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Between Innovation and Uncertainty: Challenges and Perspectives of Gamification for Medical Teachers.

Entre la Innovación y la Incertidumbre: desafíos y perspectivas de la gamificación para el profesorado de medicina.

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Abstract: There is a pressing need for medical educators to acquire skills aligned with the advancement of emerging technologies, generative artificial intelligence, and new teaching organization methods. In this context, playful pedagogical approaches have gained increasing acceptance in the medical field, enabling the consolidation of more structured and automated strategies based on gamification. These strategies foster active student participation, as well as competition, collaboration, and cooperation, considered fundamental pillars of the constructivist and humanist paradigms that currently guide training in medical schools globally. From this perspective, it is necessary to adopt gamification as a disruptive teaching tool within the teaching-learning process in medicine, in order to overcome the dichotomy between the traditional model, focused on the teacher's oratory and rhetoric, and autonomous learning methods, in which students can access innovative methodologies supported by gamification.

Keywords: gamification, teaching-learning process, didactics, educational technology

Resumen: Se hace evidente la necesidad imperiosa de que el docente de medicina adquiera competencias alineadas con el avance de las tecnologías emergentes, la inteligencia artificial generativa y las nuevas modalidades de organización de la enseñanza. En este contexto, los enfoques pedagógicos de carácter lúdico han alcanzado una creciente aceptación en el ámbito médico, permitiendo la consolidación de estrategias más estructuradas y automatizadas en torno a la gamificación. Dichas estrategias fomentan la participación activa del estudiante, así como la competencia, la colaboración y la cooperación, considerados pilares fundamentales de los paradigmas constructivistas y humanistas que actualmente orientan la formación en las facultades de medicina a nivel global. Bajo esta perspectiva, se hace necesario adoptar la gamificación como herramienta didáctica disruptiva dentro del proceso de enseñanza-aprendizaje en medicina, con el fin de superar la dicotomía entre el modelo tradicional, centrado en la oratoria y retórica del docente, y las formas de aprendizaje autónomo, en las que el estudiante puede acceder a metodologías innovadoras sustentadas en la gamificación.

Palabras clave: gamificación, proceso enseñanza aprendizaje, didáctica, tecnología educativa

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In the field of medical education, the ongoing search for innovative strategies that promote meaningful and effective learning is a priority. This interest responds to the current pedagogical orientation, which seeks to give students a leading role in their own educational process, while ensuring high levels of commitment, motivation, and involvement throughout the process (1).

In this context, the use of technological tools that allow the automation of evaluations, the implementation of tutoring, the development of both synchronous and asynchronous classes and the automatic programming of feedback has increased, all facilitated by sophisticated academic management systems (2). Research in educational technologies, consequently, has focused on

analyzing their impact on the teaching-learning process (TLP), particularly in Health Sciences (3). Along these lines, Díaz et al. (4) highlight that technology is inherent to this disciplinary field and that its use in training and medical practice has intensified, especially since the coronavirus pandemic.

In line with this perspective, Mejía et al. (5) argue that while traditional learning environments have proven effective and efficient in the past, they are insufficient to meet current educational demands. Conventional methodologies, focused on the one-way transmission of information and memorization, present significant limitations in an increasingly dynamic and digitalized scenario (6). Thus, although lectures and expository methods have historically constituted the basis of medical education, the need to promote critical thinking, problem-solving, and autonomous learning skills is becoming increasingly urgent, particularly within the framework of advances in generative artificial intelligence (4, 7).

From a holistic perspective, which seeks to avoid reductionism derived from paradigms or epistemological conceptions about educational technology, it is essential to transcend mere quantitative analysis. It is not enough to determine the degree of positive or negative impact of a technology in the educational field; it is necessary to understand the mechanisms through which this impact is produced, recognizing that didactics is not excluded from this process, but constitutes a transversal element (3). In this sense, the wide range of information technologies and digital methodologies available can be overwhelming for teachers and students. Traditional teaching supported by resources such as the blackboard, despite its effectiveness in transmitting knowledge, has been losing presence due to its limitations compared to current digital environments (6). In contrast, the automation of evaluations, the implementation of tutoring, the diversification of synchronous and asynchronous classes, and automatic feedback are increasingly observed, elements mediated by advanced academic management systems (2).

Educational technologies, along with innovative pedagogical strategies such as gamification, have been the subject of a growing body of research in the university setting. These studies demonstrate significant benefits in improving the teaching-learning process, demonstrating that these tools not only increase student interest and motivation but also promote more active participation and deeper, more effective learning (8-9). Within this framework, a teaching strategy based on educational technology can be defined as a planned set of technological procedures and resources applied to the teaching-learning process, the purpose of which is to facilitate, optimize, and personalize education (10). These strategies integrate digital tools, online platforms, educational software, and interactive resources to generate dynamic, accessible, and motivating learning environments.

The effectiveness of these proposals has been widely documented. This is demonstrated by Maldonado and Pungutá (11), who, by proposing teaching strategies based on Information and Communication Technologies (ICT) for the development of transversal competencies in university students, confirmed their effectiveness in the appropriation of knowledge within flexible, stimulating and motivating environments.

In this regard, Schneider et al. (12) and Díaz et al. (7) argue that the medical education curriculum must effectively respond to the challenges posed by Information and Communication Technologies (ICT). Consequently, they propose the following considerations:

- Basic computer skills should be a requirement for medical students upon admission.
- Applied medical informatics should be incorporated early into training to increase familiarity with essential information tools for professional practice, such as the management of digitalized medical data, access to educational resources in digital format, and intensive use of the Internet.
- Medical informatics training should be a priority for medical educators to ensure the creation, maintenance, and updating of the technological infrastructure that supports its implementation.

- Academic medical centers are called upon to evaluate the software used in educational processes, with the aim of ensuring both its proper functioning and the adequate transmission of knowledge.
- Teaching and research on the confidentiality and security of electronic records, as well as digital communication, must be explicitly integrated into medical education.

While most current gamification strategies rely on digital technologies, their scope is not limited to this area. Gamification is defined as the application of game design elements to increase user motivation and engagement. In recent years, this strategy has acquired a relevant role in medical education, where its implementation has transcended applications focused on health and patient well-being and expanded to more complex projects. Notable examples include protein structure prediction using Foldit, genome comparison using Phylo, and malaria parasite quantification (13–15).

Along similar, but more in-depth lines of analysis, Morales et al. (16) argue that gamification involves the integration of game elements, mechanics, and infrastructure into contexts and scenarios not originally designed for that purpose. The incorporation of these components diversifies learning experiences, thereby increasing students' attention, participation, and academic performance. Previous studies report a wide variety of pedagogical objectives linked to gamification processes. These range from strengthening learning principles through summative assessment tools (17), the acquisition of general knowledge and specific skills through problem-solving—as in the case of psychomotor skills training in endoscopy for medical residents—to reinforcing performance in the face of specific assessments, and even promoting teamwork. Such objectives contribute to the development of critical and reflective thinking in students, enhancing their understanding and consolidation of what they have learned, particularly when this knowledge is combined with technological tools.

Gamification also promotes the development of numerous pedagogical competencies associated with collaborative work, including perseverance, effective communication, task delegation, leadership, trust, courtesy, alternation between multiple activities, information exchange between peers, cooperation and efficient collective evaluation (18). Added to this is the influence of game theory, which essentially distinguishes three modalities: competitive, collaborative and cooperative. The choice of one type or another largely determines the mechanics of the game - that is, the procedures and dynamics of interaction that allow certain actions to be executed - as well as its effectiveness in achieving the proposed objectives (19–21).

Conclusions

- Gamification provides unique learning opportunities by enabling medical students to explore complex systems through game-like dynamics. It has become an increasingly engaging teaching tool, not only for students but also for faculty.
- One of the main challenges facing university professors today is precisely keeping students motivated, focused, and engaged in the learning process, and gamification is the preferred strategy for achieving this goal.

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