

The relevance of gamification in medical education

La importancia de la gamificación en la educación médica

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Abstract

The incorporation of recreational strategies into educational settings has progressively transformed medical education over the past few decades. Gamification, defined as the application of game-like elements in non-recreational settings, has been shown to increase motivation, encourage active participation, and strengthen clinical reasoning. The objective of this study was to analyze the relevance of gamification in medical education, with an emphasis on its integration into clinical simulation and the use of emerging technologies in Obstetrics and Gynecology. A narrative literature review was conducted using a structured search of international electronic databases, prioritizing recent publications related to serious games, game-based learning, virtual reality, and mixed reality applied to clinical training. The reviewed evidence demonstrated benefits in the development of technical and non-technical skills, improved decision-making, greater awareness of the rational use of resources, and increased confidence in simulated scenarios. Furthermore, virtual and mixed reality enable the training of skills in safe and immersive environments, particularly in complex obstetric situations. Although the results are favorable, methodological limitations persist, such as small sample sizes and heterogeneity in assessment tools. In conclusion, gamification constitutes a valuable complementary strategy that can contribute to the training of more competent professionals who are better prepared for clinical practice.

Keywords: Gamification. Medical education. Clinical simulation. Virtual reality. Mixed reality. Gynecology and obstetrics.

Resumen

La incorporación de estrategias recreativas en contextos educativos ha transformado progresivamente la enseñanza médica en las últimas décadas. La gamificación, entendida como la aplicación de elementos propios del juego en entornos no recreativos, ha demostrado incrementar la motivación, favorecer la participación activa y fortalecer el razonamiento clínico. El objetivo de este trabajo fue analizar la relevancia de la gamificación en la educación médica, con énfasis en su integración en la simulación clínica y el uso de tecnologías emergentes en Ginecología y Obstetricia. Se realizó una revisión narrativa de la literatura mediante una búsqueda estructurada en bases de datos electrónicas internacionales, priorizando publicaciones recientes relacionadas con juegos serios, aprendizaje basado en juegos, realidad virtual y realidad mixta aplicadas al entrenamiento clínico. La evidencia revisada mostró beneficios en el desarrollo de habilidades técnicas y no técnicas, mejora en la toma de decisiones, mayor conciencia sobre el uso racional de recursos y aumento de la confianza en escenarios simulados. Asimismo, la realidad virtual y mixta permiten entrenar competencias en entornos seguros e inmersivos, especialmente en situaciones obstétricas complejas. Aunque los resultados son favorables, persisten limitaciones metodológicas, como muestras pequeñas y heterogeneidad en los instrumentos de evaluación. En conclusión, la gamificación constituye una estrategia complementaria valiosa que puede contribuir a la formación de profesionales más competentes y preparados para la práctica clínica.

Palabras clave: Gamificación. Educación médica. Simulación clínica. Realidad virtual. Realidad mixta. Ginecología y obstetricia.

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Introduction

Gamification is the use of game elements in non-game contexts. It is an educational approach that promotes student motivation and engagement¹. In the field of education, this strategy has emerged as an active, constantly evolving methodology that transforms traditional teaching and learning experiences into more interactive, personalized processes that yield more objective results².

The use of game elements in contexts outside of entertainment has been a subject of interest over the past 20 years, giving rise to what we now know as gamification. The term gamification, derived from the word “*game*,” refers to the use of game elements to create experiences in fields such as health and education³. Although this concept emerged in the 2000s, we can trace its origins back to the late 19th century, before the term existed as such; specifically to S and H Green Stamps, a program that offered stamps to consumers for their purchases, which they could later redeem for prizes⁴. Although technology as such, or video games, were not used, elements typical of games – such as accumulating points, setting goals, and offering rewards – were applied to encourage people’s actions.

With technological advancements, gamification has been used as a tool in education, healthcare, and marketing. The term was formally coined by the British scholar Nick Pelling, who proposed a clear definition of the concept, thereby increasing its visibility. By 2010, gamification began to expand beyond marketing, entering the education sector with platforms such as Duolingo and Kahoot, which aim to serve as virtual learning systems that boost student motivation⁵.

In the medical field, gamification had a significant impact. In 2006, HopeLab designed a video game for adolescents with a prior cancer diagnosis, which succeeded in improving treatment adherence and fostering self-care behaviors in patients. In 2011, so-called “serious games in medical education” were developed and used in Brazil in a surgical context to train laparoscopic skills⁶.

The theory of learning through play identifies playful dynamics as highly effective pedagogical and andragogical tools for fostering learning, as it asserts that they facilitate cognitive, social, emotional, intellectual, and psychomotor development. This theory is based on the premise that, through play, knowledge is constructed by solving problems presented as challenges, consequences are experienced without real-world impact on the individual’s life while retaining the learning they

entail, and, above all, development is fostered in a safe, motivating, healthy, and meaningful environment⁷.

Various authors and educators have provided theoretical foundations that underpin this practice or the theory behind it; Jean Piaget asserted that play stimulates cognitive development, since the individual engaged in it can organize their thinking by establishing the mental schemas necessary to carry out what is asked of them. Lev Vygotsky, for his part, introduces the concept of the “zone of proximal development,” which is the midpoint between the level of “actual development” – what the individual can do on their own – and the level of “potential development” – what the individual could achieve with adequate support and knowledge. He concludes that the former is optimal for learning, and indeed, play allows the individual to reach that point by forcing them to act beyond their current level of development, through the simulation of social or even professional roles, and to resolve situations that would otherwise not be presented or would be highly improbable⁴.

The relationship between playful learning and its presumed success is directly linked to the intrinsic motivation it entails. Play is directly related to pleasure, curiosity, and autonomy – three elements that generate the drive to continue engaging in an activity. When a play-based activity is designed correctly, the individual participating in it more easily enters a state of full concentration that enhances the assimilation of knowledge and skills, and this effect is further intensified when the activity is accompanied by elements of immediate feedback, progressive challenges, and decision-making⁸.

Development

In recent years, there has been an increase in the use of gamification in clinical simulation, employing game mechanics and tools to foster meaningful learning. As a result, a positive correlation has been observed with improved patient outcomes, as students and healthcare professionals are able to enhance their skills and clinical reasoning, which enables them to make better diagnostic and therapeutic decisions⁹.

A clear example of the significant impact gamification has had on medical students can be seen in decision-making cards (DMCs), as described in a recent study published in BMC Medical Education. In this activity, students work in teams to solve clinical cases using cards that contain diagnostic information along with the corresponding medical costs. As they progressed through the case, they had to make decisions

about which tests and/or treatments to order, considering both the associated costs and the correct diagnosis. This approach improved motivation to learn and helped students become more aware of the efficient use of resources. This method represents a good alternative for medical education focused on maintaining motivation and active learning¹⁰.

There are numerous games that have gradually been adapted and incorporated into medical education; some examples include: *Isla Cleft*, a game designed to improve medical students' knowledge of cleft lip, in which a child with this condition travels through islands named after treatment protocols, resulting in a significant improvement in treatment outcomes after playing the game; *PediatricSim*, a game based on the *Pediatric Advanced Life Support Provider Manual*, which it is based on critical scenarios in pediatrics, such as diabetic ketoacidosis, anaphylaxis, and seizures, among others, in which better clinical outcomes are achieved after completing these simulations; *Antibiogame*, a game used to teach medical students the proper use of antibiotics, in which students play the role of doctors during a consultation, prescribing antibiotics in real-life primary care scenarios¹¹⁻¹⁴.

The effect of DMCs on medical students has been studied through the implementation of gamification. These cards present brief clinical cases with relevant patient information, and the rest of the cards in the game allow players to develop a diagnostic and therapeutic approach while spending as little as possible. In this game, players can choose cards by looking only at the front, which includes the card's title and cost; if they decide to purchase a card, they can then view the back and read the additional information needed to resolve the clinical case. Finally, the player who resolves the clinical case at the lowest possible cost wins. It was observed that students gain greater self-confidence when making diagnostic decisions and become more aware of the cost of each procedure requested for patients thanks to gamification¹⁰.

Gamification has been increasingly used through various techniques aimed at strengthening clinical reasoning, including serious games; the most widely used technique involves creating clinical scenarios with scoring systems and feedback; time-limited escape rooms designed to solve clinical cases using a series of puzzles; and simulation games that use scored simulations, challenges, and feedback to enhance learning⁹.

Regarding mixed reality, efforts have been made to develop soft-tissue simulators that allow for the simulation of labor through a model capable of reacting as

realistically as possible to perineal and vaginal canal tears occurring during labor, while using *HoloLens* to observe soft tissues during both eutocic and dystocic labor, as well as the residents' reactions, providing immediate feedback and thereby improving care for obstetric patients in real time¹⁵.

It is of utmost importance to train physicians and midwives in the field of gynecology, as it has been observed that simulators facilitate patient-safety-centered learning in a safe and interactive manner, building the confidence to perform procedures on patients. Furthermore, it is important to highlight the recent development of low-cost anatomical simulators that allow physicians to train even when resources are limited, which this means that the future should enable training using accessible technology with significant educational impact, with the aim of ensuring safety and providing better care for obstetric patients¹⁶.

We can also find video games and laparoscopic simulators designed to improve visuomotor and manual coordination for specific surgical skills. One example is *Play and Learn for Surgeons*, which allows users to repeatedly practice complex surgical procedures, such as arterial ligations¹⁷.

A standout example among these is *Body Interact*, a gamified simulator based on virtual patients that offers more than 1,200 clinical scenarios, including gynecological and obstetric cases. The design of this simulator allows for the evaluation of clinical reasoning and decision-making in real time, in addition to providing immediate feedback, which creates a safe environment for the student.

There is another platform that uses medical simulation through virtual reality and augmented reality called *SimX*, where students can practice with virtual patients in realistic clinical scenarios using virtual reality headsets. This tool relies solely on virtual reality and no longer requires physical simulators to create clinical scenarios, which is why it has been adopted by leading emergency departments such as the Mayo Clinic and Stanford, among others.

The use of gamification with virtual reality is part of an innovative approach to training future doctors, especially in situations that require high concentration and place significant pressure on them. Virtual reality allows for the immersive recreation of critical situations commonly encountered in hospitals while creating specific scenarios that generate a safe environment where students can confront intense emotions; thanks to this, it is possible to promote emotional learning in stressful situations. Recent studies have shown that

exposure to virtual reality experiences can help reduce anxiety and increase confidence among healthcare professionals¹⁸.

On the other hand, using gamification to manage stress has shown mixed results. Although many applications include techniques for anxiety and stress management, in numerous cases, they do not effectively integrate game mechanics with emotional regulation strategies¹⁹. For example, some systems incorporate points, challenges, or rewards, but do not actually teach how to calm anxiety or cope with pressure. To make these tools more useful, it is recommended that gamified experiences include personalized feedback, progressive scenarios, and elements that foster emotional self-regulation. Combining these experiences with immersive virtual reality enhances both the practice of technical skills and emotional preparedness, ensuring that healthcare professionals can effectively manage the emotional burden while making decisions in high-pressure scenarios^{20,21}.

Methodology

Study design

This article is a narrative literature review, whose main objective was to analyze the relevance of gamification within the medical field, specifically in its application in the area of clinical simulation and in the use of emerging technologies, with a special emphasis on gynecology and obstetrics.

Search strategy

A structured literature search was conducted in recognized electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar. The search was conducted using combinations of keywords in English and Spanish, such as: gamification, medical education, clinical simulation, serious games, game-based learning, virtual reality, mixed reality, gynecology, obstetrics, and educational technology, employing Boolean operators (AND, OR) to optimize the retrieval of relevant literature.

Inclusion and exclusion criteria

Original articles, literature reviews, observational studies, and educational experiences that use gamification as a teaching strategy in medical education, clinical simulation, or clinical skills training were

included. The search focused primarily on publications from the last 5 years, prioritizing those that presented practical applications and results in clinical and educational contexts.

We excluded duplicate publications, abstracts without access to the full text, opinion pieces without a clearly described methodology, and studies unrelated to the fields of health or medical education.

Discussion

The reviewed literature shows that gamification has a significant impact on medical education, particularly in clinical simulation settings. Several studies have reported benefits in motivation, confidence, decision-making, clinical skill development, and knowledge retention, which reinforces and supports the idea that game-based dynamics are an effective complement to traditional teaching and learning methods in medicine²².

There are several reported examples that illustrate the aforementioned benefits. DMCs had a positive impact on students' awareness of the cost-benefit ratio of certain tests, as well as on their diagnostic skills. Games such as PediatricSim and AntibioGame have proven useful in practicing pediatric scenarios and the rational and appropriate use of antibiotics, respectively. Similarly, the implementation of escape rooms focused on medical education or training for medical personnel has demonstrated benefits in knowledge acquisition, teamwork, problem-solving under pressure, and communication^{13,23}.

In the field of gynecology and obstetrics, simulators and virtual and mixed reality technologies, such as Body Interact and SimX, have made it possible to safely train critical skills, improving both clinical reasoning and care in obstetric scenarios of varying levels of complexity. Similarly, there has been a notable development of low-cost, accessible, and replicable anatomical simulators that open up the possibility of training specific skills without creating a financial burden when resources are limited¹⁰.

Despite the clearly evident benefits, certain limitations persist in the current literature. Many studies are based on small samples or pilot contexts, which makes it difficult to adequately generalize the findings. Furthermore, there is heterogeneity in study design and in the metrics used for evaluation, which hinders the establishment of broadly applicable conclusions. The literature review identifies a relationship between gamification in medicine as a mechanism for reducing stress and promoting regulation in clinical contexts;

however, the results are not yet sufficient to definitively establish this conclusion²⁴.

Taken together, the points outlined above suggest that gamification and simulation in medicine constitute a useful, valuable, and growing tool with particular potential in gynecology and obstetrics. However, broader research using standardized methodologies is needed to definitively consolidate the evidence. Similarly, more information on the subject is needed, obtained through studies that have no connection whatsoever with the various companies that promote or own the different programs or simulators, to ensure a significant reduction in the bias that may be present in the current data.

Conclusion

The findings compiled in this study support the assertion that gamification provides real value in medical education, particularly when integrated into clinical simulation scenarios. Game-based dynamics not only increase student interest and engagement but also promote more agile decision-making and more robust clinical reasoning. Overall, the evidence indicates that this approach can enrich the educational experience and offer complementary support to traditional methods, provided it is applied intentionally and with clear objectives.

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Conflicts of interest

J. Loría-Castellanos is member of the editorial committee of the journal *Anales Médicos*. The other authors declare no conflicts of interest.

Ethical considerations

Protection of human subjects and animals. The authors declare that no experiments on humans or animals were performed for this research.

Confidentiality, informed consent, and ethical approval. This study does not involve personal patient data, medical records, or biological samples, and does not require ethical approval. SAGER guidelines do not apply.

Declaration on the use of artificial intelligence.

The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

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