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Periodic domino game: a possibility for teaching and learning one of the periodic table

Jogo dominó periódico: uma possibilidade para o ensino e aprendizagem um da tabela periódica

Juego de dominó periódico: una posibilidad para enseñar y aprender uno de la tabla periódica

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Fernanda Oliveira de Souza
ORCID: https://orcid.org/0000-0001-5479-5783
Universidade Federal do Ceará, Brasil
E-mail: fernanda.harry@hotmail.com
Jakson Fernandes Lima
ORCID: https://orcid.org/0000-0001-9759-3188
Universidade Federal do Ceará, Brasil
E-mail: jaksonfernandeslima@gmail.com
Railo Cavalcante Nunes
ORCID: https://orcid.org/0000-0003-2297-4036
Universidade Federal do Ceará, Brasil
E-mail: raylocavalcante@hotmail.com
Daniel Alves da Silva
ORCID: https://orcid.org/0000-0003-3650-4828
Universidade Estadual do Ceará, Brasil
E-mail: danielsilvaquimico@gmail.com
Glória Fernandes Lima
ORCID: https://orcid.org/0000-0003-0087-0578
Universidade Estadual do Ceará, Brasil
E-mail: gloriafernandeslima@gmail.com
Rubya Macêdo Lima
ORCID: https://orcid.org/0000-0003-1368-3499
Universidade Estadual do Ceará, Brasil
E-mail: rubyaml@hotmail.com.br

Sandra Maria Barbosa de Araújo
ORCID: https://orcid.org/0000-0001-8988-8453
Universidade Estadual do Ceará, Brasil
E-mail: sandra.taua@hotmail.com
Rosilene Rosa Rodrigues
ORCID: https://orcid.org/0000-0002-0810-0538
Universidade Estadual Vale do Acaraú, Brasil
E-mail: rosilenerosa2013@gmail.com
Maria Izabel Florindo Guedes
ORCID: https://orcid.org/0000-0002-4569-8663
Universidade Estadual do Ceará, Brasil
E-mail: florinfg@uol.com.br
Luiz Francisco Wemmenson Gonçalves Moura
ORCID: https://orcid.org/0000-0001-5854-6709
Universidade Estadual do Ceará, Brasil
E-mail: wemmenson.moura@uece.br

Abstract

Studies and research show that chemistry Teaching is, in most cases, traditional, centered only on the memorization of names and formulas; with this, it distances itself from the reality of the student, becoming difficult and annoying. One of the chemistry contents that raise the most doubts in the students is the periodic table, most of them cannot assimilate the properties and the way the elements were organized. As an alternative to reduce these difficulties arise the games, didactic-pedagogical tools help the teacher in an attractive and dynamic way. In this sense, the present work should aim to verify the acceptance and the influence in the application of the game Domino Periodic in the classes on the periodic table. For that, field research was carried out with 19 students of the 9th grade of Elementary School II of the Centro Educacional Espaço Criativo School, in the municipality of Quiterianópolis-CE. The data were collected through an evaluative questionnaire, and the results graphically presented showing that the game aroused the interest of the students, since 64% of them attributed a maximum score and had an excellent influence, since 95% of the students stated that the game contributes significantly to a better understanding of the content addressed.

Keywords: Teaching chemistry; Games; Periodic table.

Resumo

Estudos e pesquisas apontam que o Ensino de Química é na maioria das vezes, tradicional, centrado apenas na memorização de nomes e fórmulas, com isso acaba se distanciando da realidade do aluno, tornando-se difícil e chato. Um dos conteúdos de Química que despertam mais dúvidas nos alunos é o da Tabela Periódica, a maioria deles não conseguem assimilar as propriedades e a forma como os elementos foram organizados. Como alternativa para diminuir estas dificuldades surgem os jogos, ferramentas didáticas-pedagógicas que auxiliam o professor de maneira atrativa e dinâmica. Neste sentido o presente trabalho teve como objetivo verificar a aceitação e a influência na aplicação do jogo dominó periódico nas aulas sobre Tabela Periódica. Para isso foi realizada uma pesquisa de campo com 19 alunos do 9º ano do Ensino Fundamental II da Escola Centro Educacional Espaço Criativo, no município de Quiterianópolis-CE. Os dados foram coletados através de um questionário avaliativo e os resultados graficamente apresentados mostrando que o jogo despertou o interesse dos alunos, já que, 64% deles o atribuíram nota máxima e que teve uma ótima influência, pois 95% dos estudantes afirmaram que o jogo contribui de forma significativa para uma melhor compreensão do conteúdo abordado.

Palavras-chave: Ensino de química; Jogos; Tabela periódica.

Resumen

Estudios e investigaciones señalan que la Enseñanza de la química es la mayor parte del tiempo, tradicional, centrada únicamente en la memorización de nombres y fórmulas, con esto termina alejándose de la realidad del alumno, volviéndose difícil y aburrida. Uno de los contenidos de química que más dudas despierta entre los estudiantes es el de la tabla periódica, la mayoría de ellos son incapaces de asimilar las propiedades y la forma en que se organizaron los elementos. Como alternativa para paliar estas dificultades, surgen juegos, herramientas didáctico-pedagógicas que ayudan al docente de forma atractiva y dinámica. En este sentido, el presente trabajo debe tener como objetivo verificar la aceptación e influencia en la aplicación del juego domino periodic en las clases de tabla periódica. Para ello, se realizó una investigación de campo con 19 alumnos del 9º grado de la Escuela Primaria II del Colegio Centro Educacional Espaço Criativo, en la ciudad de Quiterianópolis-CE. Los datos fueron recolectados a través de un cuestionario evaluativo y los resultados presentados gráficamente mostrando que el juego despertó el interés de los estudiantes, ya que el 64% de ellos le otorgó la puntuación más alta y que tuvo una gran influencia, ya que el 95% de los

estudiantes manifestó que el juego contribuye significativamente a una mejor comprensión del contenido cubierto.

Palabras clave: Enseñanza de la química; Juegos; Tabla periódica.

1. Introduction

Learning and understanding the contents and or concepts of chemistry were always considered difficult by students. Due to difficulties such as these, education in general gradually expanded over time. Several researchers have been looking for new teaching methodologies to make more accessible and more dynamic teaching of chemistry (Matias et al., 2017). In this sense, it is necessary to take a careful look at what concerns the approach to the contents treated by the discipline of chemistry, since most of them are taught traditionally. However, when we consider the lack of didactic tools that aid learning, one of the reasons that sometimes discourage the teacher and, consequently, the student (Gonzaga et al., 2020).

Most of the content related to the periodic table is traditionally approached in the classroom, with the student being held hostage by memorization. The teaching becomes mechanized and does not allow the student to reflect, characterizing a challenge for the teacher, who needs to highlight, with a certain balance, the path used in the teaching-learning process so that knowledge is incorporated correctly by students (Soares, 2019).

Chemical elements and their characteristics, configurations and related properties are topics covered in the periodic table content. We know that teaching and learning in the classroom are processes that are organized according to the “time” factor. Therefore, teachers plan the contents considering the class time they have available, leaving students with the task of appropriating the concepts involved in this content. Generally, pedagogical needs are not taken into account for this appropriation to happen. However, often the methodology applied by the teacher makes it difficult for students to understand such concepts and does not guarantee meaningful learning of the content (Oliveira & Quadros, 2020).

According to the PCNs (1999), the teaching of chemistry “should enable students to understand both chemical processes themselves, as well as the construction of scientific knowledge in close relationship with technological applications and their environmental, social, political and economic implications.” To achieve these goals, it is necessary for the educator to seek alternatives that provide real moments of learning, enabling the construction of meanings of abstract concepts. This can be done through differentiated strategies, among them, the games stand out.

Teaching practice should be guided to lead students to develop concepts that are the basis for their studies' continuity and build intellectual tools, which allow them to interpret situations in their reality. Therefore, it is necessary to invest in methodologies that provide education aimed at training that meets current social needs (Costa et al., 2017).

According to the National Curriculum Parameters - PCN (Brasil, 1988 p.47):

> Games are an interesting way of proposing problems, as they allow them to be presented in an attractive way and favor creativity in the elaboration of resolution strategies and search for solutions. They provide the simulation of situations - problems that demand immediate and lively solutions, which stimulates the planning of actions.

One of the games that help in the Teaching of chemistry is the periodic dominoes. Many of these works indicate the same as a good alternative for each content's end, where the teacher can obtain a better performance about the subject worked (Matias et al., 2017). It is believed that educational games, when properly designed and used in a pedagogically appropriate way, can be used as learning tools to improve the effectiveness of the learning process at all levels of education (Carvalho, 2018). This work aims to verify whether or not the use of the periodic domino game to teach the periodic table to assist in the construction of knowledge and stimulate learning.

2. Materials and Methods

This study verified the game periodic domino contribution in learning the content on the periodic table, with a methodology based on descriptive research, empirical basis and qualitative nature.

The research was carried out at the Centro Educacional Espaço Criativo private school, in Quiterianópolis-CE, with a single class of the 9th grade of Elementary School II. The data were collected from September to November of the year 2018. For that, a study and application of an evaluative questionnaire (Table 1) were made, composed of six questions, where three are multiple-choice, and three are subjective about the game's application.

First, the Management Nucleus, Chemistry Teacher and Students of the said School were informed about this work's purpose and proposed activities. Initially, theoretical classes were held to present and explain the content on the periodic table, then the game was already produced, and the questionnaire was used.

After collecting the questionnaires, the data were cataloged and presented in the

results and discussions, analyzing the students' evaluation and their interest in games during chemistry classes.

Table 1 - Questionnaire model applied.

Assessment questionnaire on the periodic table
01 What do you think about using games in the classroom?
02- When the teacher uses a game or a different activity in the Chemistry class, you think the class is: ( ) interesting ( ) good ( ) fair ( ) bad
03- When the teacher plans a game, you prefer it to be played at: ( ) team ( ) individual
04- Is the "Dominoes Periodic" game easy to understand? ( ) Yes ( ) No
05- Did the applied game contribute positively to the learning of the content covered, chemical elements? ( ) yes ( ) no ( ) in parts ( ) made no difference Justify
06- Assign one of these notes to the game of 2, 4, 6.8 and 10

Source: Author himself.

3. Results and Discussion

This Ported in the literature points to several types of research developed reporting the difficulties faced in chemistry Teaching. There is a need to deepen the knowledge on the exposed to better understand, through research, how the use of games can contribute to the improvement of this Teaching. (Cunha, 2004; Fialho, 2008; Cavalcanti, 2011; Cunha, 2012). In this context, this research was also carried out with 19 students from a 9th-grade class to analyze the influence of the periodic domino game on understanding the content on the periodic table.

The results presented and discussed below were obtained through the responses to the applied questionnaire.

Regarding games in the classroom, the most diverse answers were given (Table 2). The analysis of the answers to question 1 showed that 58% of students consider the use of games in the classroom to be important, as they facilitate the understanding of the contents studied and that 31. 5% attribute the use of this resource as something fun and stimulating.

Table 2. Use of Games in the Classroom.

ANSWERS OBTAINED	QUANTITY OF STUDENTS	PERCENTAGE
Important, because it facilitates learning when you have topics related to the subject that we will discuss.	**5**	
I think super **important,** because it stimulates the student.	**1**	**58%**
It is of great **importance**, since it directly contributes to a better understanding of the contents covered in a practical and effective way.	**3**	
Importantly, we practice what we know and can learn more.	**2**	
Very good and **productive,** because besides the student is interested in the content, he likes to learn the subject (in the chemical case).	**2**	**10. 5%**
Fun because it makes the class more interactive and stimulating.	**6**	**31. 5%**

Source: Author himself.

Learning science scholars had emphasized that the development of these types of skills requires a different kind of teaching and learning such as the use of games and/or play, where the student is more active in the teaching process than that emphasized in previous ages education when learning was conceptualized as the acquisition of facts and teaching as the transmission of content in a traditional way (Linda et al., 2020).

The use of games and recreational activities for educational purposes had great importance throughout human history. This thought of education for fun was shared by many educators and many schools, which today still use, in the early school years, with the motto “learn while playing” (Cavalcanti, 2011).

The use of playfulness for teaching content in the classroom can be an instrument that attracts the attention of students, arousing interest in solving problems through the proposed activities (Filho et al., 2008).

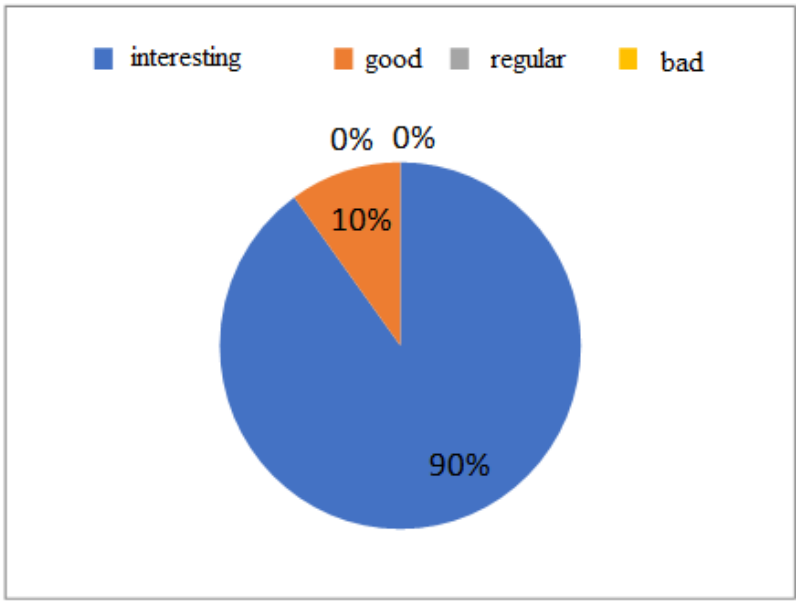
Games can be used as a didactic resource in several ways, depending, initially, on the game's characteristic and, later, on the didactic planning of the teacher. They can be used at different times, such as in the presentation of content, an illustration of aspects relevant to the content, such as reviewing or synthesizing important concepts and evaluating issues already developed (Cunha, 2004).

Playing in the classroom promotes rich situations of interaction and learning. It helps educators and students in the educational process, being, therefore, of great relevance, by promoting situations of education and socialization with others and with the environment. According to Cunha (2012), the game provides an understanding of concepts and the student's development in the classroom.

For Messeder Neto & Moradillo (2017), the game is a tool that makes students focus more on a certain point, the existence of rules, the controlled freedom of the game and the emotional factor of fun that is present in all playful activities allow the student to pay more attention to certain focus, Therefore, to take advantage of this moment provided by the game and convert it into a real acquisition of the psyche, making the student win, transforming his voluntary attention and concentration during the game, effectively appropriating the concepts worked on.

When asked about games or a different chemistry class (Question 2), most students, 90% (Graph 1), classified the class as interesting.

Graph 1. Opinion on the use of Games or Differentiated Activity in the chemistry class.



Source: Author himself.

Chemistry teaching is also based on traditional methodologies, emphasizing memorizing content, names and formulas, often meaningless and unused in the student's life, as Chassot (2004) recalls. According to Cunha (2012), the concept of more effective teaching must be associated with arousing the student's interest, and this often depends on the competence of the teacher; thus, the teacher is continuously challenged in his pedagogical practice. In this context, this author also highlights that students' interest has become the driving force in the learning process. In this case, the teacher must be the one who promotes stimulating situations for learning.

Didactic games in chemistry teaching are a pedagogical resource that stands out in classes, making it more attractive and dynamic in learning and making it a pleasant and useful discipline (Nascimento et al., 2015). The game, in this way, will be a facilitator for the understanding of specific content, resulting in the supply of playfulness that allows obtaining information (Zanon, 2008).

The use of these tools in classes improves student self-esteem, stimulates student-student and student-teacher relationships, and brings meaning to this and the satisfaction of learning a room content (Brougère, 1998).

Regarding team or individual play (Question 3), everyone chose to play in a group. The use of games in teaching allows students to develop skills that improve group living, accept, and help others in their difficulties. In addition to the importance of being willing to face challenges (Menin, 2016).

The periodic domino game involves elements and symbols from the periodic table. Likewise, a conventional domino consists of 28 pieces. Consequently, 28 elements of the periodic table, wherein one half is the symbol and in the other half the name of the element divided by colors that indicate which group it belongs to (Fialho, 2008).

It was designed to better understand the “Periodic Table” content, where he will be able to study, question, think and build his knowledge while playing. According to Godoi (2010), the periodic table study is always a challenge, since students have difficulties in assimilating the properties and the way the elements were organized.

As rules for the game, Fialho (2008) proposes the participation of four participants; that the written part of the pieces is face down and well mixed where each participant takes seven pieces, not allowing the other participants to see them; the beginning of the game is the responsibility of the student who has the symbol Hydrogen (H) on his pieces; after the start of the game, each student will place a piece that fits on one end of the game formation; if the student does not have a bit that works, he loses his turn; the participant who unloads all the

pieces wins the game, and in case everyone happens to pass, the participant who has the smallest sum of the atomic numbers of the elements in his hands wins. According to Romano et al. (2017), the student needs to have a table for possible doubts, focus on the element's location in the periodic table and the main characteristics of the elements.

Figure 1. Periodic domino game.

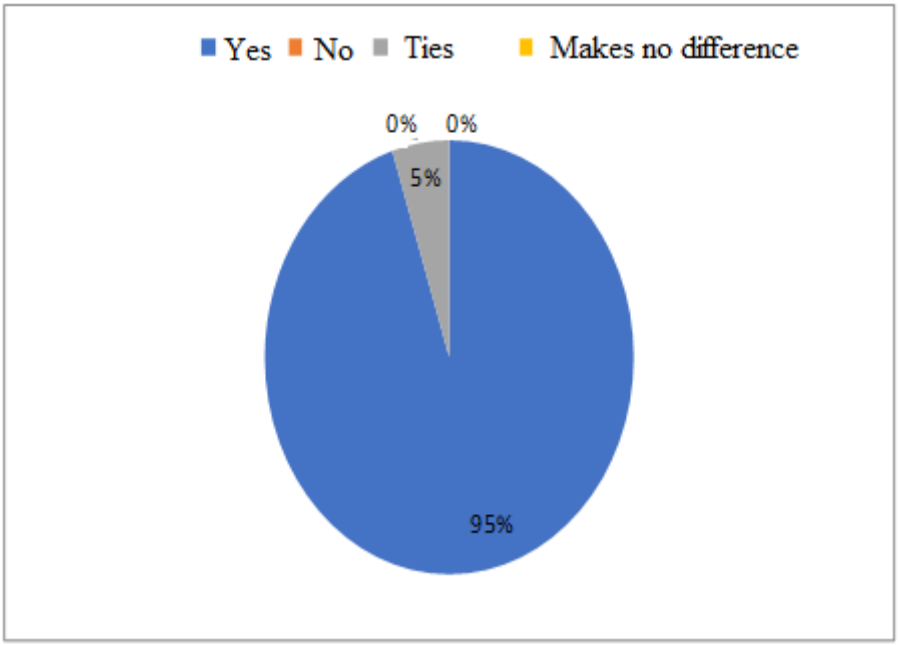
Source: Author himself.

Figure 2. Game application.

Source: Author himself.

When answering question 4. 100% of students found the periodic domino game easy to understand and 95% of them concluded that the applied game contributes positively to learning the content of the periodic table (Question 5) while only 5% of these considered that it only contributed in parts as we can see in Graph 2.

Graph 2. Opinion on the influence of the game in learning the content.

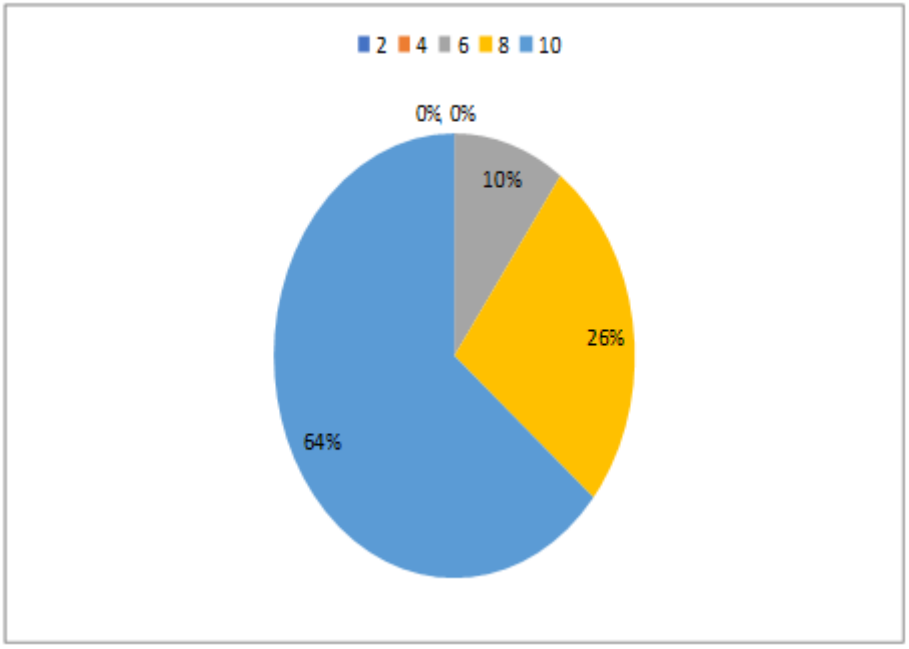


Source: Author himself.

According to the students' justifications for question 5, the periodic domino game facilitates the approach to the content about the Chemical elements, as it works with the name of the elements, their respective symbols and the division between metal, non-metal and gases.

This can be explained by Fialho (2008) when he reports the main objectives of this game: to get the student to memorize the symbols of some Chemical elements and their respective names; perform a memory and reasoning exercise; working with limitations; learn to live with the existence of rules and improve your group relationship. In Graph 3, we see the evaluation of the game.

Graph 3. Games evaluation (Students' grades).



Source: Author himself.

The results showed that the application of the game had a great acceptance on the part of the students, 64% attributed the number 10 to the game, realizing that the game attracted the students' attention for being fun and stimulating socialization among them. The games, in addition to attractive resources, are sources of pleasure and discovery for the student. Learning and teaching while playing enriches world views and the possibilities of relationship and companionship, socialization and exchange of experiences, knowledge of the other and respect for differences and reflection on actions (Cabrera et al., 2005).

Thus, our results presented in this work are considered important since the students saw in the game applied an innovative instrument that, besides allowing to learn the content, brought other benefits to the class, such as interaction and fun. To date, few studies have been reported on using the periodic domino game to improve the understanding of the content on the periodic table.

4. Final considerations

Games are auxiliary tools of great importance for teaching and building meaningful learning. In addition to stimulating students' reasoning, they arouse interest in the subject, making education more attractive and dynamic. In this context, the results obtained revealed that the game Periodic domino had an excellent evaluation because 100% of the interviewees

considered it to be easy to understand the game. The involvement of students in the development of the game was noticeable; 64% of them gave it a maximum score, showing that the proposed game arouses interest and represents a dynamic way of understanding the content.

During the application, it is still possible to observe some difficulties on the part of the students regarding the identification of the elements, as they frequently consulted the periodic table. However, it was considered a positive point, since the difficulties presented stimulated the use of the table, providing them with more familiarity in knowing how to handle it. It was also noticed that the game had a positive influence on the content approach, given that 95% of the students stated that it contributed to better assimilation of the names and symbols of the elements worked on. And that the class caught the attention of the students since 90% rated the class as attractive. Thus, it is believed that the game enabled the active participation of students in the construction of knowledge, as it related theory and practice playfully and interactively.

Given the above, it can be concluded that the application of the periodic domino game was satisfactory since it is an easy-to-use play tool that motivates, integrates and helps in the development of students.

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Percentage of contribution of each author in the manuscript

Fernanda Oliveira de Souza – 12%

Jakson Fernandes Lima – 10%

Railo Cavalcante Nunes – 9,5%

Daniel Alves da Silva – 9,5%

Glória Fernandes Lima – 9,5%

Sandra Maria Barbosa de Araújo – 9,5%

Rubya Macêdo Lima – 9,5%

Rosilene Rosa Rodrigues – 9,5%

Maria Izabel Florindo Guedes – 9,5%

Luiz Francisco Wemmenson Gonçalves Moura – 11,5%