Received: 15 May 2022 | Accepted: 27 May 2022

DOI: 10.1002/ca.23916

EDUCATION

CLINICAL ANATOMY WILEY

Benefits of gamification in medical education

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Abstract

Medical education is changing at a fast pace. Students attend medical school with a high degree of technological literacy and a desire for a diverse educational experience. As a result, a growing number of medical schools are incorporating technology-enhanced active learning and multimedia education tools into their curriculum. Gamified training platforms include educational games, mobile medical apps, and virtual patient scenarios. We provide a systematic review of what is meant by gamification in this era. Specific educational games, mobile apps, and virtual simulations that may be used for preclinical and clinical training have been discovered and classified. The available data were presented in terms of the recognized platforms for medical education's possible benefits. Virtual patient simulations have been shown to enhance learning results in general. Gamification could improve learning, engagement, and cooperation by allowing for real-world application. They may also help with promoting risk-free healthcare decision-making, remote learning, learning analytics, and quick feedback. We account for Preclinical training which included 5 electronic games and 4 mobile apps, while clinical training included 5 electronic games, 10 mobile applications, and 12 virtual patient simulation tools. There were additionally nine more gamified virtual environment training products that were not commercially accessible. Many of these studies have shown that utilizing gamified media in medical education may confer advantages. This collection of hyperlinked resources may be utilized by medical students, practitioners, and instructors at all levels.

KEYWORDS
education, gamification, medical, strategies, teaching-learning, tools

1 | INTRODUCTION

Gamification is a contemporary novel field of educational science (Gentry et al., 2019; Rodrigues et al., 2019), comprising in the development of game physical characteristics in non-game contexts, and teaching-learning sessions for the purpose of knowledge acquisition (Alsamawi & Kurnaz, 2021). The evidence for gamification in a broader educational setting is increasing (Dichev & Dicheva, 2017; Smiderle et al., 2020), and the idea is gaining momentum in the medical education field (Nevin et al., 2014; Ohn & Ohn, 2020) Using the Medical Education Research Study Quality Instrument (MERSQI) scale, a recent systematic review found modest support for the use of serious games with an educational aim as an addition to conventional techniques (Gorbanev et al., 2018). Although it is often lumped in with game-based learning or serious games, gamification is a separate entity (Gorbanev et al., 2018). Gamification is the application of game concepts to the learning process, such as a narrative and progress tracking mechanisms, to make it more enjoyable and engaging. Game-based learning involves modifying a game to teach a

specific skill or learning result, such as Name-that-tune to Name-that-murmur (Connolly et al., 2012). Serious games, on the other hand, are games created for goals other than amusement, such as teaching or behavior modification. However, gamification, game-based learning, and serious games all seek to make learning more interesting and inspiring via the use of game related mechanisms. Medical education games, mobile apps, and virtual patient simulations (together referred to as "gamified training platforms") have been created for both preclinical and clinical medical education during the last 20 years (McCoy et al., 2016). Fold It, an online puzzle based on protein folding, to the Nuclear Event Triage Challenge, in which participants must triage patients during nuclear events, are just a few examples. Gamification's capacity to enable learners to traverse complicated systems via gaming processes provides unique learning possibilities. This method requires active participation from students, and it could impact behavior and create motivation (Beylefeld & Struwig, 2007; Bochennek et al., 2007; Hill Robert & Nassrallah, 2018). The objective of this review is to describe existing gaming tools for medical education. We begin by discussing the educational benefits of gamified learning methods and technologies. Second, we offer examples of electronic medical education games, mobile apps, and virtual patient simulations (together referred to as gamified training platforms) that are appropriate for general preclinical and clinical medical education.

2 | LITERATURE REVIEW

Via a systemic review using keywords such as "gamification", "games" and "platforms" via databases such as PubMed, Google scholar etc., the following pointers were discovered. Furthermore, readers should have a good understanding of the below terms:

Electronic games are instructional methods that encourage students to win a certain activity with predefined rules (Akl et al., 2010).

Medical mobile apps are software programs that are utilized on portable devices such as PDAs, cell phones, and tablets. Clinicians are increasingly using mobile apps in their practice. These apps are especially helpful during training days (Mosa et al., 2012; Ventola, 2014a).

Virtual patients (VPs) are interactive digital simulations of clinical scenarios for the purpose of health professions education (Kononowicz et al., 2019). VPs could successfully inflate skills, and effectively improve knowledge regarding clinical aptitude. Better-quality skills attained regarding clinical reasoning, procedural skills, and a mix of procedural and team skills. These learning activities often called as situated learning - a process in which trainees acquire orientation to a professional culture by engaging in practice activities via a restricted, supervised apprenticeship and progressively taking on more responsibility over time (Ellaway et al., 2008).

3 | HOW TO MAKE GAMIFICATION WORK?

1. Make learning fun;
2. Improve the motivation;
3. Using rewards system;
4. Make use of suitable narratives;
5. Make use of experiential learning;
6. Use feedback;
7. Ensure sustainability;
8. Use technology;
9. Learning requires repetition;
10. Use competition;
11. Collaboration is essential;
12. Ensure diversity.

3.1 | Make learning fun

Fontijn and Hoonhout (2007) describes fun as an evolutionary strategy for rewarding specific behaviors, such as utilizing skills and information to improve survival chances. Games, by their very nature, need active participation from students (Fontijn & Hoonhout, 2007). There is evidence that learning-related functional changes in the brain happen best when you are actively engaged. Fun may be defined in three ways: achievement, discovery, and bonding. A practical approach to maximize enjoyment in gamification is to appeal to each of these three sources (Awan et al., 2019; Fontijn & Hoonhout, 2007; Rudolphi-Solero et al., 2021).

3.2 | Improve the motivation

Motivation simply means that individual is fired up and highly driven to achieve his/her goal (Babenko et al., 2019; Cook & Artino Jr., 2016). Learners in medical school must be motivated to complete their courses and become effective doctors (Goel et al., 2018; Wouters et al., 2016). Extrinsic motivation refers to doing something because it leads to a particular tangible result, while intrinsic motivation refers to doing something because it is pleasant or inherently fascinating (Cerasoli et al., 2014; Wu et al., 2020). The 'over-justification effect' in which extra external encouragements diminish a student's intrinsic hunger for the topic is a risk of gamification (Singhal et al., 2019). There is no clear conclusion in the research as to whether gamification has a greater effect on intrinsically driven or extrinsically motivated learners (Alsawaier, 2018). According to Buckley et al. (2016), gamification has a variety of effects on learners, with intrinsically driven learners being the most affected. In contrast to extrinsic motivation, studies have demonstrated that intrinsic motivation leads to higher creativity, cognitive flexibility, conceptual learning, and improved well-being (Buckley & Doyle, 2016). Gamification may consequently act as a catalytic agent for offer students with an extrinsic incentive in the process of short-range perquisites (Singhal et al., 2019). As a result, through boosting external rewards, gamification could rekindle intrinsic drive by piquing curiosity and interest in the core topic in a fun manner (Dichev & Dicheva, 2017; Xu et al., 2021).

3.3 | Using rewards system

Rewards refer to a system that enable a student to track their progress and receive incentives as they advance (Rademacher et al., 2017). Medical school knowledge often split up in two forms: factual and procedural (Augustin, 2014). Medical educationalists frequently prefer imitations, replications, and tests-based games captivated on knowledge preservation and capability to acquire skill through repetition (Sinclair et al., 2016). Each learner has a level (e.g., beginning at level 1), and they level up each time they get a specific score on a quiz (Baron et al., 2020; Sladek et al., 2016). As medical student improves their levels to solve more difficult questions, thereby earns perks, such as badges, character improvements, and progress bars (Gibbs et al., 2016; Sardi et al., 2017). This notion has been successfully used in the gaming teaching-learning sessions, yielding extremely addictive positive impact in earning knowledge (Gorbanev et al., 2018). Several long-term benefits of gaming and reward strategy in medicine education are observed (Akl et al., 2013; Ghelfenstein-Ferreira et al., 2021; Nicolaidou et al., 2015). Earning levels or badges via progress mechanisms may help bridge the gap in the near term. On a neurobiological level, immediate incentives may enhance learning and promote engagement with learning processes (Balleine, 2011; Howard-Jones et al., 2015; Kim, 2013). By dividing things down into smaller, more manageable areas, it may also help establish clear goals and objectives. As a result, progress mechanisms serve as another extrinsic incentive for users to interact with content (Ryan & Deci, 2000).

3.4 | Make use of suitable narratives

Humans use narratives to comprehend the world around them and remember past events (Dahlstrom, 2014; Downs, 2014; Luna-Nevarez, 2021). Learner participation in games helps to build narratives in which learning is entrenched that could help to improvise memory (Mitchell et al., 2004). Narrative synthesis often achieved by immersing learners in a gaming environment where they can perform actions and then observe and react to the results, effectively linking cause and effect (Radianti et al., 2020; Sung et al., 2016). A game could, for example, provide a medical student with a simulated case that includes the signs and symptoms of a particular illness and ask them to choose a therapy from a selection of alternatives (Helm & Jones, 2016; Ventola, 2014a; Ventola, 2014b). The implications of the learner's decision - how the patient reacts to the therapy—are displayed when the learner chooses their treatment (Durham & Alden, 2008; P, 2008). As a result, a brief story about the condition's therapy is produced that is unique to the learner. In the context of trauma triage, this kind of learning intervention has been demonstrated to enhance performance invalidated simulator tests (Mohan et al., 2018).

3.5 | Make use of experiential learning

Medical, nursing and health science course work often utilizes experiential learning method to develop clinical skills among learners. Experiential learning includes peer physical examination and peer-assisted learning where students act as patient for their peers to acquire practical clinical skills on each other (Grace et al., 2017; Grace et al., 2019). Additionally, effective clinical instructional techniques is indispensable in medical and health professional education (Burgess et al., 2020; Yang et al., 2014). Moreover, medical educators scarcely ever obtain proper training in effective clinical instructional process (Buja, 2019; Low et al., 2020; Singh et al., 2013). Again, available well-recognized guide to train medical educators to clinical aspects are every so often dreary and need substantial period and exertion (Ramani & Leinster, 2008; Yang et al., 2014). An American educational theorist David Allen Kolb developed the learning cycle involves "four stages, namely: concrete learning, reflective observation, abstract conceptualization and active experimentation"(Kolb & Kolb, 2005). Kolb's experiential learning theory inspires learners to pick up knowledge and skill actively and correspondingly improve critical thinking process (Akella, 2010).

3.6 | Use feedback

As a result, feedback engages students in the learning process and improves retention, enabling them to move toward their ultimate objective. Therefore, feedback and subsequent learner growth are as important in gaming as they are in the educational, experiential learning cycle. It has been reported that a crucial element in success is striking a balance between learning and gaming. There are several cautions to guarantee meaningful feedback in gamification, according to the research. For example, in contrast to existing educational methods, feedback should either be given often and immediately or in shorter cycles. The higher the learning efficacy and engagement, the more regular and quicker the feedback is. The flow state, which is defined as a state of involvement and immersion in an activity and is an essential aspect of gaming, has also been proven to benefit from clear and fast feedback. A post-game will be required if feedback is not included in the game mechanics (Ravyse et al., 2017).

3.7 | Ensure sustainability

When compared to conventional learning techniques, creating gamification learning materials may require more time and effort. When instructor resources are already stretched tight, this may be a major impediment. As a result, gamification may be best suited to instruction that is repeated many times to different groups of students. On the other hand, customized training sessions, such as bedside teaching, may be more difficult to integrate. It is crucial to think about how game components may be shared and utilized by others. Clear instructions may help future instructors or learners utilize the material independently. Consider how resources may be utilized in a sustainable manner over a long period of time. Such as using patient ages instead of dates of birth in clinical situations, particularly in pediatric education. Paper materials may be laminated to avoid

deterioration, or electronic resources can be used to reduce the environmental effects. Online gamification materials may be readily reproduced and disseminated across time zones and geographical borders. There are banks of existing materials in several gamification repositories that may be utilized and changed (e.g., Quizlet, Anki, Nearpod, etc.) (Choules, 2007).

3.8 | Use technology

Although the use of technology in gamification for medical education is not required, some participants say that it makes the process more manageable by recording achievements, assigning points, and aggregating results. Furthermore, as each generation of students enters medical school with a greater level of digital literacy, technology is becoming increasingly essential and ubiquitous. As a result, the use of gamified training platforms to improve medical education is becoming a popular resource for clinicians at all stages of training, not only for instructors in the classroom or for learners individually. Players face genuine difficulties in video games based in virtual worlds influenced by everyday life. This may lead to more genuine learning, which is beneficial in making real-world decisions. For example, trainees may practice triaging patients and making choices depending on their clinical condition in an A&E setting. Using technology in this manner may help to make a session more realistic and relevant. Gamification with technological enhancements may also increase engagement, problem-solving, and cooperative collaboration. These abilities will be critical in the future delivery of healthcare. In a social context, games are based on interaction with other participants. TurningPoint (Turning Technologies, LLC), Bravo (C-3 software), and DecisionSim are some examples (Kynectiv, Inc.). Gameplay could link players to learning groups, allowing for broader contemplation and planning. In the future, medical education will likely put a greater focus on the use of creative technologies to create collaborative multimedia projects (McCoy et al., 2015).

3.9 | Learning requires repetition

Although gamification may be used to teach new ideas, it can also be used to consolidate information and enhance memory in a review environment. Medical students must memorize a lot of facts, and repetition is essential for learning and retention. However, in an already condensed medical school curriculum, where many interests compete for time and space, subject repetition may be difficult to accomplish. Gamification, which is usually quick-fire, may cover a wide range of subjects in a short amount of time. Furthermore, assessing students is more effective than presenting information repeatedly, as is promoting active memory. While it may be tempting to use gamification to cover a wide variety of topics, repetition may be a more effective method of reinforcing learning. Repeated inquiries may help to solidify a shaky understanding of information, such as the stages of the asthma "treatment ladder." Similarly, repeating themes enables students to look at the same subject from various perspectives, such as the side effects of each medication, contraindications, and necessary monitoring. Returning to the same theme enables students to develop a multi-faceted understanding of the subject, which is consistent with a constructivist approach to learning. Spaced repetition (i.e., exposing the learner to the information at increasing time intervals) has been shown to improve long-term memory. Certain gamification components, such as Anki flashcards, include this. By stimulating the reward and reinforcement brain circuits, repetition also feeds the addictive aspects of gamification. Candy Crush and Farmville, for example, have made extensive use of this technique (Nevin et al., 2014; Van Gaalen et al., 2021).

3.10 | Use competition

A healthy dose of competition may boost learning motivation and engagement, particularly among peers who see each other as intellectual equals. In the classroom, competition may result in monetary prizes or just the "prestige" of winning. Competition may raise stress levels, which can affect learning in many ways. While a certain amount of stress may be helpful, excessive stress can hinder learning. Some believe that competition encourages students to concentrate on the goal rather than the learning process and that competition-related stress has a larger detrimental impact than the advantages. When introducing a competitive aspect to teaching, it is critical to examine how to manage stress levels. A pleasant low-stakes quiz, for example, may induce a healthy degree of stress, while completing quiz questions in front of a big audience may induce a level of stress that is harmful to learning. As a result, a balance between competitiveness and collaboration is optimal. Learning in teams may reduce stress levels in competition to some extent since this distributes the blame for failure (Janssen et al., 2015).

3.11 | Collaboration is essential

Despite the apparent connections between gamification and competitiveness, we suggest focusing on cooperation when bringing gamification to the classroom to reduce stress levels. Gamification may help facilitate collaborative learning by allowing pairs or groups of learners to work together on a common objective or issue. This enables people to share their skills and expertise while also dispersing responsibilities across the group. Collaborative learning has been proven to lead to greater performance, more supportive relationships, and improved self-esteem when students work together toward a shared objective. These social features are used in many games and applications to create a feeling of community and increase engagement. In medical education, there is a developing awareness of how social media sites like Twitter and Facebook may enhance learner involvement and cooperation. The social element of education, where learning happens via the dynamic interaction of the person with

others, is emphasized by the social cognitive theory. Gamification may also help students learn outside of the classroom by fostering learning communities and providing a social support system, as well as enhancing interpersonal skills. Only if gamification is promoted in a pleasant, supportive learning atmosphere will it be successful (Jackson et al., 2018).

3.12 | Ensure diversity

Learners will bring a diverse set of information, skills, previous experiences, and personal characteristics to gamification. In the classroom, successful gamification creates an atmosphere that combines all of these. Learners have different preferences for how information is presented and how they learn. According to Tomlinson et al. (2003), differentiated teaching examines how the instructor might account for these differences in the classroom. Gamification enables close monitoring and evaluation of learner capacity, which is essential for successful differentiated teaching. Furthermore, gamification adds diversity and freshness to the classroom, which may appeal to the interests of certain students. Consider how learners may collaborate to pool their varied expertise when developing gamification components for the classroom. If they require a diverse set of abilities, such as speed, accuracy, visual interpretation, and hand-eye coordination, they may appeal to a wider audience (Tomlinson et al., 2003).

4 | EXAMPLES OF GAMIFICATION IN MEDICAL EDUCATION

These were the platforms discovered in our research, and they were classified as suitable for either preclinical or clinical training.

4.1 | Preclinical training

Five electronic games and 4 mobile apps were identified as gamified teaching platforms for preclinical instruction (Table 1).

4.2 | Clinical training

Five electronic games, 10 mobile apps, and 12 virtual patient simulation tools for healthcare teaching were found during the research (Table 2).

4.3 | Exploratory studies

Some games and simulations created by medical education faculty are not still in the exploratory phase. Nonetheless, these may be of interest to academics or researchers (Table 3).

TABLE 1 Highlights the characteristics and benefits of each platform and organizes them by platform type

Title	Publisher	Description	Advantage
Electronic Games			
3D Anatomy	Cyber-Anatomy, Inc	Virtual dissection tool	Increased engagement
Bravo	C3 Softworks	Customizable game templates for any topic	Increased engagement Enhanced collaboration Real-world application Clinical decision making
Fold It	Center for Game Science	Online puzzles about protein folding	Increased engagement Distance training
Quizlet	Quizlet, LLC	Tools for studying: flashcards, quizzes, games; able to create your own	Enhanced collaboration Distance training
TurningPoint	Turning Technologies, LLC	Game-based assessment delivery and data collection for learning environments	Increased engagement Enhanced collaboration
Mobile Applications			
Doctor's Dilemma	American College of Physicians	Quizzes reviewing medical knowledge topics	Enhanced collaboration Distance training
DO OMT	American College of Osteopathic Family Physicians	Videos demonstrating OMT	Increased engagement Distance training Learning analytics Swift feedback
Neuroanatomy: Draw It to Know It	Draw It to Know It, LLC	Visual tutorials, drawing labeling for neuroanatomy	Increased engagement
Socrative	MasteryConnect	Classroom resource to distribute quizzes and play games on smartphones, tablets, laptops	Increased engagement Enhanced collaboration Distance training Real-world application

TABLE 2 Lists these clinical training materials by platform

Title	Publisher	Description	Advantage
Electronic Games			
Dapper	Unity Point Methodist and Bradley University	Web-based games to improve outcomes for patients with type 2 diabetes	Increased engagement Distance training Swift feedback Real-world application
ElderQuest	Brainstorm Rising, LLC	A video game about pharmacotherapy for geriatric patients	Increased engagement Distance training Swift feedback
Image Challenge	Massachusetts Medical Society	Collection of images to help identify health conditions	Increased engagement Distance training Swift feedback Enhanced collaboration
Second Life	Linden Lab	Residents access a virtual world to browse podcasted talks and events on diseases and illnesses	Increased engagement Distance training Swift feedback
Septris	Stanford University	Web-based game with case scenarios of best practice guidelines for sepsis	Increased engagement Distance training Swift feedback Enhanced collaboration Learning analytics
Mobile Applications			
3 M Littmann Sound Builder	3 M Company	Audio clips and sound-building capabilities to practice auscultation skills	Distance training Learning analytics Enhanced collaboration Swift feedback
12-Lead ECG Challenge	Limmer Creative, LLC	12-Lead ECG interpretation for cardiac pathologies	Distance training Learning analytics Enhanced collaboration Swift feedback
CathSource	ECGsource, LLC	Photos and videos demonstrating various cardiac anomalies	Distance training Learning analytics Swift feedback
Clinical Sense	Medical Joyworks	Role-playing game for physicians presenting difficult clinical scenarios to solve	Increased engagement Distance training Enhanced collaboration Swift feedback
drawMD	Visible Health, Inc	Tool to improve communication with patients by drawing medical sketches	Increased engagement Enhanced collaboration Real-world application
Essential Anatomy 5	3D4Medical	3D Anatomy visualization tool	Increased engagement Distance training
Heart Pro III	3D4Medical	3D heart images allow users to cut, zoom, rotate, screenshot, and make notes	Increased engagement Distance training
Prognosis: Your Diagnosis	Medical Joyworks	Simulated clinical cases to test the diagnostic ability	Increased engagement Distance training Learning analytics Enhanced collaboration Swift feedback Clinical decision making
Radiology 2.0: One Night in the ED	Daniel Cornfeld	Series of cases to simulate CT scans; includes extensive discussion after each case	Increased engagement Distance training Learning analytics Enhanced collaboration Swift feedback Real-world application
Upper Respiratory Virtual Lab	Georgia Regents University	3D simulator of the upper respiratory tract	Increased engagement Distance training Real-world application

TABLE 2 (Continued)

Title	Publisher	Description	Advantage
Virtual Patient Simulations			
3DiTeams	Duke University Medical Center	Emergency department team training with virtual simulation controlled by an instructor	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback
At-Risk in Primary Care	Kognito	CME- and CNE-approved online virtual patient simulations in various clinical scenarios	Distance training Real-world application Clinical decision making
CliniSpace	Innovations in Learning, Inc	3D, immersive, virtual simulation team training in acute, critical care, and daily medicine	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback
CLIPP	MedU	Online patient cases for education using a medical home model	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback Clinical decision making
DecisionSim	Kynectiv, Inc	Faculty create virtual patient scenarios and use them to evaluate participants at all levels	Increased engagement Enhanced collaboration Distance training Learning analytics Real-world application Swift feedback Clinical decision making
HumanSim	Virtual Heroes	Medical schools may commission immersive 3D interactive virtual scenarios for health care training	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback Clinical decision making
i-Human	i-Human Patients, Inc	Online interactive, competency-based virtual patient encounters	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback Clinical decision making
MedU	MedU	Interactive virtual patient cases	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback Clinical decision making
Open Labyrinth	GitHub	No-cost authoring software useful for designing interactive virtual patient scenarios	Increased engagement Enhanced collaboration Distance training Learning analytics Swift feedback Clinical decision making
QuantiaMD	Quantia	An online community to interact with experts, ask questions, solve test cases	Increased engagement Enhanced collaboration Distance training Learning analytics Real-world application Swift feedback

(Continues)

TABLE 2 (Continued)

Title	Publisher	Description	Advantage
SimCoach	University of Southern California	Interact with virtual human agents to help military families break down barriers to care	Increased engagement Enhanced collaboration Distance training Learning analytics Real-world application Swift feedback
VPSim	University of Pittsburgh	Clinical encounter simulation and virtual patient interaction	Increased engagement Enhanced collaboration Learning analytics Swift feedback Clinical decision making

TABLE 3 Lists gamified training platform pilot studies that were published between 2008 and 2015

Title	Publisher	Description	Advantage
Burn Center	360Ed	Virtual simulations of triages and resuscitations for burn patients	Increased engagement Distance training Learning analytics Swift feedback
Casebook	NA	Virtual patient simulations iPad app useful for constructing cases based on EMR	Increased engagement Learning analytics Swift feedback
The Virtual First Responder	University of Michigan Medical School	Immersive, virtual experience in triage training	Increased engagement Learning analytics Swift feedback
CliniSpace	Innovation in Learning, Inc	Immersive web-based 3D environment	Increased engagement Learning analytics Swift feedback
EMedOffice	NA	A serious collaborative game for teaching medical students to run a medical office	Increased engagement Learning analytics Swift feedback
Heart Murmur Sim	Second Life	Educational virtual world for cardiac auscultation training	Increased engagement Learning analytics Swift feedback
Nuclear Event Triage Challenge	NA	Virtual training for triage in nuclear events	Increased engagement Learning analytics Swift feedback
Pulse	Breakaway, Ltd	Virtual learning space for training clinical skills in responding to catastrophic situations	Increased engagement Distance training Swift feedback Learning analytics
TheraSim	TheraSim, Inc	Virtual simulations for topics such as pharmacology	Increased engagement Distance training Swift feedback Learning analytics

5 | DISCUSSION

5.1 | Advantages of gamification

In the medical curriculum games, mobile apps, and virtual patient simulations may be utilized to enhance learning, engagement, cooperation, real-world application, clinical decision making, distance training, learning analytics, and quick feedback.

The study of the efficacy of games, simulations, and mobile apps for health care learning is still in its early stages. "The existing data to date neither confirms nor refutes the usefulness of educational games as an effective teaching method for medical students," writes Akl and colleagues. Additional and better-designed research is needed to evaluate the efficacy of these games. In recent years, many comprehensive evaluations of educational research on games and simulations for health care have been published. Few rigorous, controlled studies

have been performed, according to these publications, and the findings regarding significant learning effects are mixed. A systematic review published in 2010 that looked at the impact of educational games on medical student learning outcomes showed "potential" for improvement but recommended that additional studies using rigorous methodologies be conducted to properly inform this study. They looked through 1019 papers and discovered 26 unique citations related to educational games. Five of the citations indicated "low-to-moderate methodological quality" randomized controlled trials. Three of the five educational games tested (a charades game to educate infant development, an interactive computer game to control phenytoin dosage, and a board game to enhance metabolic pathway understanding) had a positive impact on learning results. Because of the learning potential of games, the researchers suggested them when other techniques were seen to be ineffective. They stressed the importance of games aligning with learning objectives, activating higher thinking, and providing feedback to students. There was insufficient data to support or deny the usefulness of educational games in terms of learning gain, according to a Cochrane study published in 2013. There is a scarcity of research on mobile health apps for medical education. Virtual patient simulations and learning outcomes, on the other hand, are the subject of promising study. Cook and Triola identified eight outcomes in a 2009 assessment of virtual patient simulation literature, all of which showed substantial learning improvements. There were no comparison groups in any of these trials since they only looked at one intervention using virtual patient simulation. The authors also found four trials that compared virtual patient simulations to other educational interventions, all of which were positive but not statistically significant. Gamberini et al. highlighted the effectiveness of virtual reality for clinical training in mental health care settings in their study of computer games in mental health care. Completing randomized controlled trials and other methodologically rigorous research intended to evaluate learning improvements has been linked to a variety of difficulties. Using valid knowledge measures before and after using a gamified training platform, testing learner performance with standardized outcome measures that match the intervention's learning content, contamination protection to ensure control groups do not sample the intervention, and allocation concealment are all challenges (ensuring students do not preview upcoming assignments). Obtaining big adequate sample numbers, survey fatigue, and the time it takes to perform pilot studies and then modify criteria variables are additional issues (Cook & Triola, 2009; Graafland et al., 2012; McCoy et al., 2016).

5.2 | Increased engagement

Learner satisfaction, flow (fun, pleasure, and attention), and diversity are all measured in studies on games and virtual patient simulations for medical education. In stressful situations, games and gamification aspects provide fun and excitement. Games that are well-designed are intellectually demanding, but not too so. They keep pupils interested and make it easier for them to proceed through tough assignments. By dividing tasks into a series of networking activities that are diverse and engaging, games fulfill the requirement for adult learners to assess and master short- and long-term goals. These activities include learners in a variety of serious play activities including planning, cooperating, making decisions, competing, collecting evidence, evaluating feedback, and reflecting. From a neurobiological standpoint, cognitive involvement makes sense. Games stimulate pleasure regions in the brain, according to Chatfield. Studies indicate playing video games raises dopamine levels. According to cognitive psychologists, games should be fast-paced and contain an element of surprise. When there is no predictability, dispersed attention is activated, resulting in mistakes that signal that pupils' actions need to be adjusted (Dye et al., 2009).

5.3 | Enhanced collaboration

Games and simulations allow you to practice functioning as part of a group. These abilities will be required for future healthcare delivery. According to education experts, students learn better by participating in conversations and activities with teachers and peers. Social and cooperative games need cooperation or competitiveness and are focused on interaction with other players in a social environment. Bravo (C-3 Softworks), TurningPoint (Turning Technologies, LLC), and DecisionSim are examples of cooperative collaboration games and simulations (Kynectiv, Inc). Gameplay has the ability to bring individuals together in learning communities. Video game players, for example, often join collaborative groups, write about their experiences, and study data related to gameplay. As a result, adding debriefings for game players to reflect and strategize fits with health care education that utilizes case-based teaching, a technique that uses patient situations to mimic critical thinking and decision making in the classroom (Gamberini et al., 2008).

5.4 | Real-world application

Students may be able to address real-world issues via games and virtual patient simulations. Students may safely apply medical theory to a particular situation by contextualizing patient case practice, which a mentor often facilitates. Video games based in virtual environments, for example, offer realistic difficulties, which fit with the concept of "authentic learning," which is thought to be helpful for practicing real-life decision-making. This method is designed to improve a lesson's realism and relevancy (Gee, 2008).

5.5 | Clinical decision

Aspiring medical students need a lot of experience with clinical reasoning. Learning activities that encourage intrinsic motivation and make intentional practice more enjoyable are beneficial. Games give chances for intentional practice as well as various ways to

demonstrate skill and get feedback. Clinical reasoning, information retrieval, and diagnostic acumen are all abilities that may be trained in medical games and virtual simulations. Playing video games also provides for the intentional, risk-free practice of reasoning and technical abilities, as well as the development of spatial and temporal visual systems. Games are being created to supplement skill training linked to surgical training for these and other reasons (Dhaliwal, 2012).

5.6 | Distance training

Blended learning, field-based experiences, and remote learning are all part of today's healthcare curriculum. Electronic games, mobile apps, virtual patient simulations, and other technology-enhanced learning tools may help monitor competency-based learning and enable a range of engaging experiences in these settings. Furthermore, certain gamified training systems, such as Turning Technologies, LLC, can connect with a learning management system, making them ideal for remote learning (Stathakarou et al., 2014).

5.7 | Learning analytics

Educators gain from the analytics (scoring systems, statistical data) provided by many electronic games and virtual patient simulation platforms, while students profit from intentional practice in risk-free settings. For example, choice-based games may be structured to monitor every decision a student makes automatically, allowing instructors to concentrate on the post-instruction assessment of identified deficiencies. Instructors may assess important learning takeaways and offer comments to individuals or groups by reviewing end-of-game reports (Naveed Saleh, 2010).

5.8 | Swift feedback

To lead a student along a self-training route, games use the motivating power of reward schedules, immediate feedback, dashboards, and meters. Mobile case-based games like Prognosis: Your Diagnosis (Medical Joyworks) and virtual patient simulations like DecisionSim (Kynectiv, Inc) allow you to study ideas, retry, and improve your score. When a student chooses the incorrect answer or makes a clinical mistake, he or she is motivated to learn more about medicine to amend their error. Inside games and virtual patient simulations, patient data, medical information, preceptor guidance, and mini-tutorials may be presented attractively. Virtual patient cases, for example, may include meters, electronic health record data, tutorials, patient vital signs, feedback, and directions. According to game experts, games encourage kids to read more than they would otherwise. In a healthcare game or simulation, for example, the player must use instruction panels and information links to make choices and treat the patient successfully. These learning affordances and menus may be used by medical educators to store a large amount of learning material or enrichment links (Bochennek et al., 2007).

6 | CONCLUSION

There are many educational benefits of using games in medical teaching. Although there are few thorough studies that demonstrate learning benefits, the area of study is expanding. Virtual simulations have been shown to have good learning effects in the research. Furthermore, games, smartphone apps, and virtual patient simulations have all been proven to increase interest and provide chances for intentional clinical reasoning exercises. The pool of accessible resources is growing all the time. This review's collection of hyperlinked resources may be used by medical educators and students as a resource. We hope that this article will encourage experimentation, spark cross-platform integration conversations, and provide the foundation for the creation of a comprehensive reference website or database for health care practitioners at all levels - students, residents, fellows, and practicing clinicians.

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How to cite this article: Krishnamurthy, K., Selvaraj, N., Gupta, P., Cyriac, B., Dhurairaj, P., Abdullah, A., Krishnapillai, A., Lugova, H., Haque, M., Xie, S., & Ang, E.-T. (2022). Benefits of gamification in medical education. *Clinical Anatomy*, 1–13. https://doi.org/10.1002/ca.23916