Medical Olympiads Through Interdisciplinary Simulation: Didactic Strategy And Student Perception

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Abstract

Background: Serious games in medical education have demonstrated benefits in student adherence, motivation, and active participation in simulated practices, improving teaching-learning processes, professional training, and academic performance.

Methods: A mixed-methods descriptive study on the design, perception, and evaluation of a group of medical students subjected to "Medical Olympics," an educational strategy through interdisciplinary simulation.

Results: Three phases were established for the development of the activity over an average period of 2 weeks, including 300 undergraduate medical students in clinical courses. Empathy and compassion, critical thinking (61%), and ethical responsibility were the main competencies evaluated during the event. Most students were satisfied with the strategy, highlighting its benefits and differentiating factors for their professional training.
Discussion: The incorporation of interactive pedagogical methods and serious games in medical education has demonstrated benefits in learning, knowledge retention, and decision-making. Strategies like the "Medical Olympics" promote competencies through quantitative assessments, improving skills and fostering interdisciplinary collaboration, aligned with current learning theories and evidence.
Conclusion: Serious games in medical education improve the handling of clinical problems in students, reinforcing both theoretical learning and technical and non-technical skills in a safe and controlled environment. Although positively evaluated, it is recommended to standardize assessments and use emerging technologies for greater effectiveness.
Keywords: Education, Medical; Simulation Training; Interdisciplinary Placement.

INTRODUCTION

Simulation-Based Learning (ABS) has established itself as a didactic and innovative strategy, coveted in the teaching-learning processes. This is due to the integration of knowledge and the incorporation of digital technologies in safe and controlled environments that facilitate the consolidation of knowledge and the development of professional skills, including teamwork, creativity, leadership, problem-solving, and critical thinking, among others (Elendu et al., 2024; Keller et al., 2019; Nomura et al., 2023; Piot et al., 2021). This, through methodological structuring of simulated practices by spheres of knowledge, and by the determination of learning outcomes, which favor the training of more competent and comprehensive professionals, particularly in health sciences programs (Villanueva et al., 2020; Shah et al., 2019; Koenig et al., 2023). Therefore, imperative needs are established for higher education in order to align academic demands with ABS tools.

In this way, improvements have been generated in the pedagogical strategy through the inclusion of information and communication technologies. From this, serious games have been incorporated into medical education, which have managed to demonstrate benefits on student adherence, motivation, and active participation in simulated practices, promoting learning outcomes (Shrivastava et al., 2024). This is taking into account that the education of health professionals requires strict and reproducible standards that promote safe and quality care practices (Haoran et al., 2019). Thus, unlike traditional teaching models, ABS can add playful and interactive elements to concepts or areas historically addressed through more rigid structures, obtaining better benefits and facilitating the evaluation processes on skills, competencies, attitudes and knowledge, necessary in real clinical practice for decision-making and teamwork (Xu et al., 2023; van Gaalen et al., 2021; Koelewijn et al., 2024). Therefore, the structural establishment of serious play is required to achieve specific objectives according to the needs of the students.

The steps for the adoption of ABS with playful and interactive practice are not clearly defined. Pajor et al., (2023) established the Sim Wars, a live simulated competition that allowed the experimental learning of medical students under controlled conditions on topics related to communication skills and clinical management, achieving acceptability in the academic community and high-performance experience potentially beneficial for professional training. Likewise, Raupach et al., (2021) in Germany, designed a prospective study based on serious games on medical emergencies such as acute myocardial infarction, pulmonary thromboembolism, and hypertensive crisis with the aim of evaluating clinical reasoning processes and focused critical thinking, diagnostic evaluation, and therapeutic alternatives; It was evidenced that exposed students were twice as likely after 1.5 years of follow-up to make an accurate diagnosis and to generate clinical action aligned with the recommendations of evidence-based medicine, compared to those not exposed. Likewise, some authors describe strategic models for the ideal planning of these initiatives (Edwards et al., 2023; Watsjold et al., 2022). However, similar academic experiences have not been documented in Colombia, therefore, a pioneering initiative for the design and implementation of ABS through serious and interdisciplinary games for the promotion of quality education is presented.

METHODS

A mixed descriptive study was carried out in two stages, the first consisted of the design and implementation of a didactic learning strategy through interdisciplinary simulation called "Medical Olympics" developed in the Simulated High Complexity Hospital (HUSAC) of the Navarra University Foundation in the city of Neiva; the second stage consisted of analyzing the student perception of the implementation of the "Medical Olympiads" after their completion.

Participants

Undergraduate medical students from a higher education institution in the southern region of Colombia were included in courses from semesters V to X, in which the academic training of the theoretical-practical-clinical subjects of semiology (V), internal medicine (VI-VII), pediatrics (VIII), gynecology-obstetrics (IX) and general surgery (X) is carried out. The formation of work groups was carried out through stratified probabilistic sampling with at least one member for each academic semester, with a total of 6 participating students per group.

Evaluation rubrics

Forms were created for the evaluation of the Rally stations through the Structured Objective Clinical Examination (OSCE) modality, which were approved by intra-institutional academic peers. Each station was created with the aim of representing a clinical challenge to discipline the doctor; the questions raised during the development of this phase were articulated with the professional competencies (Empathy and compassion; ethical responsibility; oral communication) and reasoning (Critical thinking and quantitative reasoning) determined by the Association of Medical Colleges of the United States (AAMC). Subsequently, a categorization by competencies of the questionnaires assigned to each station was carried out, which were analyzed by arithmetic mean and graphed through a spider diagram.

Student Perception Survey

An open and voluntary online survey was designed through Google Forms to know the student perception of the impact, advantages, disadvantages and differentiating elements of the "Medical Olympiads" applied after the end of them. The data were studied using the qualitative analysis tool ATLAS.ti version 24 with an institutional license. The Sankey diagram was used to correlate the responses, taking into account 5 focus groups of interest: pre-university youth, the external community, other higher education institutions (HEIs), UNINAVARRA and medical Olympiads.

Descriptive statistics were performed to characterize the sample distribution according to sex and the current semester; additionally, the students were asked if the development of the activity contributed to their professional training using the Likert scale with the following response options: 5) Strongly agree, 4) Agree, 3) Neither agree nor disagree, 2) Disagree and 1) Strongly disagree. The above information was graphed through a multilevel circular diagram.

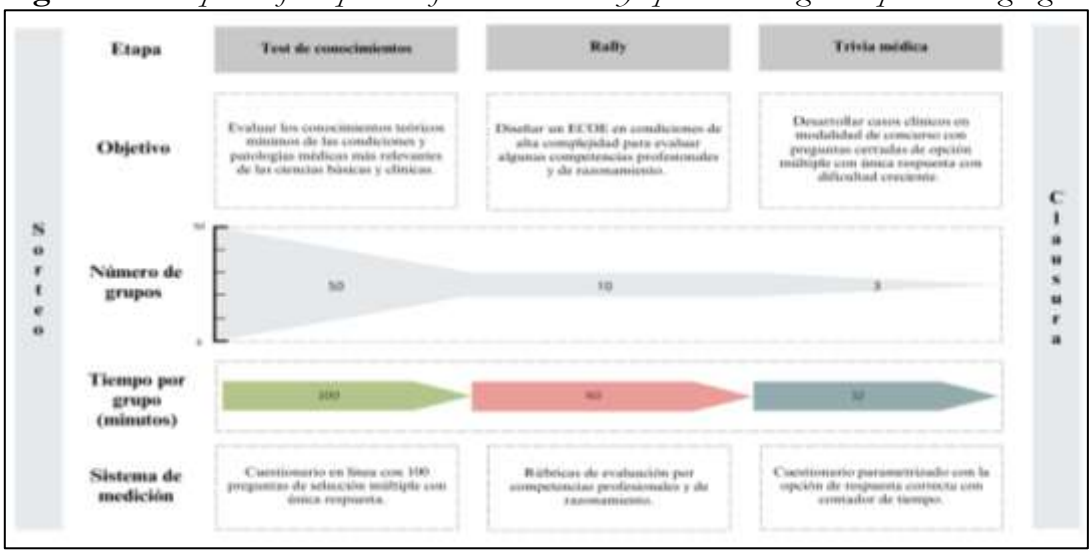
RESULTS

Design of the innovative pedagogical strategy

Figure 1 describes the phases and characteristics of the "Medical Olympiads". 3 stages were included that were prepared and evaluated by medical instructors with experience in interdisciplinary simulation practices with specialized training in the different areas of learning; and supported by a multidisciplinary team of professionals, including nursing assistants, biomedical engineering and systems engineering. After the first two phases were carried out, a winner was selected. In the first stage, the students developed a questionnaire of theoretical knowledge on the main topics of the strategic subjects; subsequently, the best 10 participating groups were exposed to clinical challenges in OSCE modality in a highly complex simulated hospital, in which high-fidelity experiential, environmental and technological situations were designed with the purpose of promoting teamwork with an interdisciplinary approach. Finally, in the medical trivia, clinical questions were presented with a gamification system by score, so the team with the best performance was considered the winner.

A total of 300 undergraduate medical students were taking some of the strategic subjects during the execution phase of the event, therefore, they were distributed through a simple random sampling in groups of 6 people, obtaining a total of 50 participating teams. The students did not receive any incentive or any consequences for their participation. The phases are carried out over the course of 2 weeks, including from the draw stage and group assignment to the symbolic delivery of awards for the 3 best teams; in such a way that the participation per student/group was approximately 170-180 minutes, distributed among the 3 phases. In addition, the annual "Medical Olympics" were proposed to obtain an adequate student rotation taking into account progress and academic demand.

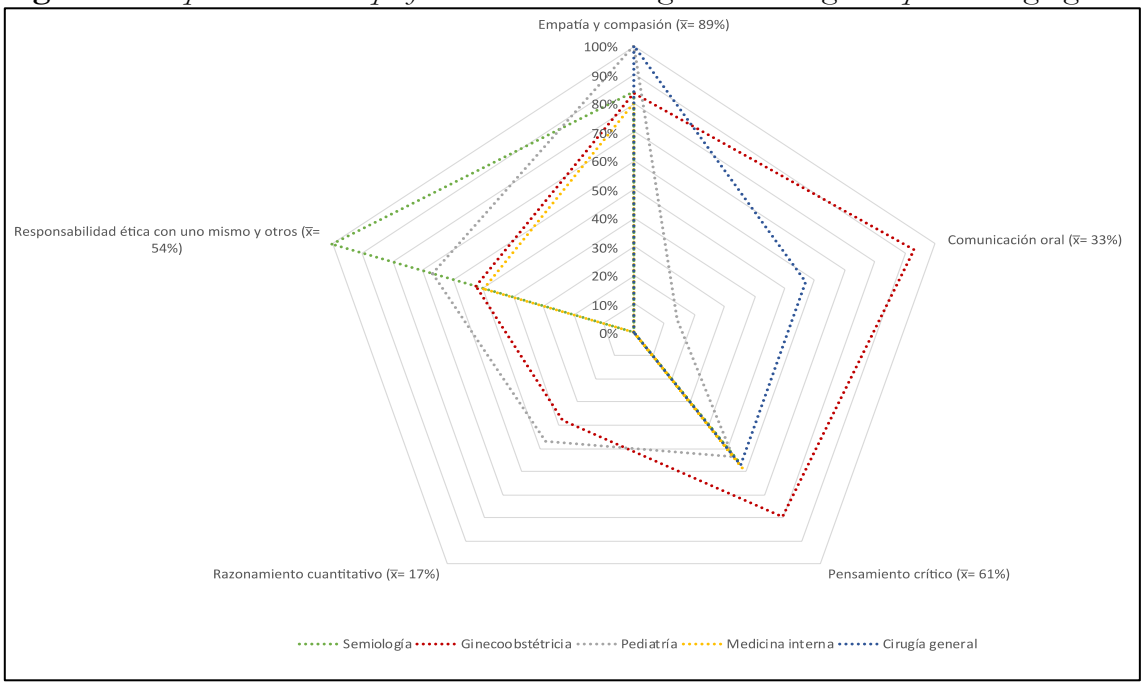
Figure 1 *Description of the phases of the Medical Olympiads. In original Spanish language*



Evaluation rubrics

In phase 2, an OSCE was carried out with a clinical case for each strategic subject; designed and committed by an interdisciplinary team of health professionals and educators, who established evaluation rubrics contemplating some of the professional and reasoning competencies established by the Association of Medical Colleges of the United States. In this way, at least one medical instructor from the Simulated University Hospital of High Complexity was assigned for the evaluation of each group by the circuit of stations. Figure 2 shows the averages by station of the groups that participated in this phase. It is evident that empathy and compassion (89%) was the category of professional competence with the best performance, followed by critical thinking (61%) and ethical responsibility (54%).

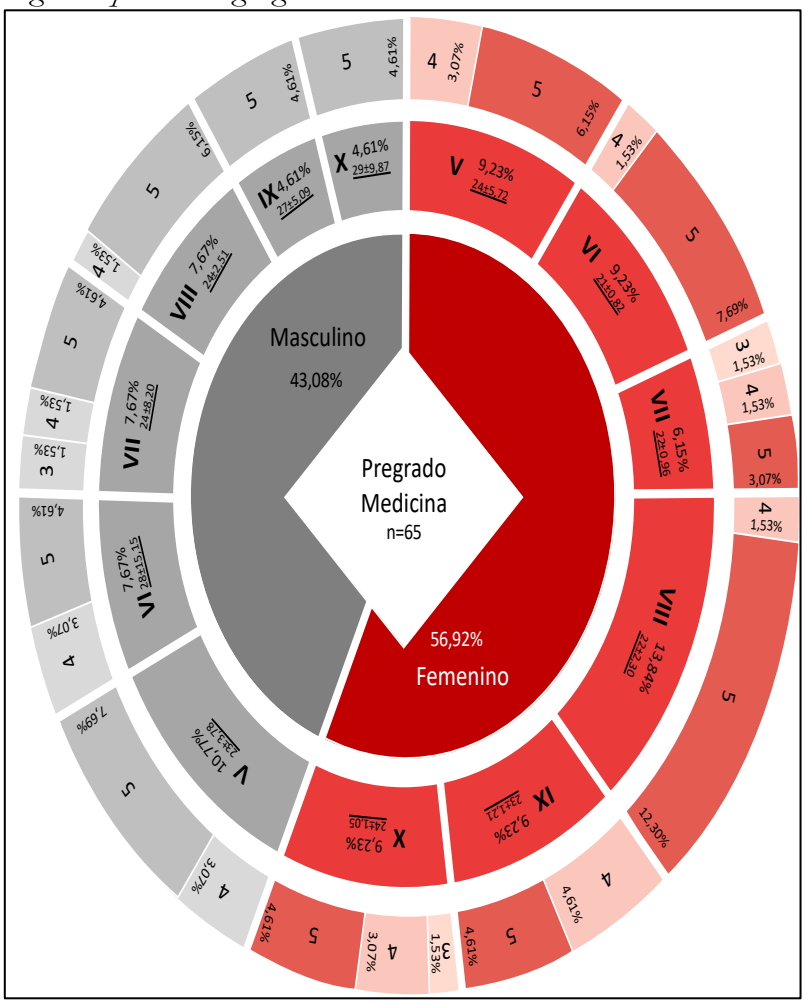
Figure 2 *Comparison between professional and reasoning skills. In original Spanish language*



Student perception

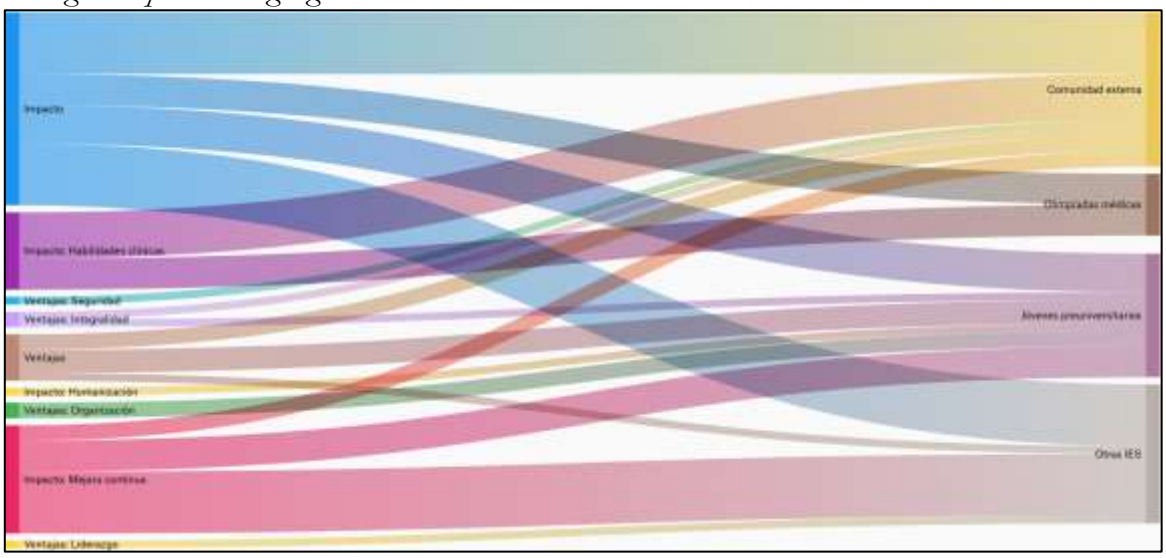
The voluntary perception of 65 students who participated in the medical Olympiads was obtained, the distribution characteristics are presented in Figure 3. Most of the respondents were women (56.92%), among whom there was a greater participation in eighth-semester students (13.84%); Likewise, within the distribution by sex, 38.46% of women considered that they fully agree with the premise that the pedagogical strategy contributed to their development as professionals. On the other hand, in the group of men (43.08%), the most representative percentage of participation was that corresponding to fifth-semester medical students (10.77%), of which 29.23% gave a grade of 5/5. In addition, the overall ranking of the event according to the majority of participants (67.69%) was 5/5.

Figure 3 *Circular diagram with the distribution by sex, semester and participatory evaluation. In original Spanish language*



Note. The data are presented in proportions based on the categorical representation of the total number of respondents according to each variable. The outermost circle presents the student rating on the perception of the impact on professional training of the "Medical Olympics" evaluated from the Likert scale of 1 to 5, the latter being the maximum score. In ascending order from the innermost circles, it corresponds to the distribution by sex, academic semester and evaluation of the strategy, respectively.

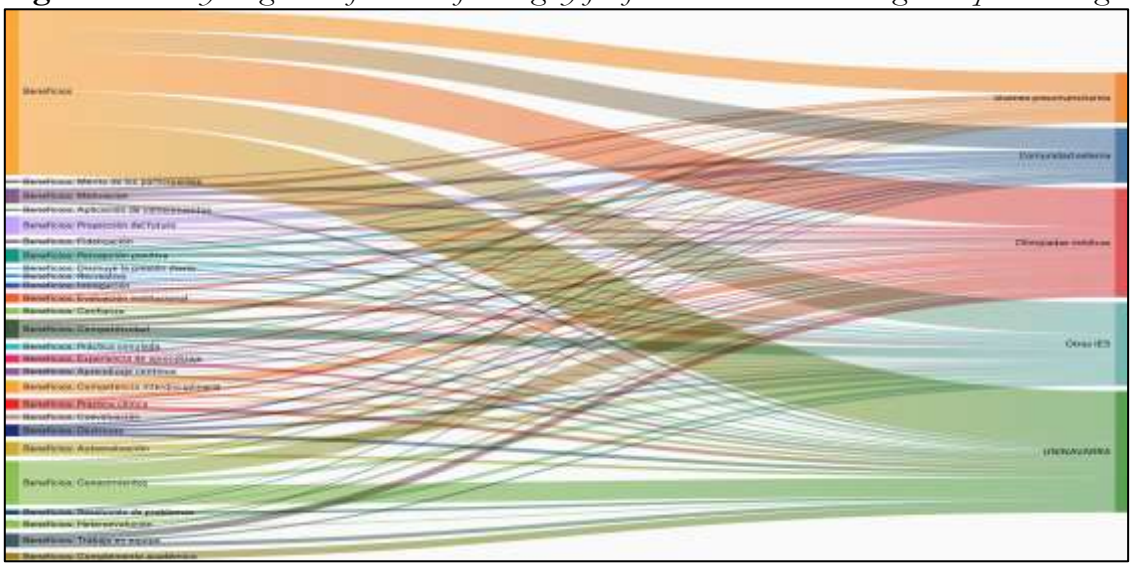
Figure 4 *Sankey diagram of the categories of impact and advantages identified for four stakeholders. In original Spanish language*



Note. Higher Education Institutions (HEIs).

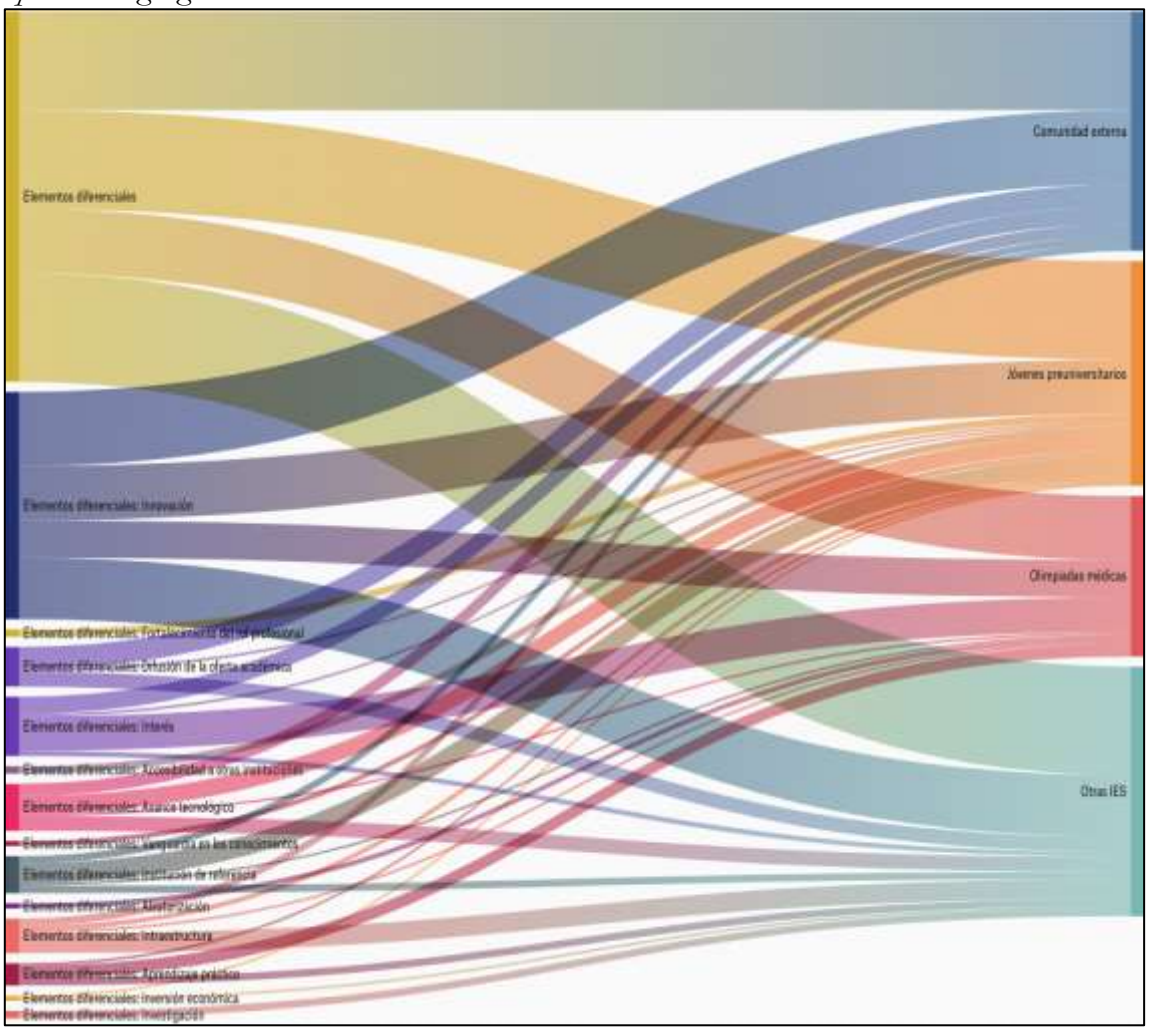
Figure 4 shows the result of the coding through the Sankey diagram. It is observed that the category with the greatest rootedness was impact, of which the highest density was for the external community and other HIAs. This indicates that the participating students consider that the development of the medical Olympiads allows, mainly, to generate processes of continuous improvement and strengthening of clinical skills that are notorious in the external community and in other HEIs. Likewise, advantages such as leadership, comprehensiveness and humanization that are more relevant for the young pre-university population stand out, which could boost the notoriety and attractiveness of the university.

Figure 5 *Sankey diagrams of the benefit category for five stakeholders. In original Spanish language*



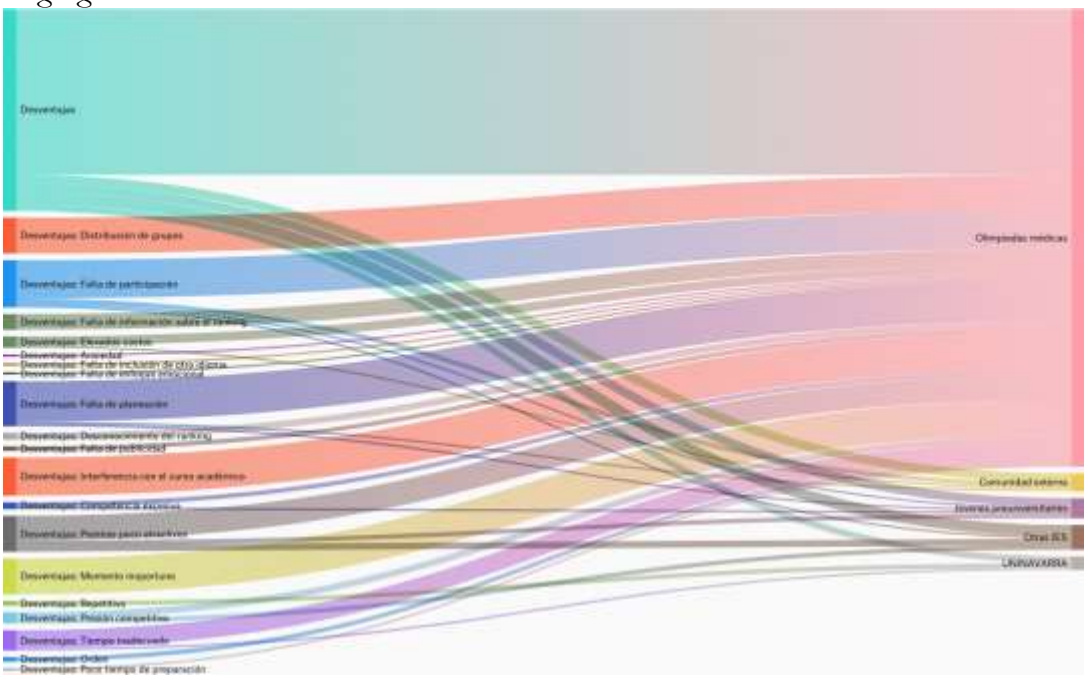
The benefits documented by the students were coded and distributed using the Sankey diagram (Figure 5). The greatest rootedness of the benefits was on the UNINAVARRA community and the participants of the medical Olympiads, specifically in relation to knowledge, competitiveness, projection towards the future and teamwork. This allows us to recognize that the students perceive that during the development of the competence they were able to strengthen theoretical components and disciplinary aspects of the professional role. They also highlighted the processes of self-evaluation, heteroevaluation and co-evaluation characteristic of the simulated practices.

Figure 6 *Sankey diagrams of the categories of differential elements for four stakeholders. In original Spanish language*



In Figure 6, the main differentiating elements and their effect on particular groups according to student perception were identified. It is highlighted that innovation was the most rooted with significant densities for the external community, other HEIs and for pre-university students; which indicates that students consider this characteristic to be the most important and potentially visible, especially from the extra-institutional sector. Additionally, infrastructure and investment in technologies are elements that highlight the academic initiative and that is recognized by UNINAVARRA students.

Figure 7 *Sankey diagrams of the category of disadvantages for five interest groups. In original Spanish language*



The main disadvantages of the medical Olympiads were recorded in Figure 7. It was observed that the aspects with the highest density were the distribution of the groups, lack of participation, lack of planning and interference with the academic year. In other words, the students consider it challenging to carry out innovative activities with people who are not part of their usual social and academic circle, as well as, they indicated that the development of the event was an additive to the semester load that implied greater effort to achieve ideal performances, however, some students indicated greater prioritization of their activities in clinical practice, resulting in selfless participation in some cases.

DISCUSSION

In medical education, the incorporation of ABS and interactive pedagogical methods has shown potential benefits for future professionals in the field of health. Therefore, the design of serious games requires rigorous methodological structuring processes based on learning models and/or theories that facilitate the generation of multidimensional impacts and evaluations of professional performance (Aster et al., 2024; Sharifzadeh et al., 2020). Some of the strategies with the most evidence in the field of medical education are: game mechanics and the correct scoring system, which allow numerically representing progress by team, and establishing a hierarchical classification range, which generate operant conditioning aligned with the descriptions of Pavlov and Skinner's theories of learning; however, some authors highlight the need to link a multidisciplinary team of professionals during the design phase to optimize learning reach and outcomes through more loyal and immersive experiences (Zohari et al., 2023; Watsjold et al., 2022). In this way, the "Medical Olympics" were designed with qualifying phases given by quantitative evaluations for correct answers during the different stages of the event, which were designed and supervised by a qualified team of multidisciplinary professionals.

On the other hand, according to a scoping analysis by Sharifzadeh et al. (2020) in more than a hundred publications on serious games and gamification for undergraduate and graduate students from different health programs, the general characteristics of the design are fundamental for the objective evaluation of the impact, benefits, and satisfaction of the strategy. Thus, on average, the duration of participation per student was between 15 and 30 minutes with a number of repetitions ranging from 0 to 25 times in a total interval of between 1 week and 8 years (Sharifzadeh et al., 2020). This reflects the disparity of educational strategies implemented around the world, and gives rise to wide limits of intervention that depends on learning objectives and outcomes; as well as the financial resources and time available for its execution. For this reason, the design of this strategy is considered appropriate and innovative because it follows the global trend of intervention, and because it establishes curricular transformations for the structured incorporation of simulated practices during the professional training of students in the health sector.

The benefits of incorporating serious games in medical education have been described, such as the improvement of learning processes, knowledge retention, decision-making, modulation of feelings, motivation and conscious reflection; which constitute ideal complements to traditional teaching models, contributing in the future to the improvement of quality of care indicators in essential aspects such as patient safety, satisfaction with health care and outcomes (Ghoman et al., 2020; Xu et al., 2023). Likewise, the implementation of interdisciplinary simulations fosters effective communication and collaboration between students from different disciplines, strengthening mutual understanding and cooperation among future health professionals, which is essential for teamwork and decision-making in real clinical settings (Koukourikos et al., 2021; Gue et al., 2022). In addition, evidence suggests that high-fidelity simulations, combined with constructive feedback, can significantly improve students' competence and confidence in their ability to perform in complex clinical situations (Okuda et al., 2009; Anders et al., 2023; Shrivastava et al., 2024).

Finally, through the post-intervention survey, it was determined that for most of the students the event was excellent, allowing them to improve their knowledge and skills, as well as incorporate comprehensive processes of evaluation and healthy competitiveness. This is similar to that found by Gue et al. (2022) in a study that aimed to evaluate the motivation and commitment of a group of emergency residents in a game called East EMWars, which integrated group competencies for the development of curricular themes over the course of a year. An optimal level of satisfaction and commitment to serious play was found among the participating students (72.2%) compared to traditional education. Likewise, the results in a virtual learning model called escape room showed that the majority of residents (88.9%) were satisfied with the inclusion of didactic elements in the teaching-learning processes, associating them with qualifiers such as "interactive", "pleasant", "different" and "interesting" (Turner A; Tichter A; Pillow, 2021). It also contributes to improving communication and interpersonal skills necessary in the practice of routine care. However, the lack of national references for the creation of learning strategies mediated by interdisciplinary simulation limits the appropriate comparison of results according to the socioeconomic context, academic competitiveness, and health system needs.

CONCLUSIONS

Interdisciplinary simulation experiences, such as those implemented in the "Medical Olympiads", allow students to face and solve complex clinical problems in a controlled environment, which improves their ability to handle similar situations in real practice. In such a way, this type of training not only reinforces theoretical learning, but also provides an invaluable opportunity to practice technical and non-technical skills in a risk-free environment, reducing medical errors and improving clinical outcomes, underlining its importance in medical training.

This work identified the impact of the application of a didactic strategy and the perception of the participants. The results indicated that most of the students valued this didactic strategy positively, highlighting its effect on the development of clinical skills and the ability to promote teamwork and decision-making in high-pressure situations. Thus, the "Medical Olympics" not only enrich traditional academic training, but also prepare students for the challenges of the real clinical environment, where interdisciplinary collaboration and rapid response capacity are crucial. Therefore, the benefit of integrating similar strategies into the curricular activities of the different medical programs to improve the competencies and performance of future health professionals is underlined.

However, the study has certain limitations that should be considered when interpreting the results. One of the main limitations is the sample size and the implementation of the didactic strategy in a single setting, which restricts the generalization of the findings, and conditions their applicability in other institutions with different structural and evaluative conditions. Likewise, the group-weighted evaluation of professional and reasoning competencies may not adequately represent the real performance of the students, due to the lack of individualization in the evaluation of the participants. In addition, the qualitative evaluation of the data could generate subjectivity with the results and in the assessment of the impact of the didactic strategy.

For future research, it is recommended to carry out standardization and validation processes of evaluation rubrics aligned to particular clinical cases for simulated training environments in order to improve the objectivity of the results. Also, the need to carry out longitudinal studies that evaluate the long-term effects of the didactic strategy is raised, focusing on the professional performance and quality of care of the graduates. It is also suggested to investigate the integration of emerging technologies, such as virtual reality and artificial intelligence, in clinical simulation to increase the immersion and effectiveness of learning.

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