

Organic functions: ludicity as a learning facilitation tool

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Abstract: The learning process can be more engaging and relaxed when instructional resources promoting these qualities, such as instructional games, are employed. Ludicity, *i.e.*, the quality of being playful and enjoyable, can be much more than mere play; it can assist in the teaching and learning of the curriculum content. When alternative teaching methods are adopted, outcomes can exceed mere learning. They can also motivate students to participate actively in the teaching-learning process. In this context, the game “Unravelling Organic Functions” was conceived with the aim of facilitating student learning and retaining of organic functions and nomenclature of organic compounds by promoting student engagement. Based on traditional follow-the-path board games, “Unravelling Organic Functions” was employed as an instructional activity at a public school in Itacoatiara (AM), Brazil, as part of an intervention-research project of a qualitative nature. Data were collected by means of questionnaires responded by the participating students and teacher and pre- and post-intervention tests responded by the former. The results indicate that the participants found the experience engaging and enjoyable. They also suggest that the game in question facilitated learning and retaining of the aforementioned concepts and theories, thus corroborating the importance of including ludic classroom activities in the teaching-learning process.

Keywords: Teaching methods, ludic classroom activities, games, play, learning

Funções orgânicas: o lúdico como facilitador da aprendizagem

Resumo: O aprendizado pode ser um processo mais leve e interessante quando se tem o auxílio de recursos didáticos que proporcionem tais características, como por exemplo, o jogo lúdico. O lúdico pode ser muito mais do que apenas uma brincadeira, mas um método de apoio ao conteúdo disciplinar. Ao inserir metodologias alternativas para o ensino, os resultados podem ir além do “aprender”, servindo também de motivação aos alunos e colocando-os como parte do processo de aprendizagem. Neste contexto, o jogo “Desvendando as funções orgânicas” foi elaborado com o objetivo de facilitar a compreensão sobre funções orgânicas e nomenclatura dos compostos

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orgânicos por meio do uso de metodologias lúdicas. Este jogo foi baseado em um jogo de tabuleiro tradicional e desenvolvido numa escola pública do município de Itacoatiara-AM e seus resultados foram avaliados empregando uma pesquisa quali-quantitativa com aplicação de uma entrevista aberta com alunos e professora da disciplina e um questionário pré e pós-jogo. Os resultados obtidos nesta pesquisa indicaram uma ótima aceitação dos entrevistados, além de mostrar que os alunos aprenderam melhor o conteúdo aos quais foram expostos, facilitando o processo de ensino-aprendizagem e demonstrando a importância da inclusão de outros recursos didáticos nas metodologias de ensino.

Palavras-chave: Métodos de ensino, atividades lúdicas em sala de aula, jogos, reproduzir, aprendendo.

Introduction

Notwithstanding the wealth of teaching tools available to teachers nowadays, the conventional teaching methods, *i.e.*, lecture-based, prevail in most classrooms (Fialho, 2008; Filho; Cavagis; Benedetti, 2020). In conventional classrooms, teachers are in charge of transmitting knowledge, leaving to the students the onus of acquiring and making sense of ready-made information, *e.g.*, established concepts and theories. In many conventional classrooms, textbooks are the only teaching-learning resources used (Castoldi; Polinarski, 2009; Marasini, 2010).

Yet, many teachers seek, albeit unsuccessfully, new teaching methods as they can see that lecture-based classes and textbooks alone do not suffice to promote student learning. They know that lecture-based teaching makes for tedious and monotonous classes that fail to motivate students and, therefore, compromise their understanding of curriculum content (Marasini, 2010). This situation could be changed were teachers willing to give up their role as knowledge holders, and embrace that of mediators, and adopt instructional resources capable of promoting student engagement (Fialho, 2008).

Pinto and Tavares (2010) claim that ludic classroom activities promote student creativity, place them at the center of the teaching-learning process, and awaken in them the desire to understand, the will to participate, and the enjoyment of discovering. However, Fialho (2008) and Souza (2007) believe that instructional games should be used only as support to learning, *i.e.*, as useful tools to reinforce previously taught concepts and theories, not as a way of introducing them to students. In addition, Souza (2007) warns that the role played by teachers in ludic classroom activities is critical to accomplishing the proposed goals. As with other instructional resources, teachers must have adequate training, abilities, and some creativity to obtain maximum potential using games. Instructional resources should not be used carelessly; there should be careful

planning on the part of teachers, who must know how to use them to meet the course objectives.

Based on the above discussion, the aim of this research was to devise and use a follow-the-path game at a Chemistry classroom focusing on course content in order to promote student-student and teacher-student interaction and contribute to the teaching-learning process by facilitating student understanding of organic functions and nomenclature of organic compounds.

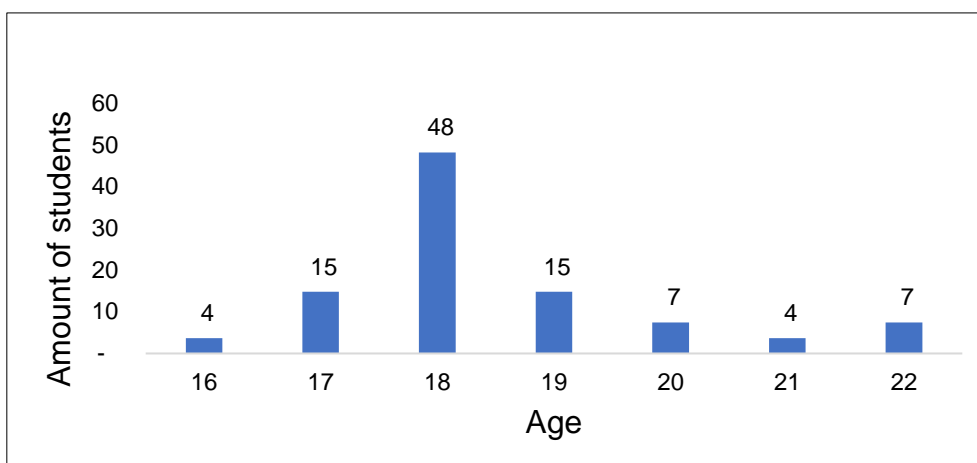
Method

Research Design

This intervention-research of a qualitative nature aimed at assessing student participation in class, engagement with course content, and learning and retaining of concepts and theories. With that in mind, the researchers devised the game “Unravelling Organic Functions” to promote student understanding of organic functions and nomenclature of organic compounds.

Context and Participants

The intervention was implemented with 3rd-year students and teacher from two evening classes at a secondary public school in Itacoatiara (AM), Brazil. There were 27 students in each group, but only about half of them participated in the project (48% female and 52% male), *i.e.*, pre-intervention lecture-based classes and intervention itself (game). The teacher, a 38-year-old woman with 17 years of teaching experience, had majored in Science and Chemistry and conducted postgraduate studies in Biology and Chemistry. The participating students' ages ranged from 16 to 22, as shown in Graph 1.

Graph 1. Age of the participating students

Source: The authors, 2022.

The game “Unravelling Organic Functions” consisted of a traditional follow-the-path board game adapted to the following course content: organic functions and nomenclature of organic compounds. After five conventional lecture-based classes on the concepts and theories in question were given to both groups of students, the game was employed to reinforce the learning of the previously taught concepts and theories. The research project consisted of five lecture-based classes prior to the intervention, the intervention itself, *i.e.*, the ludic instructional activity using the proposed board game, one multiple-choice quiz responded by the students after the lecture-based classes, *i.e.*, before the intervention, and after the intervention. In addition, the participating students and teacher responded to questionnaires at the end of the project (TABLE 1).

Table 1. Days, course content, and time spent

DAY	COURSE CONTENT/CLASSROOM ACTIVITY	TIME SPENT (MINUTES)
1	Hydrocarbons	40
2	Hydrocarbons and oxygenated functions	40
3	Oxygenated functions	40
4	Nitrogenated functions	40
5	Nitrogenated functions and application of pre-intervention test	40
6	Use of the proposed game, application of post-intervention test, and open-ended interview with participants	80

Source: The authors, 2022.

Data Collection

As aforementioned, the researchers conceived a multiple-choice quiz in order to assess the participating students' knowledge of organic functions and nomenclature of organic compounds. The quiz was applied twice, before and after the intervention using the board game "Unravelling Organic Functions" (APPENDIX A), to assess the efficacy of the proposed instructional activity. The pre- and post-intervention test comprised 10 multiple-choice questions covering some of the previously taught concepts and theories.

Two interview questionnaires with closed-ended and open-ended questions were also prepared to be responded by the participating students (APPENDIX B) and course teacher (APPENDIX C) at the end of the project. Their aim was to elicit the participants' reactions, conceptions, and opinions about the instructional method used at the intervention.

The researchers also collected data through classroom observation before and during the intervention.

Conduction of Research

At first, the researchers contacted the school administration, presented the project (*i.e.*, intervention, game, etc.), and asked whether they would like to participate. After authorization was granted, the course teacher was contacted in order to plan the lecture-based classes and set the dates for the intervention.

The lecture-based classes began on March 21, 2022 for both groups of 3rd-year secondary school students and they lasted two weeks. Although both groups had about 27 students each, only half of them attended the lecture-based classes. The topics were divided into hydrocarbons and oxygenated/nitrogenated functions. The lecture-based classes employed a whiteboard, marker pens, and an overhead projector. Despite the short length of time, given that evening classes lasted only 40', it was possible to adequately address the topics in question.

On day 6 (Table 1), the participating students were divided into three 4-5 member teams. Then, the game rules were discussed with the participants, *i.e.*, students and teacher. The game "Unravelling Organic Functions" consisted of a conventional follow-

the-path board game in which the first player or team to arrive at the end of the path won the game.

When the first pawn reached the “Fim” space (*i.e.*, The End) and the game was over (FIGURE 1), the participating students were asked to respond to the post-intervention test. Subsequently, both students and teacher were asked to respond to the interview questionnaires.

Creating and Assembling the Board Game

The instructional game “Unravelling Organic Functions,” modelled after traditional follow-the-path games, was devised with the intention of facilitating student learning and retaining of the concepts and theories in question. The game board had 60 spaces, alternately labeled as “P” (for question), “?” (onus/bonus), and “C” (interesting fact/information) (FIGURE 1).

Figure 1. “Unravelling Organic Functions” game board



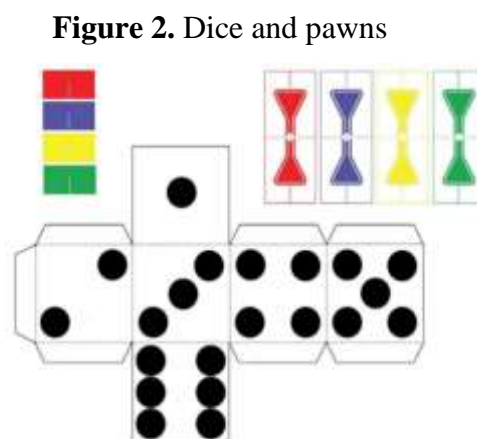
Source: The authors, 2022.

The game board was downloaded free-of-charge from Silhouette Studio at <https://silhouettebrasil.com.br/produto/silhouette-studio/>. The game was conceived to be easily printed on an A4 sheet of paper to minimize costs. “Unravelling Organic

Functions” comprised a game board, one dice, four pawns (red, blue, green, and yellow), and 120 cards.

Dice and Pawns

The dice and pawns were devised so that they could be easily prepared, *i.e.*, cut off and glued together (dice) or assembled (pawns) (FIGURE 2).



Source: The authors, 2022.

Cards

There were 120 cards: 60 questions (P), 30 pieces of interesting information/facts (C), and 30 onuses/bonuses (?) (FIGURE 3).

Figure 3. Back of “P,” “C,” and “?” cards



Source: The authors, 2022.

Divided into three levels of difficulty: easy, intermediate, and difficult (FIGURE 4), the questions were based on the concepts and theories previously taught to the students, *i.e.*, general characteristics and nomenclature of organic functions.

Figure 4. Examples of “P” card questions

Level Easy	Level Intermediate	Level Difficult
Ethanol is considered a: a) Primary alcohol b) Secondary alcohol c) Tertiary alcohol Answer: a	Hydrocarbons are _____ substances: a) Polar b) Nonpolar c) Both Answer: b	Which organic function does the following structure represent? $\begin{array}{c} \\ -C-OH \end{array}$ a) Aldehyde b) Alcohol c) Carboxylic acid Answer: b

Source: The authors, 2022.

The “C” card faces presented interesting pieces of information or facts about the topics in question (FIGURE 5). Some of them also offered tips concerning some of the “P” card questions.

Figure 5. Examples of “C” card information and facts

Did you know?	Did you know?	Did you know?
According to the new nomenclature, one no longer writes, for instance, 1-butene nor butene-1, but but-1-ene.	To name an alkene, one should number the carbon molecules to indicate where the double bond is; start with the carbon molecule closest to unsaturation...	Fruit releases ethene, which is why bananas ripen faster when wrapped in paper.

Source: The authors, 2022.

The cards labeled as “?” conferred advantages or disadvantages to the players (FIGURE 6).

Figure 6. Examples of “?” cards, *i.e.*, bonus or onus cards

OOPS!	OOPS!
You are going too fast. Go back to start.	You are going too fast. Skip one round.

Source: The authors, 2022.

Game Instructions

A booklet with instructions to the game was provided to the students beforehand (FIGURE 7 and 8). The game rules were similar to those of most follow-the-path board games: the first player to arrive at the last space is the winner.

Figure 7. Pages 1 and 4 of the instruction booklet



Source: The authors, 2022.

Page 1 cited all the materials needed to play the game.



Figure 8. Pages 2 and 3 of the instruction booklet

Source: Authors, 2022.

Then, the “P,” “C,” and “?” cards were separated into three corresponding decks. The players decided who was going to be the mediator, *i.e.*, the person in charge of drawing the cards from the “P” and “?” deck and reading the questions or bonuses/onuses aloud. The players also decided who was going to go first.

The first player or team to play rolled the dice and moved forward the corresponding number of spaces. In case the players landed on a “P” space (*i.e.*, question), the mediator would draw a “P” card from the “P” deck and read the question aloud. The players had one minute to answer the question. If the response was correct, their pawn would stay where it had landed. If the response was incorrect or the answering time had elapsed, their pawn would go back to its previous space and the mediator would place the “P” card back at the bottom of its deck. If their pawn landed on a “C” space (*i.e.*, interesting fact/information), they would draw a “C” card and read it silently to themselves (or their team), as the card might have information that could help them to answer a “P” card question. Once the game was over, each player or team was asked to read their “C” cards aloud to all players.

When their pawn landed on an “?” space (bonuses or onuses), they had to do what was written on the card, *i.e.*, they would have to:

- Go back to the start;
- Skip a round;
- Choose a player to skip a round (they were not allowed to tell the same player/team to skip two rounds in a row).
- Go forward or back ‘n’ spaces.

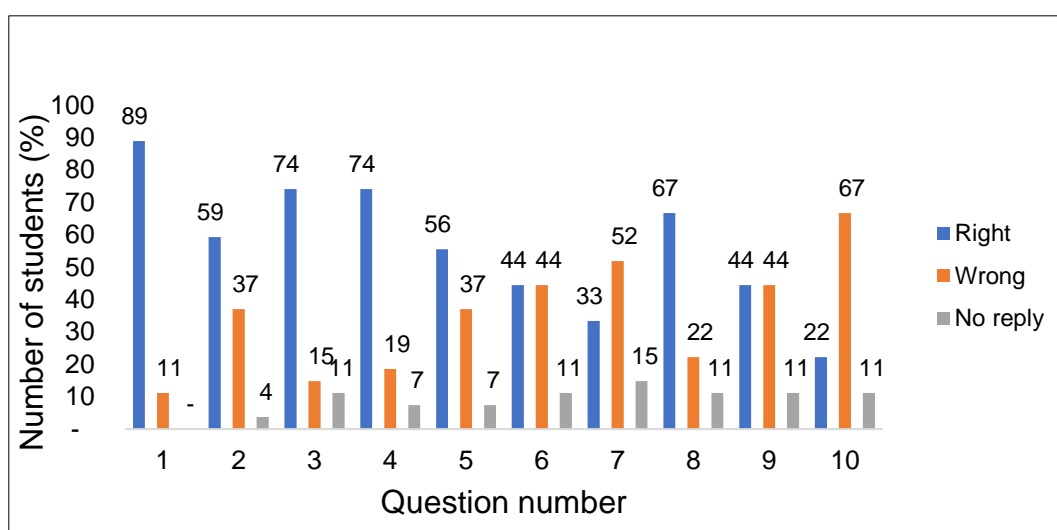
When their pawn landed on an “?” space, as a result of a “?” card instruction or due to having answered a “P” card question incorrectly, no extra “?” card was drawn. The game winner was the first player (or team) to reach the “Fim” space, whether the number shown on the dice sufficed or exceeded that needed to reach it.

Results and discussion

Analysis of Pre- and Post-intervention Test Data

The analysis of the data collected by means of the pre-intervention test shows that the participating students gave more correct responses than incorrect responses to the test questions (GRAPH 2). For instance, 89% of students answered Question 1 correctly. However, the students did not perform as well concerning other questions, *e.g.*, Question 10, which was answered correctly by only 22% of the participants. Overall, the pre-intervention test results point to satisfactory student performance after the lecture-based classes alone.

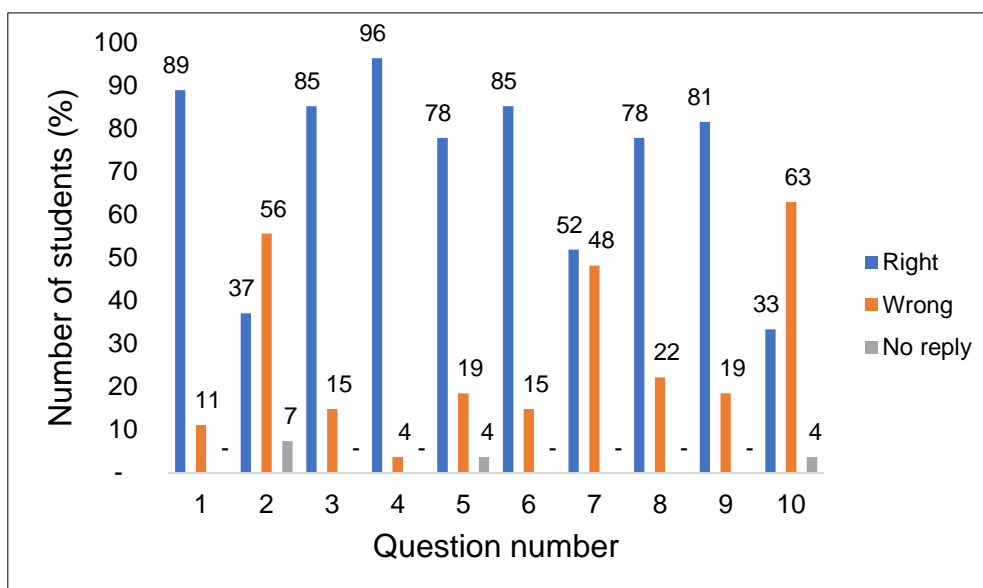
Graph 2. Pre-intervention test results



Source: The authors, 2022.

Graph 3 shows the participants' responses to the same test after the intervention, *i.e.*, game. It should be observed that Question 4 was the one with the most correct responses (96% against 74% in Graph 2). Question 10 received the largest number of incorrect responses in the post-intervention test as well, albeit with a 4% decrease in errors and an 11% increase in correct responses as compared to Graph 2.

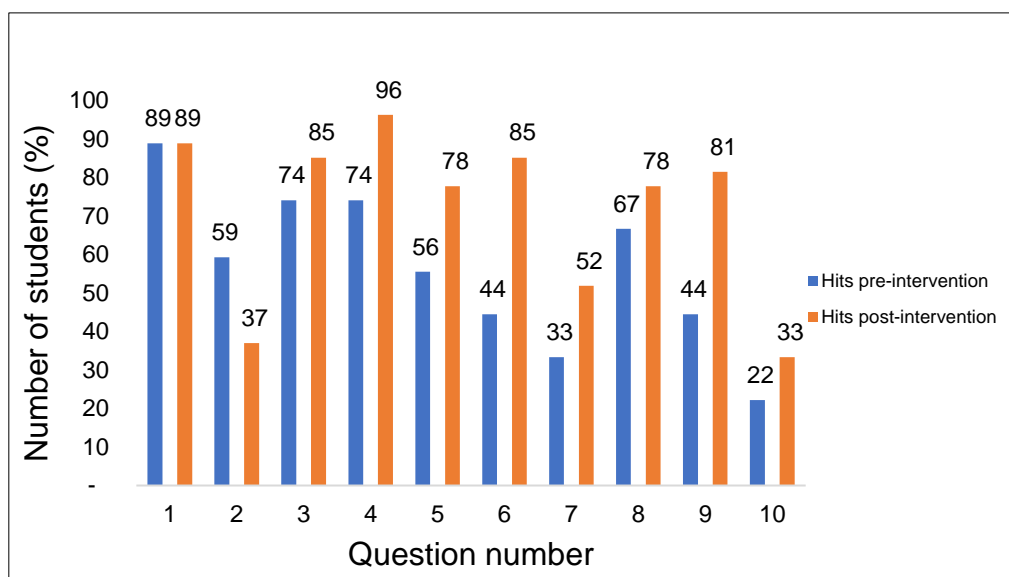
Graph 3. Post-intervention test results



Source: The authors, 2022.

In order to assist in the analysis of the collected data, results from pre- and post-intervention tests were plotted together (Graph 4). Again, it can be observed that Question 4 received the largest quantity of correct responses in both pre- and post-intervention tests, 74% and 96%, respectively — a significant improvement. Likewise, Question 10, which received the largest quantity of incorrect responses in both pre- and post-intervention tests (67% and 63%, respectively) showed an increase in the quantity of correct responses, from 22% to 33%.

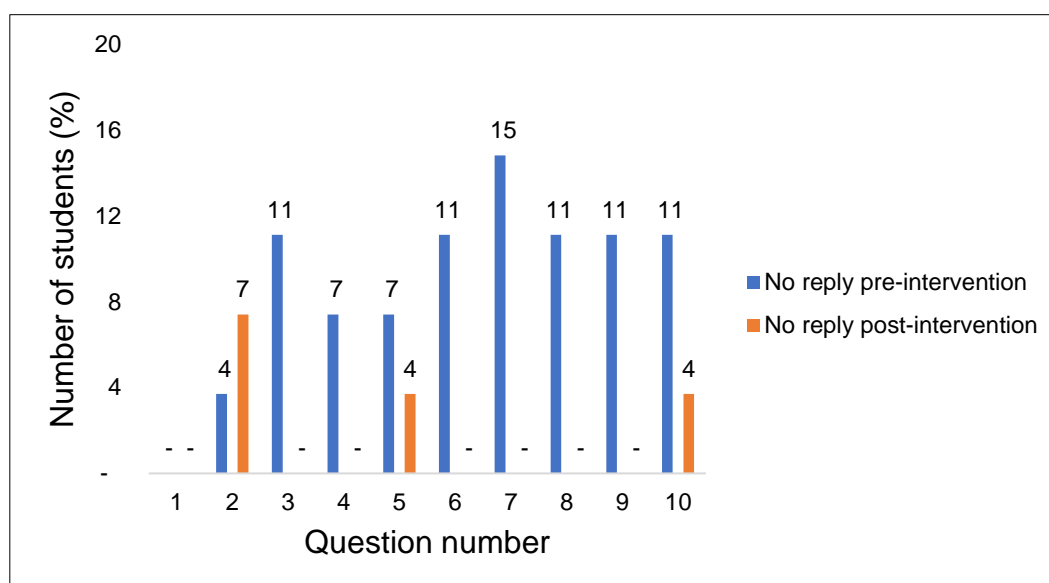
Graph 4. Percentages of correct responses to pre- and post-intervention test questions



Source: The authors, 2022.

The number of correct responses to the post-intervention test questions increased by 26% as compared to those to pre-intervention test questions (GRAPH 5). There was also a decrease in the quantity of questions left unanswered after the intervention (game). Nine pre-intervention questions were left unanswered by at least one participant whereas only four post-intervention questions were left unanswered, a 44% decrease.

Graph 5. Percentages of unanswered questions in pre- and post-intervention tests



Source: The authors, 2022.

Overall, there was an 84% decrease in the number of participants who left questions unanswered in the post-intervention test as compared to that in the pre-intervention test. This significant decrease (GRAPH 3) validates the positive effect of instructional games on student understanding of curriculum content indicated in the literature.

Moreover, the joint analysis of the above graphs suggests that the ludic aspect of the intervention contributed to student understanding of the concepts and theories in question, thus corroborating Pinto and Tavares (2010). These authors claim that ludic classroom activities play an important role in student learning because they enable students to see themselves as participants in the knowledge construction process and, as a result, meaningful learning to occur.

Analysis of Data from Interview Questionnaires

The teacher, an experienced professional as aforementioned, reported that she had already used instructional games in class. She asserted that the game “Unravelling Organic Functions” had led her students to engage further with the course content and participate more actively in the teaching-learning process, consequently making it more dynamic and interactive. In addition to promoting student interaction and participation, this type of game could be adapted to the teaching of other course or subject content, thus improving classes and making them more interesting to students.

Similar to their teacher, the participating students reported that the ludic classroom activity had made learning more motivating and dynamic. They also stated that the instructional game had promoted their understanding of the concepts and theories in question. The students liked most the questions and the interesting facts/information on the cards, the game dynamics, and interaction among their peers. Some students declared they had enjoyed the whole project, *i.e.*, the lecture-based classes and intervention.

The students also said that they hoped that instructional games would be used more often in the teaching of Chemistry and other school subjects. They reported that the game “Unravelling Organic Functions” had favored interactivity and learning, besides being livelier and “cool.” They also indicated that the game had motivated their learning even when their responses to the card questions were incorrect; these situations became good opportunities to recap and revisit the previously taught concepts and theories.

In the participants’ opinion, the instructional game contributed to the teaching and

learning of Chemistry by helping students to understand better the course content and solve their doubts. They also reported that it accelerated learning and favored peer and teacher-student interaction.

The participants' opinions and perceptions are corroborated by the pre- and post-intervention test data, which indicate that the teaching activity reinforced student learning of the course content in question, as demonstrated by their improved scores in the post-intervention test.

The analysis of the collected data and classroom observation at the intervention suggest that the game enriched the class, making it more dynamic, fun, and interactive. It placed the students at the center of the knowledge construction process by motivating them to participate and seek more information about the topics at hand in order to win the game.

It should be noted that the game "Unravelling Organic Functions" could be readily used by other teachers since its materials can be easily prepared and assembled. The game could also be adapted to address other course or subject content, provided it is used only as support to lecture-based classes, *i.e.*, to facilitate student learning and retaining of previously taught concepts and theories (Souza, 2007). To this end, it is essential to present the content covered in the game to the students before using it, which helps them to formulate correct answers and avoid needless frustration.

It is also important to make the instructions clear to the players beforehand so the waste of time during the game is minimal. Despite the participating students' excitement and engagement, the activity with the game "Unravelling Organic Functions" was smoothly and satisfactorily conducted with both groups of students, which contributed to their positive reactions as well.

Final remarks

Ludic classroom activities are more than just play; they are ways of making learning more enjoyable and dynamic. In addition, they can promote more peer interaction, encouraging students to help each other to reach a common goal, *i.e.*, formulating correct responses to advance in the game and win it. They can also develop teamwork skills and a spirit of healthy competition by competing for mutual improvement, learn complex and relevant curriculum content, and cultivate cognitive, intellectual, and social skills.

In this research, it was possible to observe how much the participants enjoyed the game in question and the collected data showed that the proposed learning objectives were met satisfactorily, *i.e.*, the students improved their knowledge of organic functions and nomenclature of organic compounds while practicing and developing social and teamwork skills.

Therefore, it is possible to assert that the use of ludic classroom activities in Education, *i.e.*, fun, relaxed, and engaging classroom activities, can promote student learning and participation, thereby contributing to their education. Hence, we hope that ludic classroom activities, such as the game used in this study, will be employed more often in order to make classes more productive and enjoyable to students and teachers alike.

References

CASTOLDI, R.; POLINARSKI, C. A. A utilização de recursos didático-pedagógicos na motivação da aprendizagem. *In: I SIMPÓSIO NACIONAL DE ENSINO DE CIÊNCIA E TECNOLOGIA*, 2009, Ponta Grossa. **Anais** [...] Ponta Grossa: UFTPR, 2009. p. 684-692

FIALHO, N. N. Os jogos pedagógicos como ferramentas de ensino. *In: CONGRESSO NACIONAL DE EDUCAÇÃO*, 2008, Curitiba. **Anais** [...] Curitiba: PUC-PR, 2008. p. 12298-12306.

FILHO, E. B. CAVAGIS, A. D. M.; BENEDETTI, L. P. S. Um jogo didático para revisão de conceitos químicos e normas de segurança em laboratório de química. **Química Nova Escola**. São Paulo, v.42, n.1, p. 37-44, 2020.

MARASINI, A. B. **A utilização de recursos didático-pedagógicos no ensino de biologia**. 2010. Available at: <<https://www.lume.ufrgs.br/handle/10183/35273>>. Accessed on: January 22, 2022.

PINTO, C. L.; TAVARES, H. M. O lúdico na aprendizagem: Aprender e aprender. **Revista da Católica**. Uberlândia, v.2, n. 3, p. 226-235, 2010.

SOUZA, S. E. O uso de recursos didáticos no ensino escolar. *In: I ENCONTRO DE PESQUISA EM EDUCAÇÃO, IV JORNADA DE PRÁTICA DE ENSINO, XIII SEMANA DE PEDAGOGIA DA UEM: “INFANCIA E PRÁTICAS EDUCATIVAS”*, 2007, Maringá. **Anais** [...] Maringá: UEM, 2007. p. 110-114.

Link to access the APPENDIX A, B and C: [Click here](https://drive.google.com/file/d/1t1n_KuGcfSt7soUBu8GRJzLLltG5dyBl/view?usp=drivesdk) or access https://drive.google.com/file/d/1t1n_KuGcfSt7soUBu8GRJzLLltG5dyBl/view?usp=drivesdk

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