identified through the database searches (PubMed = 354, Google Scholar = 342, ScienceDirect = 7). Studies were screened in a stepwise manner based on titles, abstracts, and full-text review. After removing duplicates and irrelevant studies, 28 articles were included in the final narrative synthesis.

Inclusion criteria included English-language publications, full-text availability, relevance to one or more of the key concepts of the review, including connectivism, gamification, problem-solving, and clinical education, and a focus on educational technology in health professions education. Exclusion criteria included non-English publications, inaccessible full texts, and studies not aligned with the conceptual focus of the review.

Because this study was designed as a narrative review rather than a systematic or scoping review, independent duplicate screening was not undertaken. Study selection was guided by relevance to the review objectives, and uncertain cases were discussed among the authors to reach agreement. No formal risk-of-bias assessment or methodological quality appraisal was conducted, as the review was narrative and conceptual in nature. However, the included studies were considered in relation to their relevance, educational context, intervention focus, and contribution to the conceptual synthesis.

The selected studies were analyzed using a conceptual thematic analysis approach. This process involved repeated reading of the included studies, extraction of key concepts, identification of recurring patterns, grouping of related concepts into thematic

categories, and interpretation of these themes in relation to connectivism, gamification, and problem-solving in medical education. Findings were organized into thematic categories focusing on the application of connectivism theory in gamified educational interventions and its role in supporting problem-solving skills in clinical education. Data were synthesized in analytical tables to facilitate interpretation of recurring patterns across studies.

The overall process of study identification and selection is illustrated in Figure 1. The figure provides a visual summary of the literature search and screening pathway used in this review and is intended to enhance transparency in the reporting of the selection process.

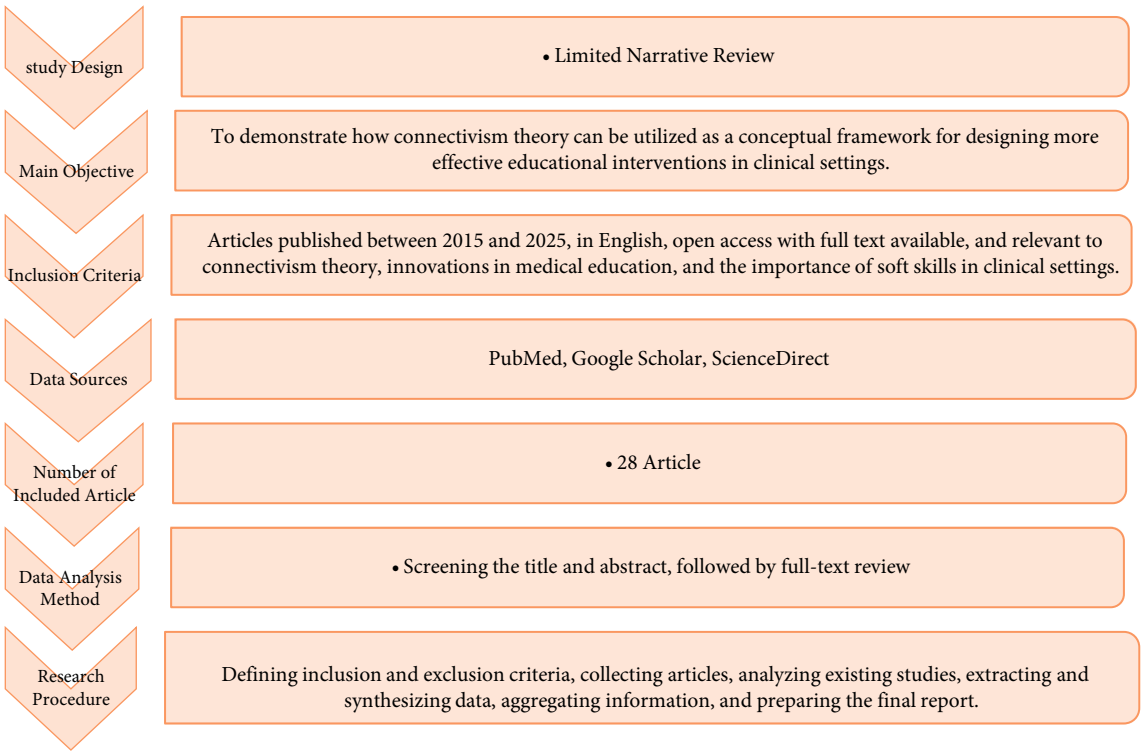

Figure 1. Overview of literature search, screening, and selection process

Results

The content analysis of the 28 selected articles in this study revealed that, despite variations in study designs, methodologies, and contexts, most studies emphasized common and key themes regarding the role of connectivism in supporting problem-solving through gamified clinical education. These themes are presented in Table 1 and are discussed in detail below.

1. The Role of Connectivism Theory in Promoting Learning and Active Participation

As an innovative approach in medical education, connectivism provides a conceptual framework for understanding the learning process within networks of communication and interactive technologies. By emphasizing the connections among knowledge resources, human interactions, and emerging technologies, this approach may foster active participation and interactive learning. Within this framework, gamification serves as a potentially useful educational strategy that, by creating competitive and interactive environments, may enhance students' cognitive engagement and facilitate a deeper understanding of clinical concepts. Immediate and continuous feedback, delivered through digital platforms and intelligent simulations, may promote self-directed learning and sustain interaction among the learner, content, and educational environment (2, 16, 21, 22).

2. Effectiveness of Gamification in Enhancing Motivation and Learning Engagement

Gamification, by incorporating competitive and reward-based elements, has considerable potential to increase intrinsic motivation and active learner engagement. This educational approach, by designing activities grounded in challenge, immediate feedback, and collaborative work, creates an engaging and purposeful learning environment. The outcomes reported across the reviewed studies suggest improvements in cognitive and emotional participation, academic performance, and inclination toward deep learning.

Table 1. Key Themes of the Findings

Extracted Themes	Description
Role of Connectivism Theory in Enhancing Learning and Active Participation (2, 16, 21, 22)	Distributed knowledge, networking, collaborative learning, immediate feedback
Effectiveness of Gamification in Increasing Motivation and Learning Engagement (15, 23–32)	Cognitive engagement, constructive competition, rewards, deep learning
Development of Problem-Solving and Critical Thinking Skills through Gamification (29, 30, 33–36)	Clinical reasoning, critical thinking, rapid decision-making, teamwork
Impact of Innovative Educational Technologies on Medical Learning (25, 31, 37, 38)	Augmented reality, intelligent simulations, interactive learning, safe environment
Challenges and Limitations of Implementing Gamification in Medical Education (39, 40)	Resource constraints, cultural resistance, competitive pressure, technological infrastructure

Note. *Summary of the key themes, descriptions, and corresponding source references identified through the narrative review of connectivism-based gamification in medical education.*

Implementing gamification in the form of clinical simulations or structured group activities may also promote interaction skills, facilitate better understanding of complex concepts, and reinforce learning retention (15, 23-32).

3. Development of Problem-Solving and Critical Thinking Skills through Gamification

From an educational perspective, gamification is considered a promising approach for enhancing problem-solving and critical thinking skills. By creating simulated clinical scenarios and challenging conditions, it exposes students to situations requiring analysis, reasoning, and rapid decision-making. Active engagement in such environments, combined with continuous feedback, may contribute to refinement of cognitive strategies, improvement in clinical data analysis, and enhancement of evidence-based decision-making. Additionally, the collaborative nature of many gamified activities may strengthen teamwork skills and the ability to manage complex situations (29, 30, 33-36).

4. Impact of Innovative Educational Technologies on Improving the Quality of Medical Learning

The application of innovative technologies, such as augmented reality and advanced simulations, has opened new horizons for enhancing the quality of medical education. Augmented reality, through interactive and three-dimensional representation of complex structures, not only may increase motivation and active engagement but also may improve spatial understanding and reduce conceptual difficulties. Intelligent simulations provide a realistic clinical environment with immediate feedback, offering safe and repeatable learning opportunities that may support clinical skills and decision-making. Integrating these technologies into educational programs, in addition to increasing learning effectiveness, may play a significant role in preparing students for real clinical settings (25, 31, 37, 38).

5. Challenges and Implementation Considerations of Gamification in Medical Education

Despite its numerous advantages, implementing gamification in medical education faces several barriers and limitations. Excessive competitive pressure, insufficient technological infrastructure, financial constraints, and cultural resistance to change are among the limiting factors. Locally adapted and contextually aligned instructional design is a key factor in increasing both effectiveness and acceptance of this approach. Neglecting to tailor gamification content and design features to the needs and characteristics of learners may reduce its effectiveness and even lead to negative learning experiences (39, 40).

Overall, the existing evidence indicates that combining connectivism theory, gamification, and innovative educational technologies may provide a useful conceptual and educational framework for enhancing problem-solving skills, motivation, and interactive learning in clinical medical education. A detailed summary of the 28 reviewed articles, including author, title, methodology, and main findings, is provided in the Table 2, "Characteristics and Key Findings of the Selected Studies."

Table 2. Characteristics and Key Findings of the Selected Studies

Author(s) & Year	Article Title	Method	Results
Huang WD et al., 2024 (14)	Reflecting on Gamified Learning in Medical Education: A Systematic Literature Review Grounded in the Structure of Observed Learning Outcomes (SOLO) Taxonomy 2012-2022	Systematic review collecting studies on gamification in medical education (2012–2022) and analyzing them using the SOLO framework to evaluate learning levels. Purposeful sampling was applied.	Gamification enhances analytical, evaluative, and creative learning and develops soft skills such as problem-solving and critical thinking in medical education.
Danka, 2020 (16)	Motivation by Gamification: Adapting Motivational Tools	A qualitative-analytical study conducted in Hungary, examining how the use of	Applying gamification motivational components in cMOOCs significantly

Author(s) & Year	Article Title	Method	Results
	of Massively Multiplayer Online Role-Playing Games (MMORPGs) for Peer-to-Peer Assessment in Connectivist Massive Open Online Courses (cMOOCs)	elements from multiplayer online games in cMOOCs based on connectivist theory enhances motivation in peer-to-peer assessment. Data were extracted and analyzed from content analysis of user interactions on educational platforms.	increased participation, self-regulation, and learning continuity, and improved peer assessment quality and motivation in instructor-free environments.
Bani Hashem et al., 2017 (21)	Connectivism: Implications for Distance Education	A qualitative study in Iran using deductive content analysis. Researchers purposefully sampled 10 published sources from 2007 to 2015 and analyzed them in six steps, focusing on key concepts of connectivism in technology-based learning.	Connectivism emphasizes the learner's role in building knowledge networks, interacting with diverse resources, and self-regulating technology-mediated learning. Effective communication, resource diversity, and continuous information flow are key components of these environments.
Amir Thalingam et al., 2023 (23)	Gamification through Collaborative Learning in Medical Education	A quasi-experimental study on first-year medical students at Pondicherry Institute of Medical Sciences, India. The intervention group participated in a collaborative learning program with gamification elements such as group scoring, challenge missions, and immediate feedback. Simple random sampling was used.	Intervention students showed significant improvement in analytical thinking, clinical problem-solving, teamwork, and intrinsic motivation compared to the control group.
Davis et al., 2024 (25)	Gamification, Serious Games, and Simulation in Health Professions Education: An Overview	Analytical review covering studies from 2015 to 2024; data extracted from major databases to examine gamification, serious games, and simulation in health professions education.	Gamification and serious games are effective in increasing motivation, engagement, practical skills, and critical thinking in health professions students.
McCoy et al., 2016 (26)	Gamification and Multimedia for Medical Education: A Landscape Review	A review study conducted in the United States, searching PubMed and Google Scholar up to 2016. Relevant articles on gamification and multimedia in medical education were collected and categorized based on educational application, tool type, learning objective, and effectiveness.	Gamification and multimedia in medical education are expanding, though most studies are in early stages. Preliminary evidence indicates increased motivation, engagement, self-directed learning, and cognitive improvement through these technologies.
Nylén-Eriksen M et al., 2025 (27)	Game-thinking: Utilizing Serious Games and Gamification in Nursing Education – A Systematic Review and Meta-Analysis	Systematic review and meta-analysis following PRISMA 2020, with comprehensive search across six databases; 70 studies on the effectiveness of serious games and gamification in theoretical and practical nursing education were analyzed.	Game-thinking with serious games and gamification significantly improved academic performance in nursing students (effect size 0.99), with greater impact on theoretical knowledge than practical skills; motivational elements enhanced engagement and deep learning.
Pawar et al., 2024 (28)	Gamification in Medical Education: A New Approach	Descriptive review in India, searching PubMed, Scopus, and Google Scholar to examine the effect of gamification on motivation, engagement, and active learning in medical education.	Gamification, especially in clinical courses, increased motivation, active learning, engagement, and concept comprehension; using elements like scoring and real-world scenarios enhanced student participation.
Pepin et al., 2019 (29)	Gamification: An Innovative Approach to Reinforce Clinical Knowledge for MD-PhD Students During Their PhD Research Years	A descriptive-applied study at the University of Michigan, USA, involving MD-PhD students during their PhD research years. Researchers designed a digital educational game to maintain and reinforce clinical knowledge during non-clinical periods. Data were collected via satisfaction questionnaires, qualitative feedback, and in-game performance.	Educational games effectively maintained clinical knowledge, increased active engagement and interest in clinical learning, and reduced the gap between theoretical and practical knowledge among non-clinical students.
Sadati et al., 2025 (30)	5cardsgame, Innovative Comprehensive Integrative Puzzle to Enhance Clinical Reasoning in Surgical Technologist Students: A Pre-Experimental Study	Pre-experimental study at Alborz University of Medical Sciences; surgical technologist students purposefully selected and trained with the 5cardsgame puzzle for one semester.	The comprehensive puzzle game significantly improved students' clinical reasoning and critical thinking skills.

Author(s) & Year	Article Title	Method	Results
Walker et al., 2022 (31)	Leveraging Technology and Gamification to Engage Learners in a Microbiology Curriculum in Undergraduate Medical Education	An interventional study at the University of Alabama Medical School on second-year microbiology students. The gamified program included online competitive quizzes, scoring activities, and interactive learning sessions to assess its impact on student engagement and learning.	Gamification increased active engagement, intrinsic motivation, and conceptual learning, resulting in improved academic performance and high student satisfaction with the learning approach.
Mansoory MS et al., 2024 (32)	Effectiveness of Gamification-Based Teaching in Approach to Eye Trauma: A Randomized Educational Intervention Trial	Randomized experimental study at Kermanshah University of Medical Sciences, Iran, assessing gamified teaching on medical students' knowledge and skills in eye trauma. Participants randomly assigned to gamified vs. traditional teaching groups.	Students in the gamified group showed significantly improved clinical skills in eye trauma, problem-solving, motivation, and engagement.
Lee C-Y et al., 2025 (33)	Emerging Trends in Gamification for Clinical Reasoning Education: A Scoping Review	Scoping review of articles published between 2015–2024 on gamification in clinical reasoning education; resources collected from international databases and analyzed thematically to identify emerging trends.	Gamification enhanced motivation, engagement, problem-solving, and clinical reasoning skills in medical students; interactive technologies and collaborative learning facilitated concept deepening in clinical education.
Rushdan et al., 2025 (34)	Effect of an Escape Room as a Gamification Evaluation Tool on Clinical Reasoning and Teamwork Skills among Nursing Students: A Quasi-Experimental Study	Quasi-experimental study at an Egyptian higher education institute; 92 nursing students randomly assigned to two groups. Data collected via questionnaires and statistical analysis.	Escape room participation improved clinical reasoning and teamwork skills significantly compared to control; the interactive method increased motivation, collaborative learning, and satisfaction.
Salafia MA et al., 2025 (35)	Game-Based Educational Experience in Clinical Simulation and Academic Achievement in Medical Students: A Retrospective Study	Retrospective study at a Spanish university; purposeful sampling of medical students participating in clinical simulation courses with gamification. Data analyzed from academic records and experiences.	Gamification in clinical simulation enhanced academic performance and clinical skills of medical students.
Shadan M et al., 2025 (36)	Diabe-teach: A Randomized Controlled Trial of a Gamified Approach to Enhance Medical Undergraduates' Knowledge and Comprehension of Diabetes Mellitus	Randomized interventional study at Dubai Medical College with 56 medical students; intervention group used the Diabe-teach gamified learning tool, control group received traditional instruction. Pre- and post-tests assessed knowledge.	Both groups improved in post-test scores, but the gamified group performed better, with higher ability to identify knowledge gaps, increased motivation, communication skills, and preference for game-based learning over traditional methods.
Choubdaran E et al., 2024 (37)	Application of Augmented Reality Technology in Anatomy Education: A Review Article	Narrative review searching PubMed, ScienceDirect, and Google Scholar (2012–2022), analyzing studies on augmented reality in anatomy education for medical students.	Augmented reality increased motivation, active participation, and 3D understanding, facilitating comprehension of complex structures, shortening learning curves, and improving teaching efficiency in resource-limited or crowded settings.
Masters et al., 2024 (38)	Online Learning in Health Professions Education	A scoping review at Sultan Qaboos University, Oman, analyzing English articles from 2010–2021 in PubMed, Scopus, and ERIC. Out of 330 articles, 84 met inclusion criteria for analysis of trends, tools, and innovative online teaching methods in health professions education.	Educational technologies such as gamification, simulation, and problem-based learning are expanding in health professions education, and when combined with self-directed and collaborative learning, they enhance cognitive, behavioral, and problem-solving skills.
Kirsch et al., 2023 (39)	Caution with Competitive Gamification in Medical Education: Unexpected Results of a Randomized Cross-Over Study	A randomized cross-over trial at LMU Munich with second-year medical students comparing competitive gamified vs. traditional physiology teaching. A software tool with competitive badges was used; assessment via progress tests and learning perception questionnaires.	Competitive gamification produced heterogeneous results; no clear impact on academic performance and, in some students, reduced motivation and increased stress due to competition.
Tabassum, 2024 (40)	Challenges of Implementing Gamification in Medical	Scoping review searching PubMed, Scopus, and Web of Science; 45 relevant articles published between 2010–2023	Key barriers included cultural resistance, lack of infrastructure, need for training, design complexity, long-term

Author(s) & Year	Article Title	Method	Results
	Education: A Scoping Review	analyzed to identify barriers and challenges in gamification implementation.	motivation decline, and unclear effectiveness assessment.
Prochazkova K et al., 2019 (42)	Teaching a Difficult Topic Using a Problem-Based Concept Resembling a Computer Game: Development and Evaluation of an E-Learning Application for Medical Molecular Genetics	A developmental-evaluative study conducted at Charles University, Czech Republic, with voluntary sampling. Medical students participated in a problem-based gamified software environment for learning molecular genetics. Data were collected via questionnaires and performance analysis and compared using statistical tests.	Participants achieved significant understanding of molecular genetics, and engagement, motivation, and satisfaction were significantly higher in the gamified group compared to traditional methods.
Hicke Y et al., 2026 (43)	MedSimAI: Simulation and Formative Feedback Generation to Enhance Deliberate Practice in Medical Education	Quantitative experimental study in a U.S. university; medical students used an AI-based simulation system for deliberate practice and feedback. Sampling was convenient and data analyzed statistically.	Intelligent simulation with immediate and continuous feedback significantly improved clinical skills and decision-making, enhancing focus and depth of learning.
Ishizuka K et al., 2023 (44)	The Influence of Gamification on Medical Students' Diagnostic Decision Making and Awareness of Medical Cost: A Mixed-Method Study	Mixed-method study at Tsukuba University, Japan, with clinical medical students. Gamified simulation platform designed for diagnostic decision-making and medical cost awareness. Quantitative data (pre- and post-questionnaires) and qualitative content analysis were collected.	Gamification improved diagnostic decision-making accuracy and students' awareness of medical costs; interactive experience with immediate feedback enhanced participation in the diagnostic process.
Gaalen et al., 2021 (45)	Gamification of Health Professions Education: A Systematic Review	A systematic review at Utrecht Medical School, Netherlands, using structured searches in PubMed, Scopus, and ERIC. Thirty articles on gamification in health professions education between 2000 and 2020 were analyzed based on game type, educational context, learning outcomes, and intervention design.	Gamification in health education was mainly implemented through digital games, scoring, competition, and immediate feedback, generally improving motivation, engagement, and cognitive skills, although design quality and evaluation varied across studies.
Sannathimmappa MB et al., 2022 (46)	Learning out of the Box: Fostering Intellectual Curiosity and Learning Skills among Medical Students through Gamification	An interventional study at Sultan Qaboos University, Oman, on third-year medical students. The gamified program included competition, rewards, interactive quizzes, and scoring; total sampling of volunteers was conducted.	Gamification increased intellectual curiosity, independent learning, and active student engagement, resulting in higher satisfaction and better concept comprehension compared to traditional instruction.
Zhu et al., 2025 (47)	Transforming Molecular Diagnostics Learning: The Power of Gamification in Higher Medical Education	Quasi-experimental study on graduate medical students in molecular medicine in China; participants randomly enrolled in a gamified course.	Gamification enhanced motivation, active engagement, and deep learning in molecular diagnostics, facilitating understanding of complex concepts.
Lee DZ et al., 2021 (48)	Insights for Medical Education: Via a Mathematical Modelling of Gamification	An original study of 100 medical students over four years using the Personal Responsibility Orientation to Self-Direction in Learning Scale (PRO-SDLS). Gamified clinical-anatomy maze activities and Script Concordance Tests were examined using paired t-tests and logistic regression to study motivation, control, self-efficacy and initiative.	The combined maze and Script Concordance Test approach was associated with significant gains in self-efficacy and initiative ($p < 0.05$). Motivation did not improve significantly with the maze alone; students' comments indicated that the activities were engaging and useful for anatomy learning.
Lee JX et al., 2023 (49)	Open Distance Learning in Medical Education: Does It Improve Students' Motivation?	An observational questionnaire-based study at Universiti Kebangsaan Malaysia, comparing undergraduate medical students before and during COVID-19 (n = 302; 150 before and 152 during). Digital learning usage and learning motivation were assessed using questionnaires, including the Students Motivation towards Science Learning (SMTSL) scale; group comparisons and association analyses were performed	Digital learning use increased significantly during COVID-19, particularly among clinical students, whereas overall learning motivation did not differ significantly between the pre-pandemic and pandemic groups ($p = .872$). Higher digital learning use was associated with learning motivation; these observational findings do not establish a causal effect of gamification or connectivism on problem-solving

Note. *Characteristics, methodologies, educational interventions, and principal findings of studies on gamification, connectivism, and problem-solving in medical education.)*

Discussion

This review suggests that integrating gamification with connectivism creates a powerful synergy for developing clinical reasoning and problem-solving skills. Rather than acting as a standalone tool, this integration serves as a theoretically informed strategy that prioritizes learner interaction, feedback, and active engagement. It shifts the learning process from passive reception to a participatory, self-regulated activity, allowing students to synthesize diverse knowledge resources effectively.

Connectivism reframes learning as participation in knowledge networks. This perspective is vital for medical students, who must navigate scattered, multi-sourced information to reach clinical decisions. In digital environments, it encourages learners to actively integrate and apply what they acquire (2).

Research consistently indicates that gamification—when anchored in principles of connectivism —boosts intrinsic motivation and refines critical thinking and problem-solving (26, 41, 42). Gamification has been investigated as a strategy to promote active participation and support self-directed learning among medical students (41). Likewise, immersive game-based simulations force students to tackle realistic scenarios, which directly hones their problem-solving tactics (35, 43). While these findings align with Carcamo et al., who show that combining problem-based learning with gamification sparks creativity (24), we must be careful. An overemphasis on competition can stifle collaboration or trigger anxiety (39). Therefore, interventions require a balanced design that respects individual differences and environmental context (25, 40). Ultimately, the value of gamification lies not just in game mechanics, but in how well those mechanics align with specific clinical learning goals.

Regarding theory-based design, Huang et al in 2024 recommend aligning with the SOLO framework to ensure students' progress through levels of conceptual complexity (14). Active learning strategies are indispensable here; online or blended environments, when guided by connectivism, provide a structure for students to handle complex clinical problems (38). Evidence also indicates that gamification is linked to stronger reasoning skills in medical decision-making contexts (30, 33, 44). This suggests that gamified environments work best when they are not only used to reward students but also to actively guide them through progressive reasoning and reflection cycles.

Danka's work on connectivist MOOCs illustrates that gamified designs in open learning environments significantly lift motivation and cognitive engagement (16). Similarly, Shadan et al. found that educational games in diabetes training improved both conceptual understanding and clinical application. The strength of this body of research lies in its methodological diversity and practical relevance. It confirms that modern learners need what connectivism offers: active involvement, continuous assessment, and immediate feedback (36).

Despite these benefits, the literature reveals significant gaps. Some studies lack a firm theoretical framework or rigorous instructional design; others prioritize entertainment over conceptual learning and ignore long-term impact (39, 40). We must therefore view the reported benefits with caution—short-term engagement spikes are not the same as long-term clinical competence.

A significant limitation of our current knowledge is the lack of systematic research explicitly applying connectivism to medical instructional design. Furthermore, the sheer diversity in contexts, populations, and soft-skill assessment tools makes cross-study comparisons difficult. Given the narrative nature of this review, these findings represent a conceptual synthesis rather than definitive proof of efficacy.

This review offers a fresh perspective by centering problem-solving as a core component of professional competence. Future research should prioritize explicit integration of connectivism in technology-enhanced interventions, specifically targeting higher-order thinking such as clinical reasoning. We need longitudinal studies using standardized tools that account for cultural and educational diversity. As soft skills become increasingly central to medical practice, applying connectivism alongside gamified, problem-based designs stands out as a promising path forward. These methods can deepen motivation and practical competence, providing a solid foundation for curricular revisions that prepare students for the complexities of modern clinical environments.

Conclusion

The findings of this narrative review suggest that aligning gamification with a connectivism framework may support active learning and the development of higher-order skills, particularly problem-solving, in medical education. By viewing learning as participation in evolving digital and social knowledge networks, connectivism offers a useful basis for designing learning environments that foster critical thinking, adaptability, and self-regulation. When aligned with clear learning outcomes, gamified and technology-enhanced

approaches may help create more engaging and educationally meaningful experiences. However, as this review provides a conceptual rather than systematic synthesis of the literature, its conclusions should be interpreted with caution. Further longitudinal and context-sensitive research is needed to determine whether these benefits translate into sustained improvements in clinical reasoning and real-world performance.

Consequently, medical school curriculum developers and instructional designers are advised to deliberately integrate connectivism-aligned gamification strategies into digital medical curricula to optimize collaborative clinical problem-solving and learner engagement.

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Data Availability: No new datasets were generated or analyzed during this study. All information discussed in this narrative review is derived from previously published literature, which is cited in the manuscript.

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