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The use of gamification in teaching renal physiology

O uso da gamificação no ensino da fisiologia renal

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ABSTRACT

Introduction: The traditional teaching model, in which the teacher is the mentor of the educational process and focuses on extensive lectures, is still quite prevalent in educational institutions at different levels of education. This scenario can be considered incongruent with the new technological era and new way of thinking. In contrast, gamification is an active methodology that aims to make the student the center of learning, aiming to increase their interest and improve content absorption.

Objective: This study aims to analyze the perception of students attending the second semester of a medical course about the use of a game that covers the main concepts of renal physiology.

Method: This is a descriptive, prospective study. The activity consisted of a dynamic that used a board game with cards about renal physiology for 104 students. Subsequently, a questionnaire with 11 questions was applied, mostly objective, whose main variables investigated were previous experience with gamification, the adequacy of the practical class duration, how they evaluated the use of gamification in the practical class, among others.

Results: The results showed that most students stated that this type of methodology is stimulating (93.3%) and that it helps in the study of the proposed subjects (94.2%), consolidating the topics previously covered in the classroom using the traditional method. The students also pointed out that the best way to assimilate the content would be to add gamification, after the traditional method of dialogue exposition (61.5%). When asked about their perception of the use of gamification in practical classes, most students classified it as excellent (65.4%) or good (30.8%).

Conclusion: Given the results presented herein, it can be concluded that gamification proved to be an excellent ally to the traditional theoretical class, serving as a mechanism for sedimentation and increased interest for students.

Keywords: Gamification; Renal Physiology; Teaching; Medicine.

RESUMO

Introdução: *O modelo tradicional de ensino em que o professor é o mentor do processo educativo, tendo enfoque em extensas aulas expositivas, ainda é bastante predominante nas instituições de ensino de diferentes níveis de escolaridade. Esse cenário pode ser considerado incongruente com a nova era tecnológica e o novo modo de pensar. Em contrapartida, a gamificação é uma metodologia ativa que visa tornar o aluno o centro do aprendizado, a fim de aumentar o interesse dele e melhorar a absorção do conteúdo.*

Objetivo: *O presente estudo visa analisar a percepção de alunos do segundo semestre de um curso de Medicina sobre a utilização de um jogo que contempla os principais conceitos da fisiologia renal.*

Método: *Trata-se de um estudo descritivo, do tipo prospectivo. A atividade consistiu em uma dinâmica que usou um jogo de tabuleiro com cartas sobre a fisiologia renal para 104 alunos. Em seguida, foi aplicado um questionário com 11 perguntas, majoritariamente objetivas, cujas principais variáveis investigadas foram a experiência prévia com a gamificação, a adequação da duração da aula prática, como os discentes avaliaram o uso da gamificação da aula prática, entre outras.*

Resultado: *Os resultados mostraram que a maioria dos alunos afirmou ser esse tipo de metodologia estimulante (93,3%) e que auxilia no estudo dos assuntos propostos (94,2%), consolidando os temas já vistos em sala de aula pelo método tradicional. Também foi pontuado pelos estudantes que a melhor maneira de assimilar o conteúdo seria adicionar a gamificação, após o método tradicional de exposição dialogada (61,5%). Quando questionados sobre a percepção do uso de gamificação nas aulas práticas, a maioria a classificou como ótima (65,4%) ou boa (30,8%).*

Conclusão: *Diante dos resultados expostos, pode-se concluir que a gamificação se mostrou uma excelente aliada à aula teórica tradicional, servindo como mecanismo de sedimentação e aumento de interesse para os discentes.*

Palavras-chave: *Gamificação; Fisiologia Renal; Ensino; Medicina.*

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INTRODUCTION

The traditional teaching model began with illuminism, or Age of Enlightenment, in the 18th century[1], having the teacher as the mentor of the educational process and placing the entire mission of disseminating knowledge on this figure. Students, in turn, behaved as passive individuals in the learning process, being presented with extensive content in expository classes and periodically evaluated through tests, which served to measure the absorption of a given subject[2]. Thus, students graduated tending not to take full advantage of their potential and having difficulty correlating the studied content with professional practice.

This scenario can be considered incongruent with the new technological era and the new way of thinking, linked to this panorama[3], resulting from the emergence of the Internet in 1947. From then on, the process of disseminating information became increasingly easier, which opened several doors for the modernization of teaching, especially in the medical field[4].

Within this context, the term 'gamification' was coined in 2002 by Nick Pelling, which is defined as the application of game strategies in everyday activities, aiming at increasing the participants' engagement. The psychological motivation behind gamification shows that the goal and the dispute move a good part of human beings, and competition is often the basis of the knowledge acquisition process[5].

In this context, although it is currently possible to access any information via cell phone, as well as participate in online meetings, take part in competitions, games, and quizzes, most educational institutions, at different levels of education, still adopt the traditional teaching model, which does not stimulate students' autonomy, analytical skills, and critical reasoning[6].

Therefore, aiming to avoid the educational flaws inherent to traditional methodologies, such as lack of attention and interest and, consequently, lower knowledge absorption, it would be appropriate to use an active methodology, also placing the student as the protagonist in the teaching and learning process[3]. From this perspective, gamification would be perfect for the occasion, and could use, as TAKENAMI et al.[7] did, board games, which were part of many people's childhood and adolescence and have many attractive features that are the reason for countless hours spent among groups of friends and family.

Certainly, some of the particular features of board games include attention, enthusiasm, motivation, dynamics, fun, attractiveness, competitiveness and interaction between participants[8], which are considered extremely valuable for the learning process, especially in relation to broader subjects, such as renal physiology. This subject is indispensably important for medical training but is often classified by students as difficult because it requires a lot of study and individual commitment to understand it correctly.

Because of these facts, it is often not possible to achieve the learning objectives using only the traditional teaching methodology, thus suggesting the complementary use of active methodologies to facilitate learning. Therefore, the present study aimed to analyze the perception of students attending the 2nd semester of a medical course regarding the use of a game about the main concepts of renal physiology.

METHOD

This is a descriptive, prospective study, based on the experiences of medical students. The board game was applied to 104 students attending the second semester of 2022 and supervised by a physiology professor. The project was evaluated and approved by the Human Research Ethics Committee, and students only participated in the research after signing the Free and Informed Consent Form (TCLE).

Planning meetings were held to adapt the renal physiology content to the practical activity. The board game called Perfil® served as inspiration for the production and creation of the game, to address contents about the nephron structure and function, in addition to the hormones and medications that are involved in renal physiology.

The game structure was defined for an audience of 4 to 60 participants in each game match, containing 25 question cards, each with 5 tips regarding concepts of the renal system physiology, and five guess cards at any time (Figure 1).

Regarding the distribution of students in the game, the gamification activity was carried out in four different shifts, lasting around 100 minutes (90 minutes for the game and 10 minutes for filling out the questionnaire), with a group of no more than 30 people in each shift, totaling 104 participants.

The classroom consisted of six tables with five chairs each, where the students were divided into groups of up to five students, randomly, and each table received a dice. The nephron-shaped board was designed using the Canva® website and was projected on the board. It contains 18 squares that go from the glomeruli, passing through each tubular segment until reaching the collecting duct (Figure 2). Some squares had consequences that could be burdens or bonuses for the players who stopped on them. For example, we have the 10th square with the bonus of winning a guess card at any time and the 17th square with the burden of having to go back two squares.

Six pegs were used, each representing one of the six tables, numbered from 1 to 6. They were differentiated by color and, at first, were positioned on the glomeruli, as this was the starting point for all participants in the game (Figure 2).

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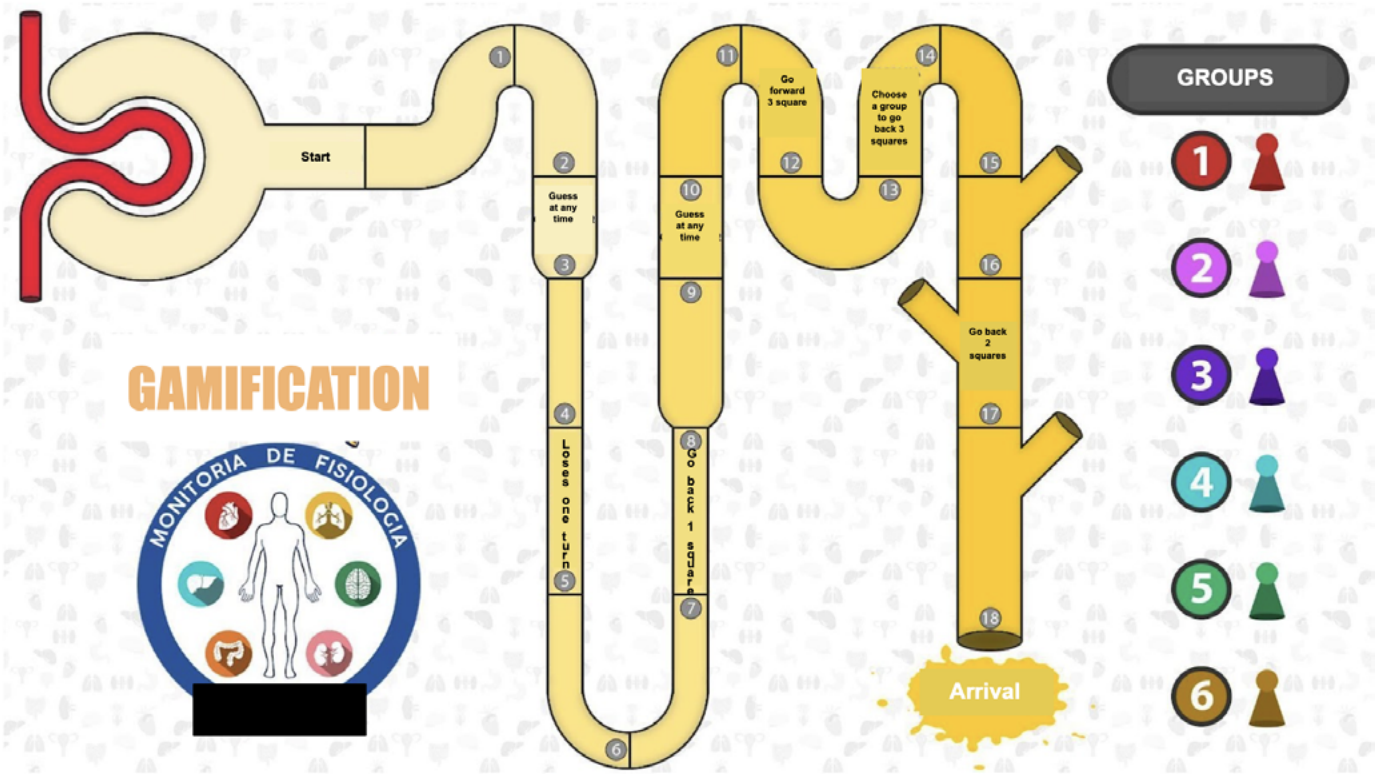
Figure 1. Representative figure of some cards present in the game, including structures correlated to the nephrons and the guess card at any time.

Source: prepared by the authors, 2022.

Figure 2. Representative figure of the nephron-shaped board used during the practical class.



Source: prepared by the authors, 2022.

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As the players advanced on the board, the pegs were moved with the help of the mouse along the 18 squares.

Before starting the game, the game dynamics were presented to the students, following the steps below:

1. An order will be chosen randomly among the teams present;
2. A card will be drawn from among the 25 and its title will be read aloud to everyone in the room, for example "I am a segment of the nephron";
3. The members of the team in question must choose which of the 5 clues they want to know and, after hearing the clue aloud, try to answer correctly what the card is about. The team will have 30 seconds to reach a consensus on an answer;
4. In case of a correct answer, the team will roll a dice whose result corresponds to how many squares their group will move on the board and advance in the segments of the nephron;
5. In case of a wrong answer, the card will be passed to the next team, which can choose another clue contained in the card to listen to. The team will have the same 30 seconds to reach a consensus on an answer;
6. If all the clues contained in the card have been revealed and no team answers correctly, everyone in the room will be asked out loud if anyone knows the answer. If yes, the team will be given the right to answer and, if they provide a correct answer, they will roll the dice to advance on the board. If no one answers or if the answer is incorrect, the person organizing the game reveals the correct answer, the card is discarded and a new round begins with another card;
7. There are special squares on the board that add an extra interaction, for example the "guess at any time" option, in which the team can answer a card during another group's turn. This interaction is for a single use;
8. The group that first reaches the end of the collecting duct will win the game.

At the end of the game, a QR code was made available so that students could answer a questionnaire using Google Forms, giving their opinion on the activity.

The questionnaire consisted of 11 questions (9 objective and 2 subjective ones). The variables investigated were: age, gender, previous experience with gamification, the contribution of the theoretical class to practice, the suitability of the duration of the practical class, the change in stimulus to study after practice, whether the practice facilitated the understanding of the subjects, whether the students would like to have more subjects covered in this way, which method would be the best to assimilate the content (traditional class, traditional class followed by gamification or gamification alone), how they perceived the use of gamification in the practical class (good, excellent, average or indifferent) and whether they had any additional comments to make about the activity.

The data obtained were stored in Google Forms spreadsheets for future analysis. In this same location, the graph was generated automatically, the percentage data were obtained through Microsoft Excel Software and the tables were created using Microsoft Word Software.

RESULTS

A total of 104 students participated in the study, the majority of which were female (72). The most prevalent age group was 19 to 20 years old, corresponding to 54% of all participants. The data obtained through the questionnaire revealed that the experience with gamification was new for 45.2% of the students. Furthermore, 93.3% stated that after this type of activity they felt more stimulated to study the content, in addition to considering the duration of the activity adequate, without it becoming tiring (Table 1).

The results showed the importance of this method to facilitate understanding of the subject, reinforced by 94.2% of the students. However, 96.3% of them also recognized the importance of theoretical classes to support group discussion during practice.

When asked about the addition of theoretical subjects addressed using gamification, 91.3% answered that they would like to have more subjects addressed in this way (Table 1). Moreover, when asked about which would be the best method to assimilate the studied content between the traditional method alone, gamification alone, traditional class followed by gamification, and indifferent, the following results emerged: 61.5% of the students considered the traditional class followed by gamification to be the best and 30.8% considered gamification alone to be the best way to improve the learning process (Graph 1).

Regarding the use of gamification in practical classes, only 3.9% of the respondents considered the use of this tool to be regular or indifferent, while 96.3% perceived it as good or excellent (Table 2).

When asked if they had any additional comments to make about the activity, 45 (43%) students gave their opinion. Of these, the majority wrote comments similar to the following: "*Very good, very useful*", "*It was a great way to put the theoretical lesson into practice*", "*Very good class, very dynamic, a relaxed and fun way to assimilate the subject*!" and "*It was very interactive and helped us a lot with understanding*".

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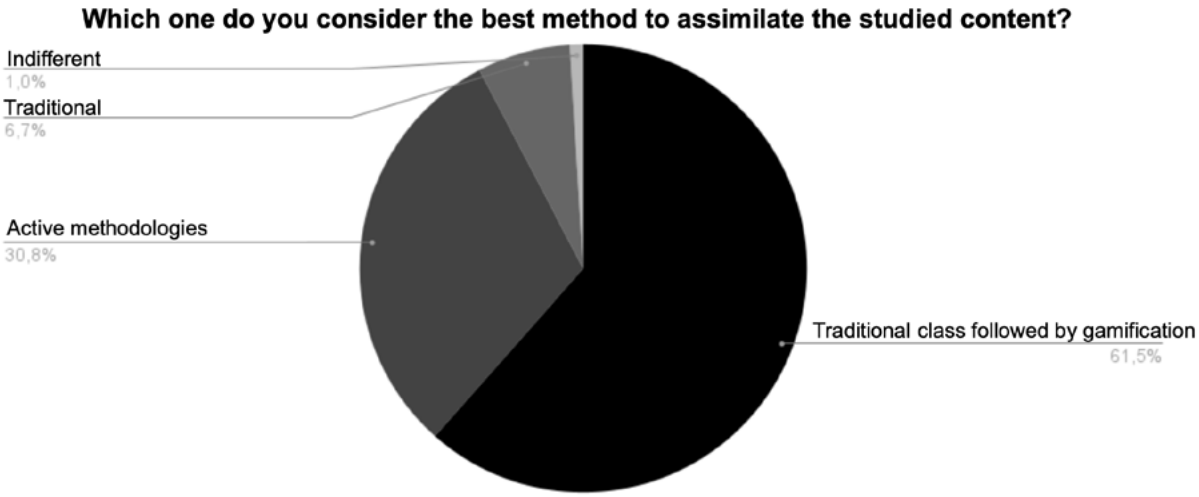
Table 1. Opinions on gamification.

Question	Yes	No	Indifferent	Total
Have you ever had any experience similar to today's gamification?	57 (54.8%)	47 (45.2%)	-	104 (100%)
Did the theoretical classes that were taught contribute to the group discussion during the practice?	100 (96.3%)	1 (0.9%)	3 (2.8%)	104 (100%)
Did you feel more encouraged to study the content covered after the class with gamification?	97 (93.3%)	7 (6.7%)	-	104 (100%)
Was the activity of adequate duration, without becoming tiring?	97 (93.3%)	7 (6.7%)	-	104 (100%)
Has the understanding of the topics become easier with the use of gamification?	98 (94.2%)	1 (1%)	5 (4.8%)	104 (100%)
Would you like to have more theoretical topics covered in this way?	95 (91.3%)	9 (8.7%)	-	104 (100%)

Source: prepared by the authors, 2023.

Graph 1. Figure representing the students' opinions on the best way to assimilate the content.



Source: prepared by the authors, 2023.

Table 2. Students' perception of gamification.

Question	Indifferent	Regular	Good	Excellent	Total
What is your perception about the use of gamification in practical classes?	1 (0.9%)	3 (2.8%)	32 (30.8%)	68 (65.4%)	104 (100%)

Source: prepared by the authors, 2023.

It is important to emphasize that none of the comments made indicated dissatisfaction by the students regarding the activity.

DISCUSSION

Introducing new learning strategies in medical education is of great importance for the students' academic training. The gamification strategy aims to stimulate memory, create cognitive bridges with previous learning, and foster many other skills that are extremely important for future medical professionals, such as insight and teamwork[9,10].

The results of this study showed that gamification was very well received. Most students said they were more motivated to study the content, understanding the subject more easily. This information is consistent with studies in the literature that show that gamification improves students' knowledge, skills, and satisfaction[11,12].

Another important factor is that the practice was not considered tiring; on the contrary, it was considered dynamic, with an adequate duration, interactive, and aroused the students' interest in more approaches like this. Certainly, a time-consuming practice without many steps that move the game forward can increase the students' dropout and/or dispersion from the activity, that is, the duration of the gamification

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application is an essential factor to consider when investigating the effectiveness of these methods in student learning[13]. Moreover, a meta-analysis study demonstrated that learning with gamification has an ideal maximum effect achieved when the practice lasts less time[14].

In this context, it is relevant to mention that the organizers of the practical activity were also able to identify in students, during the day of the experiment, more attention, interactivity and enthusiasm without dispersion, as seen in a previous study, also carried out with board and card games[7]. PAIVA. et al. explains that this is due to gamification that complements and optimizes learning, in addition to increasing interest and desire to study[2].

These data demonstrate how gamification, as well as other active methodologies that, unfortunately, are still scarce in medical education, are desired by students, as they have several characteristics that are extremely useful for the learning process, which makes them more frequently used as tools for consolidating content and increasing interest in opportune situations.

It is also worth noting that, unlike previously cited studies[2,7,15], this study has a larger sample size and assesses students' perceptions through something more concrete, in this case, the questionnaire at the end of the practical activity, which allows a more objective documentation of the results.

Furthermore, in a systematic study of more than 40 articles on gamification in the education of health professionals, no negative results were reported due to the use of gamification. It has also been suggested that it is possible to improve learning outcomes in health professions education using gamification, especially when games that stimulate the search for learning are used[11]. This information corroborates our data, since none of the students expressed a negative opinion about the class, and 93.3% of the students reported feeling more motivated to study the content after having completed this type of activity.

In fact, although the sample size is significant, since it only included one class, it does not represent the student population as a whole, suggesting that the study could be extended to more semesters in possible future implementations. Furthermore, it was not possible to analyze the effectiveness of gamification through a pre- and post-test comparing the traditional teaching method with the active methodology, which would provide greater amplitude to the results. The analysis of this study was a subjective one, through our perception of the students' reactions during the practice and, later, their answers in the questionnaire.

Within this bias, another limitation observed was the need to constantly update the cards used in the dynamics, since the students wrote down the questions and answers during the practice, which allows the transfer of these data from one semester to the next. Such an event requires updating the information described in the cards between semesters. A promising way to minimize this damage would be to create a question bank and use a different set of cards each semester.

Finally, although gamification has proven to be effective, this study also revealed that, for students to have a complete experience, prior exposure to the subject is necessary, whether through a traditional theoretical class or through prior personal study. This shows that, within the teaching-learning process, active methodologies, in fact, have the important role of complementing the traditional method, and not replacing it.

FINAL CONSIDERATIONS

In conclusion, gamification has proven to be an excellent ally for traditional theoretical classes, serving as a mechanism for sedimentation and increased interest, and its use can be suggested more frequently. Moreover, it is a method that can be easily adapted to numerous teaching areas.

More experiments are needed to improve the method, and pre- and post-tests are suggested for a more objective and comparative assessment.

AUTHORS' CONTRIBUTIONS

Marcelo Coelho Parahyba Júnior contributed to the study concept and design, preparation of the teaching material, data acquisition, data analysis and interpretation, preparation of the manuscript and final approval. Renato Brito Oliveira Martins and Karla Maryana Lima Loiola Weyne contributed to the preparation of the teaching material, data acquisition, preparation of the manuscript and final approval. Natália Pessoa Eufrásio Nogueira contributed to the preparation of the teaching material, data acquisition, data analysis and interpretation, preparation of the manuscript and final approval. Edson Lopes da Ponte and Gabriela Fernandes Oliveira Marques contributed to the critical review of the manuscript and intellectual content, administrative and technical support and final approval. Leidiane Pinho da Silva contributed to the study concept and design, preparation of the teaching material, data acquisition, critical review of the manuscript and intellectual content, administrative and technical support and final approval.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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