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ANALYSIS OF THE APPLICATION OF THE GAME "HOT GRENADE" AS A TOOL FOR TEACHING CHEMISTRY

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ABSTRACT

The lack of motivation represents one of the main causes of students' lack of interest in teaching chemistry and to arouse their interest it is necessary to differentiate in class. A promising resource to achieve this goal is the use of playful activities. Playful activities are considered didactic tools that can motivate and make learning more pleasurable and meaningful. In this work, a previous investigation was carried out with students from a class of the 1st year of high school, about the use of play, as well as about the content to be worked on, and later the application of the game was analyzed. This tool was created based on the so-called "Hot Potato", where conceptual issues were worked on as a team following a different dynamic. It is possible to notice the development of personal knowledge, in this way the game enabled students to learn in a pleasurable way, in a context disconnected from the formal learning situation. With this, it can be affirmed through the speeches during the application and in the post-game questionnaire that its insertion in the school daily life is very important, as it becomes easier and more dynamic the teaching-learning process.

Keywords: Chemistry Teaching, Playful, Hot Grenade.

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INTRODUCTION

Currently, there is a growing search for innovative teaching methodologies, mainly due to numerous technological advances to which students have access, making traditional classes monotonous, making teachers have to "compete" with them to obtain quality and attractive teaching for students. This refers to the common neglect of students typing on their cell phones during classes instead of observing the teacher's explanations, especially in subjects involving exact sciences.

Learning in exact sciences is not simply to increase young people's knowledge about phenomena, nor only to develop or organize their common sense reasoning. Learning science requires more than challenging students' previous knowledge through inappropriate situations (DRIVER *et al.,* 1999).

Today's world expects high school to be not just preparatory for an assessment exam, where the student ends up becoming a reproducer of content. This new era has required students to take a stand, judge and make decisions, and to be critical of social reality.

The Teaching of Chemistry, currently, is still presented in the classroom in a traditional, abstract and decontextualized way, characterized by the memorization and repetition of names, formulas and calculations, that is, totally disconnected from the daily life and reality in which students are inserted. Chemistry, in this situation, becomes a dull and monotonous discipline, causing young people not to be interested in it and to question the reason why it is taught to them (LIMA; LIMA-NETO, 1999).

This shows that the teaching of chemistry should take the student much more of their reality, their daily life and the context in which they are inserted, seeking to teach in a way that they learn meaningfully, all in a pleasant way.

Teaching-learning in Chemistry, as well as in other science disciplines, has been a real challenge for teachers in the area. In order to stimulate the interest of students and motivate them to search for their own knowledge, the teacher seeks pertinent alternatives for his class, these activities are means for the teaching process, and often these methodologies do not bring the daily life to the classroom.

To try to minimize this discrepancy, a tool that can help is the use of playfulness, such as didactic games, which present a way to encourage the student to be interested in learning in a more pleasurable way.

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Learning takes place in the form of processes that include the one who learns, the one who teaches and, moreover, the relationship between these people (TEZANI, 2006). Fostering students' interest can provide greater involvement in the educational process. The use of playfulness, not only in the teaching of Science, but in other disciplines, brings with it the motivating and instigating characteristic, and can lead the student to learn by playing and playing by learning.

The being who plays and plays is also the being who acts, feels, thinks, learns and develops. Therefore, play is an integrating link between motor, cognitive, affective and social aspects (ROBAINA, 2008). This fact reinforces the relevance of the use of play in the classroom and allows us to think that by acting and being involved in the activity it is possible to learn.

Currently, there is a wide variety of published works involving playful activities in the Teaching of Chemistry, and their publication has grown year by year. Analyzing several texts, there is a growing increase in student-teacher interaction, but it should also be noted that these games can stimulate the student-student relationship, and in this context build knowledge, through team learning. Through the curiosity and willingness to compete that students have, this energy can be used for the benefit of teaching.

The application of didactic games is also very broad. This made use of this tool as a theme to develop a work aimed at review and evaluation in the teaching of chemistry. For this purpose, a "Hot Grenade" game was developed, an adaptation of "Hot Potato", to allow students to better learn the content of salts and oxides.

In view of the above, it is intended with this work to demonstrate how the didactic game can be useful in the classroom and also contribute to the teaching-learning process. For this to happen, the teacher needs to be prepared, because with the awakening of interest provided by the game, there may be numerous questions regarding both the content to be addressed in the game, and the insertion of a new teaching tool.

In this sense, the present work aimed to verify the influence and acceptance in the application of the didactic game Hot Grenade to assist in classes on salts and oxides.

Understanding the relevance of didactic games in the educational process, it is essential to explore how they were implemented and evaluated. Next, the methodology adopted to integrate the game 'Hot Grenade' in chemistry classes will be detailed, describing the stages of preparation, execution and evaluation.

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METHODOLOGY

THE UNIVERSE OF RESEARCH

At first, it was necessary for the approval of the research proposal by the coordination and direction of a public school located in the city of Dourados, Mato Grosso do Sul.

The choice of the educational institution was made based on works already developed in it by one of the authors of the work, such as in the disciplines of supervised internships I, II, III and IV and in other activities related to the teaching of chemistry. Another relevant factor for this selection was the receptivity on the part of the management, coordination and professors, who always encouraged the participation of the University in the School.

Subsequently, a meeting was held with the professor responsible for the 1st year class, since the contents of salts and oxides had already been previously chosen by the professor and the undergraduate student responsible for the research project.

First-year classes were chosen due to the need to bring these students who are having their first contacts with chemistry as a school subject, a differentiated form of teaching. When explaining the research, the class showed excitement about the idea.

For the development of the research and use of the data, it was requested that the students take to their parents to sign the consent form for participation in the study, as all were over 12 years old, it was also mandatory to sign it to prove voluntariness in the research. The project was explained leaving free choice to participate in it.

DATA COLLECTION

This research has a qualitative character and as a method of data collection, to verify how the class thinks about the chemistry discipline and about the previous knowledge they had with playful activities and the contributions that the game provided to the students in the review of the content, pre and post-questionnaire were used.

The questionnaire can be defined as the investigation technique composed of an even high number of questions presented in writing to people, with the objective of knowing opinions, beliefs, feelings, interests, expectations, situations experienced, etc. (GIL, 1999), so it was decided to apply it so that the previous concepts and ideas of the students about the subjects discussed could be known.

Barbosa (2008) states that among the various ways of obtaining qualitative and quantitative information, the questionnaire is a widely used instrument. It has an average

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cost, it is clear and precise in the information, it can provide that the people involved do not identify themselves, it presents the same issues to the same people, it can be applied in different ways.

Initially, a questionnaire was applied to the students that was answered individually and anonymously so that they could answer in the most sincere way, expressing their real opinions. The questionnaire was set up with questions related to the chemistry discipline, its difficulties and about playful activities that the class had already carried out and which they found interesting to be able to work on some content in the classroom.

Together with the class teacher, the content of salts and oxides was chosen to assemble the questions that would be part of the Hot Grenade game. The choice of this content was made because it was the most recent one the class had studied.

At the end of the first questionnaire and collection of the consent forms, the class was notified about the content that would be used in the proposed activity. After applying the game, the second questionnaire was made, where the students reported their difficulties with the content, game rules, dynamics, suggestions, negative and positive points and classified the game according to their opinions.

"HOT GRENADE" GAME

In view of the importance of developing new teaching methodologies and analyzing the dynamics of the game "Hot Potato", the game Hot Grenade was elaborated, which has a similar dynamic added to conceptual questions of Chemistry. To build the game, simple materials were used, such as a small *pet* bottle , black electrical tape, bandage torch and a hook. For the game "Hot Grenade", it was made by adapting a hot potato, disposable materials.

Figure 1 - Preparation of the "Hot Grenade".

Source: authors (2019)

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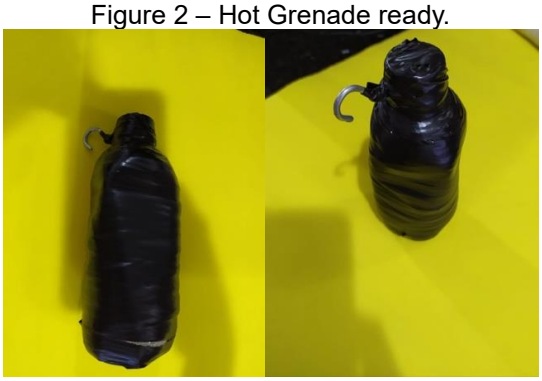
Figure 2 – Hot Grenade ready.



Source: authors (2019)

This type of material was chosen for its low cost and ease of manufacture, remembering that several other versions can be produced using alternative and recyclable materials.

In order for the game to become more dynamic and attractive to the students, a sound design application was used. In the application, animal sounds, applause, famous songs, songs from *current anime* were used where they were chosen according to the stage of the game. The sound design app with fast and slow music gave the touch in which the grenade was passed, forcing them to have to concentrate on the question to be asked by the teacher.

Figure 3 - Sound design application, Meu Teatro.

Source: authors, my theater app (2019)

The game entitled "Hot Grenade" was elaborated, where questions related to the recently studied concept were worked on, which in the case of the research was salts and oxides. Various resources were used such as a sound design application, speaker and multimedia projector.

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The class was distributed as follows: they formed a large circle, where one of the students took the grenade to start the game. If necessary, the teacher can choose a student to assist him with the sound design application.

GAME RULES

1. Students must form a circle.
2. The teacher will stand in the center of the circle with the clipboard where the questions are.
3. The grenade will be given to the hand of any student.
4. The grenade can rotate clockwise or counterclockwise, the direction is indifferent.
5. At the beginning of the game, the grenade will be passed from hand to hand of the students, an instrumental song (without lyrics) will be played. The music needs to be instrumental and with moderate pitch so as not to disturb the voice of the teacher or the person who is going to ask the question. Another detail is that some songs are very fast and some are very slow and lead students to pass the grenade sometimes faster and sometimes slower to each other.
6. The teacher will read the question and when he finishes, the music will stop with him and the student who is holding the grenade will answer.
7. If the student answers correctly, the sound of applause will be played, if the student answers wrong, the sound of an explosion will be played.
8. Regardless of whether the student gets the answer right or wrong, the question will appear on *the slide* with the answer in a contextualized way and with images of what the answer refers to.
9. The student who makes a mistake in the question must choose another student from the circle to assist in the answers.
10. If the grenade falls into the hand of a pair and they don't know the answer, they are out and without a right back.
11. The activity continues until only 2 participants remain.
12. The grenade will continue to pass through the hands of the last participants and whoever falls with the grenade responds. If that participant makes a mistake, the victory goes to the other.
13. If he gets it right, the game continues, but now without the grenade. The questions will be asked one after the other to each participant.

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14. A symbolic detail is that in this final stage, the grenade must always be in the hand of the responder.
15. It is necessary for the teacher to be attentive throughout the activity, as he will define who will answer the question in case of an attempt to cheat by the participants when they are passing the grenade.

MATERIALS USED

Speaker: Used to play music while the grenade is passing through the players' hands.

Multimedia Projector and Notebook: Used after the student answers the question. It will design the questions with the answers.

Sound design app: It can be found easily on the *Google Play Store*.

The Meu Teatro *application was used* on the cell phone because it is easier for the sound designer to handle. These apps make it very easy and allow many possibilities with the sound of the activity. The orchestrated musical sequence was based on *well-known* pop songs, *anime, animal sounds, applause, and explosions.*

Grenade: The main piece of the game made with recyclable materials.

Clipboard and list of questions: The clipboard was only to support the teacher.

APPLICATION OF THE GAME

The game was applied after the teacher responsible for the class had finished the contents of salts and oxides, as it was necessary for students to know certain concepts in order to play it.

As previously mentioned in the framework, according to Cunha (2012), there are several possibilities for teachers to introduce the game in their planning. The techniques used in this case aimed to illustrate the main aspects of the content, thus addressing in the game subjects that were considered more relevant and for contextualization of knowledge.

The space for the application was the math lab, as the style of the game did not require a wider space. The spaces for the application of the games must be adequate to the proposed actions (SOARES, 2015). The space was adequate in relation to noise, as there were no rooms leaning against it that could be harmed by the noise generated by the application. The hot grenade game is a game with a well-defined space and all the noise and action generated by the game was well restricted to the game space.

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The ease of review and evaluation with the use of didactic games is valid as long as the teacher has well-defined objectives and prepares the materials in advance. The games must be tested in advance, aiming to anticipate possible questions in the classroom, which may happen during their application.

The class formed a circle and the author of this work passed all the rules before starting. A student was chosen at random to start the game. For each question answered, the slides showed the answers with images and explanations.

According to Fialho (2010), such games develop aspects such as sociability, creativity and the spirit of competition and cooperation among students.

After the application of the activity, the difficulties seen to answer the proposed questions were analyzed through the analysis of the second questionnaire.

A class was held to explain the concepts in which the students did not have knowledge and that they were still presenting a non-learning. This class aimed not to let this activity be a simple game without concept and functionality to be able to assist in learning.

DATA ANALYSIS AND DISCUSSION

For the analysis of this work, the answers to the final questionnaire will be considered.

After the application of the game, in one class hour, the students answered a final questionnaire, in which there were open and closed questions to find out what they thought of the game, its application, the relationship with learning, difficulties with the content, all anonymously, as well as the first questionnaire allowing them to give their real opinion. Through the observations of the application, discussion and answers of the last questionnaire, they served as a basis to prepare the class that was taught to try to solve the doubts raised during the application of the game.

First question: "Did you have any difficulties regarding the content presented in the game 'Hot Grenade'? If so, what are they?".

The first question consisted of knowing if the student had presented any difficulties in relation to the content that was seen in the game and if so, what they were. The majority of the class (84%) reported that they had difficulties with the content, highlighting that they could not understand how to name the compounds, the difference between salts and oxides, and some cases reported not understanding the nomenclature applied to the content. The rest (16%) reported that they had no problems related to the content applied in

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the game. Analyzing the playing class, it can be noted that some students stood out with comments and answers, and also that they had a greater affinity with discipline and fewer difficulties than the others.

Second question: "In your opinion, did the use of the game 'Hot Grenade' with the content 'salts and oxides' help in learning? Regardless of whether your answer was positive or negative, explain it."

This question consisted of knowing if the game helped in learning and for 82% of the class, yes, it did, even the students who in the first question said they had not understood very well, answered that the game helped in the relationship of this content.

The use of the game as a form of teaching is a didactic tool that has stood out for its effectiveness in terms of drawing students' attention. This attention arouses interest in classes, this is due to the fact that the game is able to teach in a fun and pleasant way, making the classroom a more attractive environment (SANTOS; MICHEL, 2009).

We agree with the authors and add to their statements that during the application these interactions are clear. The student-student interaction during the discussions that follow each round; the exchange of experiences when some discuss their techniques, victors and their difficulties. The teacher-student interaction, when the former interacts with the students in order to evaluate and then revise, the contents that have not yet been effectively learned, can be observed in any playful teaching activities.

The use of the game goes against the argument that chemistry is difficult, boring and has no use, because through this tool added to the contextualization, the student's awakening to the discipline is noted, giving objectivity and pleasure in learning.

The illustration shown through the *slides* and the explanation of the author of this work was highlighted by the students, after the right and wrong answers, saying that it was easier and more fun to "memorize the content". It is understood that memorizing is not learning, but for students it is the same as learning, this is the way to relate all the content seen in class with the game.

For 18% of the class did not help in learning, the only two arguments that were highlighted were the short time to apply the dynamics and not liking the content. The time for application is one of the main difficulties in carrying out activities such as the didactic game, and planning and adaptation to the reality of each school is indispensable.

Third question: "Thinking of diversifying classroom teaching with the game 'Hot Grenade', did you like the use of this tool in chemistry teaching? Why?"

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The question consisted of knowing if the class liked the game, which 91% of the class liked, reporting that it is a different, fun, dynamic way that facilitates learning. The rest of the class (9%) reported that they did not like it, because there was a lack of discipline on the part of their classmates, making it difficult to develop the game.

When starting to organize the class to apply the game, it was noticed due to the change of room and the dynamics of the game there was a certain uproar and parallel conversations of some students, delaying the start of the activity a little. However, according to Parizotto and Soares (2017), this may not be a problem as long as it is well treated, as working with the game is unpredictable.

It is expected that in the course of the activity it will occur without difficulty, but dealing with adolescents where competitiveness and the desire to win are awakened ends up becoming almost impossible. Even with the conversations and uproar, the teacher cannot forget the playful character, imposing behaviors and silence so that he does not lose the essence of learning through play.

Fourth question: "Did you have any difficulties during the application of the game 'Hot Grenade'? If so, what are they?".

For 83% reported that they had difficulty in the application, analyzing their arguments, it is noted that there were mistakes in the students' answers, as they related the application of the game with the conceptual difficulty to answer the questions. In the arguments, 80% were unable to answer the questions because they did not understand the content and 20% reported the pressure due to the dynamics. The hot grenade game requires the teacher to direct the dynamics, as it involves all students. When starting the game with all the equipment previously connected, there were short pauses for punctual explanations during the game. Throughout the game there is a certain pressure, as no one wants to keep the grenade to answer the question, generating tension when listening to and passing the artifact. The remaining 17% reported having no difficulty with the game.

Fifth question: "Do you have any suggestions to improve the game Hot Grenade?"

For 60% of the class reported that the game is great in this format and that they would not change anything and 40% gave their suggestions to improve the game. However, it was suggested that he have more time for the game and greater organization of his colleagues. Fact discussed in the third question above.

According to the students' suggestions, the questions should be less complex, as many were confused, especially when it came to the nomenclature of the compounds.

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Beforehand, all the questions that were applied were in the material that everyone received and had been applied by the teacher, being direct questions with no loophole to confuse with any other subject. Another great suggestion that will be accepted to improve this teaching tool is the use of questions with multiple choices, where it would facilitate the answers and reduce the tension reported in the previous question.

Sixth question: "Analyzing the dynamics of the game, would you like to use it in any other content or discipline?".

According to the answers, it is observed that 62% of the class would like to use the game in the subject of mathematics, 19% in physics and 19% in Portuguese.

The presence of playful activities can be verified in magazines specialized in education, board games, pastimes and riddles are being used not only in content that is difficult to understand in the discipline of Chemistry, but also in disciplines that students are more disinterested in. According to the students' answers, it is evident that the use of dynamics is seen favorably in the disciplines that are considered the most difficult by most students.

In summary, it was evidenced that the students expressed many behaviors and emotions such as: discipline, concentration, anxiety, joy, challenge, enthusiastic dialogue inherent to the universe of the game and entertainment.

Seventh question: What are the positive points of the class that the game was worked on?

According to 47% of the class said that the game makes teaching more attractive because they learn while having fun, another point that 35% of the class raised was that the game had the participation of everyone in the class, making it very dynamic, in which the one who left helped the classmate in the continuity of the game. Directly linked to the two points mentioned above, 6% of the class evaluated it as positive to have left the routine, which helps and makes the class more comfortable with the discipline and the content applied. Another point that was remembered by 12% of the class and highly praised in the application was the use of sound design, making the game different and interesting.

From these data, it is understood that games are part of the activity of playing, but at the same time they build their learning, when they elaborate well the activity to be put into practice, they enable the construction of the student's knowledge and at the same time respecting the various singularities, thus having here an opportunity to introduce knowledge,

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socialize and develop the staff, social and cognitive aspects of the student (SANTANA; REZENDE, 2008).

Eighth question: What are the negative points of the class that the game was worked on?

For 37% of the class there were no negative points, arguing that the game is good following the molds applied. For 36% of the class, the negative point that was most taken into account was the discipline of the class, which due to the euphoria of changing rooms and different activities did not collaborate.

It is understood that the student must have freedom of choice, a fact that gives the playful character of the activity, when the teacher controls by imposing the activity, it loses this character, leaving only the educational attitude, making the game uninteresting. Thus, the teacher can use new resources such as playful activities that should not be used as a mere pastime, but as the main objective in the review and evaluation of knowledge.

As already mentioned above and taken into account by 27% of the students, it was the time to carry out the dynamic, which is very little. It is believed that, because the teacher is not the teacher in charge of the discipline, the percentage reported in the lack of class discipline and in the time of completion could be minimized due to the relationship and authority of the teacher in charge of the class.

Ninth question: "What is your assessment of the game 'Hot Grenade'?" According to the answers, 73% of the students evaluated the game as "Good", taking into account the positive points mentioned above, and 27% as regular.

With the application of the game, it can be noticed that the students who participated in the game had fun reporting that it is easier to learn with games, in this case "Hot Grenade" minimizes the non-learning of these concepts.

According to Albareli (2011), the game awakens motivation in the individual, as well as the feeling of joy, for fulfilling desires. However, there can also be a feeling of frustration. And it is precisely this coming and going of emotions that underpins the construction of the human personality, making the person able to deal with their desires. In this way, because it requires attention and concentration, the game provides self-esteem and self-confidence, contributing to the development of future activities.

The game also helps the person to work on their relationship with those around them, that is, with other people, with the world (ALBARELI, 2011). And this is of enormous

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importance when working with students who are having initial contacts with the chemistry discipline, which is the case of 1st year high school students.

We agree with Soares (2008), when he emphasizes that by proposing playful activities, a form of entertainment is accompanying these activities. In the case of the game, for example, the player is given a pleasurable and satisfying form of entertainment, which can give more meaning to the learning of chemistry.

After the delivery of the questionnaire and analyzing the difficulties of the class in relation to the content of salts and oxides, a class was taught with the questions of the game, giving meaning to the entire application and evaluation of the knowledge of the class regarding the content applied. The class applied had expressive participation of the class, managing to solve their doubts about the content presented.

Based on the analysis of the data collected, one can begin to draw conclusions about the value of play in chemistry teaching. In the final section, the main learnings, challenges encountered and the potential for future applications of this didactic method will be reflected.

FINAL CONSIDERATIONS

Playfulness has achieved great goals over the last few years, and it can be proven through research and with the results that support this work.

The game "Hot Grenade" was developed and applied with the intention of addressing the contents of salts and oxides associating them with the daily life of students, but the same game can be adapted to several other contents, depending only on the exchange of questions. The choice for this game is due to the affinity with the rules that are known, being a dynamic similar to a children's game known by all.

It is important to note that the game was made with simple and easy-to-obtain material, which makes it easier to apply. It is possible to notice the importance of the teacher as a mediator in conducting the activity, since he is responsible for the success of the didactic resource used in the classroom, helping students to understand the rules of the game, not letting it become just a game and lose its playful sense.

Analyzing the applicability of the game, through the answers obtained in the questionnaire due to its versatility, easy obtaining of resources for the execution of the activity and the possibility of working with various concepts, it can be said that the hot grenade can be used as a teaching tool.

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Playful activities, and in this case, the game, can help in the teaching process by escaping from traditional teaching. It should be noted that one should not fail to consider the suggestions given by the students in their analyses, especially the use of questions with alternatives. The game has become an option that involves curiosity, improves initiative and self-confidence, being able to work with other students' skills involving even linguistic concepts, promoting a more interesting teaching. It is evident that this process will not replace traditional teaching in our country, but it will help the teacher to have another tool as an aid in the teaching-learning process.

It is concluded that playfulness in teaching can contribute to the construction of knowledge, taking into account the suggestions given by students where it can improve more and more. Each step is reached one at a time, in which the student can form his critical sense, which can directly and indirectly influence the way the individual sees, not only the teaching of chemistry, but also all the phenomena that occur around him.

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REFERENCES

1. Albareli, A. C., et al. (2011). O lúdico, a criança e o educador. Efdeportes. Buenos Aires, 16 dez. 2011. Disponível em: https://www.efdeportes.com/efd163/o-ludico-a-crianca-e-o-educador.htm. Acesso em: 24 nov. 2019.

2. Barbosa, F. E. (2008). Instrumentos em coletas de dados em pesquisas educacionais. Inf UFSC. Santa Catarina, 5 dez. 2008. Disponível em: http://www.inf.ufsc.br/~vera.carmo/Ensino_2013_2/Instrumento_Coleta_Dados_Pesquisas_Educacionais.pdf. Acesso em: 24 nov. 2019.

3. Cunha, M. B. (2012). Jogos no Ensino de Química: considerações teóricas para sua utilização em sala de aula. Revista QNESC, 34(2), 92-98. Disponível em: http://qnesc.sbq.org.br. Acesso em: 16 jun. 2019.

4. Defensores da natureza. (2013). Vamos brincar! Maio de 2013. Disponível em: http://defensoresdanatureza.com.br/vamos-brincar.html. Acesso em: 25 jun. 2019.

5. Driver, R., et al. (1999). Construindo conhecimento científico na sala de aula. Revista QNESC, 9. Disponível em: http://qnesc.sbq.org.br. Acesso em: 16 jun. 2019.

6. Fialho, N. N. (2007). Jogos no ensino de Química e Biologia. Curitiba: IBPEX.

7. Gil, A. C. (1999). Métodos e técnicas de pesquisa social (5. ed.). São Paulo: Atlas.

8. Lima, M. B. P., & Lima-Neto, P. (1999). Construção de modelos para ilustração de estruturas moleculares em aulas de química. Revista QNESC, 22(6). Disponível em: http://quimicanova.sbq.org.br/imagebank/pdf/Vol22No6_903_v22_n6_20%2820%29.pdf. Acesso em: 03 dez. 2019.

9. Parizotto, G. M., & Soares, M. H. F. B. (2017). O paradoxo do jogo educativo e a cultura lúdica corrompida: uma abordagem utilizando noções de programação em Python para o ensino de Física no Ensino Médio. XI Encontro Nacional de Pesquisa em Educação em Ciências – XI ENPEC, Florianópolis.

10. Robaina, J. V. L. (2008). Química através do lúdico – Brincando e aprendendo. Canoas: Editora ULBRA.

11. Santana, E. M., & Rezende, D. B. (2008). O Uso de Jogos no Ensino e Aprendizagem de Química: Uma Visão dos Alunos do 9º ano do Ensino Fundamental. XIV ENEQ.

12. Santos, A. P. B., & Michel, R. C. (2009). Vamos Jogar uma SueQuímica?. Revista QNESC, 31(3), agosto. Disponível em: http://qnesc.sbq.org.br/online/qnesc31_3/05-EA-0108.pdf. Acesso em: 03 dez. 2019.

13. Soares, M. H. F. B. (2008). Jogos para o Ensino de Química. Guarapari-ES: ExLibris.

14. Soares, M. H. F. B. (2015). Jogos e atividades lúdicas para o ensino de química (2ª ed.). Goiânia: Kelps, p. 33-188.

Revista ARACÊ
ISSN: 2358-2472

15. Tezani, T. C. R. (2006). O jogo e os processos de aprendizagem e desenvolvimento: aspectos cognitivos e afetivos. Educação em Revista, Universidade Estadual Paulista (UNESP) - Campus de Marília, 7(1-2), 1-16. Disponível em: http://www2.marilia.unesp.br/revistas/index.php/educacaoemrevista/issue/view/59. Acesso em: 16 jun. 2019.