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Creation of meanings in educational processes: Teaching practices with playful and experimental activities in the teaching of chemistry

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ABSTRACT
This chapter aims to share partial results of a research that evaluated the development of a Potentially Significant Teaching Unit on the organic function of alcohol in Chemistry classes, with emphasis on recreational and experimental activities. The execution of the qualitative research, with the case study approach, took place in the months of February and March 2023, in a state school, in the municipality of Bom Jesus, with the participation of students from the third year of high school. The relevance of this study lies in the finding that, by using playful and experimental activities in teaching practices in different educational processes involving the Teaching of Chemistry, we create in students different senses with a view to meaningful learning. The discursive textual analysis allowed the construction of metatext that pointed to the construction of knowledge through the awakening of students' interest by using playful and experimental activities created by teachers in Potentially Significant Teaching Units.

Keywords: Educational Processes, Meaningful Learning, Playful and Experimental Activities.

1 INTRODUCTION

The traditional teaching of Chemistry in High School is seen by society as a simple memorization of the contents and, according to Ausubel *et. al.* (1980), as little effective to meaningful learning[1], since it is based on the unidirectional transmission of knowledge, with students being passive figures, who practically do not exercise criticality. Given this understanding, it is necessary to help teachers to reflect on their educational practice, so that classes are more attractive and pleasurable, aiming at the learning of the student who is willing to learn. These assumptions are in line with the Theory of Meaningful Learning proposed by Ausubel (1963) and addressed in this chapter.

Thus, we sought in this study to share the partial results of a research that evaluated the development of a Potentially Significant Teaching Unit on the organic function of alcohol in Chemistry classes, with emphasis on recreational and experimental activities. The execution of the qualitative research, with the case study approach, took place in the months of February and March 2023, in a state school, in the municipality of Bom Jesus, with the participation of students from the third year of

[1] The discussion and understanding of meaningful learning will be deepened in the chapter "Meaningful Learning and Playfulness".

high school. The relevance is the creation of playful and experimental activities in teaching practices in the different educational processes that involve the Teaching of Chemistry.

Moreira (2011) highlights that meaningful learning can occur in two ways: (a) the first depends on the didactic material, which must be potentially significant; (b) the second depends exclusively on the learner, that is, the student must have a predisposition to learn. In this approach, the teacher ceases to be the center of teaching and learning, as it was in other premises, [2]and begins to act as a facilitator/mediator who will lead the student, through significant didactic materials, to an environment that favors the construction of a solid knowledge. In the Theory of Meaningful Learning, it is evident the need to promote discussions that integrate the previous knowledge that accompanies each student, since they are more effective as a didactic resource to explain the relatability of the new material with subsuming concepts already existing in the cognitive structure of the student. To promote this relatability, it is necessary for the teacher to develop didactic resources that enhance these interactions.

The use of games in the Teaching of Chemistry as a way to motivate students is, according to Russell (1999), a teaching practice existing for decades to teach nomenclature, formulas, chemical equations, general concepts in chemistry, organic chemistry and instrumentation, and the first detailed game is dated 1935 and was called Chemical Bingo. The game is an effective, pleasurable and motivating methodology, which in a playful way involves the student, making him participate in all stages. So, what are the meanings in the educational processes of valuing this teaching practice in the contemporary moment?

The sense is to make this game a significant methodological material, and for this, it needs to be well elaborated and have well-defined commands. This is in line with Kishimoto (1996), who says that games, specifically educational games, are directly linked to play, fun, pleasure and displeasure and the educational function, whose objective is the expansion of knowledge. It is necessary that there is a balance between pleasure and knowledge, being able to achieve them through the rules that must be "freely consented, but absolutely obligatory" (HUIZINGA, 2007, p. 24). With this, we seek to signal the meanings in the educational processes that involve: student interest, teacher mediation and syntheses of the construction of knowledge. These meanings interfere in the promotion of the construction of knowledge by students by using playful and experimental activities created by teachers in Potentially Significant Teaching Units in the Teaching of Chemistry.

In the development of the work, the Theory of Meaningful Learning proposed by Ausubel (1963), the Potentially Significant Teaching Unit proposed by Moreira (2012b), the playful activities and games by Brougère (2003), Huizinga (2007), Kishimoto (1994,1996,1997), Ramos (1997) and Soares (2013, 2004) were deepened. The analysis of the data that make up the *corpus* of the research was carried out from the Discursive Textual Analysis, by Moraes and Galiazzi (2016).

[2] In traditional learning, the teacher is seen as a transmitter of knowledge.

The chapter is organized into three topics of discussion: (a) the first presents a literature review on the playful and experimental activities in the Teaching of Chemistry; (b) the second addresses how each experiential activity assists in meaningful learning; (c) the third points to the use of playful activities in the UEPS, especially games, as resources used in teaching practices. This chapter ends with a discussion of the topics presented.

2 LITERATURE REVIEW ON RECREATIONAL AND EXPERIMENTAL ACTIVITIES

In order to deepen the literature review, searches were conducted on the page of the journal Química Nova na Escola[3], the most important journal in the area of Chemistry Teaching and Learning in Brazil, and a six-year time frame was carried out, from 2015 to 2021. The search terms used were: Teaching Chemistry, Playfulness in Chemistry and Didactic games in Chemistry classes. A total of 16 articles were found. Table 2 shows a summary of what was found, containing the title, authorship, volume of the journal, number and keywords.

Table 2 - Results of the Bibliographic Review in the journal Química Nova.

Title	**Authors**	**Vol. and Publication No. in the journal**	**Keywords**
Pedagogical game for the teaching of thermochemistry in youth and adult education classes	Maria Aparecida S. Leite and Márlon H. F. B. Soares	Vol. 43, No. 3, p. 227-236, August 2016	Pedagogical game; thermochemistry; EJA
The educational game as an interdisciplinary resource in the teaching of Chemistry	Antonio L. de Oliveira, José Clovis P. de Oliveira, Maria Jucione S. Nasser and Maria da Paz Cavalcante	Vol. 40, No. 2, p. 86-89, May 2018	Chemistry Teaching; educational game; Didactic resource
The use of a teaching workshop in the formative process of teaching students and undergraduates	Manuel E. G. Winkler, João R. B. de Souza and Marilde B. Z. Sá	Vol. 39, No. 1, p. 27-34, February 2017	Initial teacher education; teaching workshops; differentiated teaching
Investigative didactic game: a tool for teaching inorganic chemistry	Bruna da Silva, Márcia Regina Cordeiro and Keila Bossolani Kiill	Vol. 37, No. 1, p. 27-34, February 2015	Didactic game; periodic table; Inorganic functions
A board game involving concepts of mineralogy in the teaching of Chemistry	Edemar Benedetti Filho, Alexandre D. M. Cavagis, Karen O. dos Santos and Luzia P. dos S. Benedetti	Vol. 43, No. 2, p. 167-175, May 2021	Chemistry Teaching; mineralogy; board game
Active-collaborative-interactive learning: interrelationships and investigative	Tâmara N. P. Santos, Carlos H. Batista, Ana P. C. de Oliveira and Maria C. P. Cruz	Vol. 40, No. 4, p. 258-266, November 2018	Electrochemistry; experimentation; homemade batteries

[3] Research link, New Chemical Journal: http://qnesc.sbq.org.br/

experimentation in the teaching of electrochemistry			
Organic clues: a game for the teaching and learning process of Chemistry	Janduir E. da Silva, Carlos N. da Silva Jr., Ótom A. de Oliveira and Diego O. Cordeiro	Vol. 40, No. 1, p. 25-32, February 2018	Didactic games; organic functions; Chemistry teaching
A didactic game for the review of chemical concepts and safety standards in Chemistry laboratories	Edemar Benedetti Filho, Alexandre Donizeti Martins Cavagis and Luzia Pires dos Santos Benedetti	Vol. 42, No. 1, p. 37-44, February 2020	Playful activities; Chemistry teaching; Chemistry Laboratory
The use of concept maps in the teaching of the periodic table: an experience report in PIBID	Neusa N. Fialho, Ricardo P. Vianna Filho and Magda R. Schmitt	Vol. 40, No. 4, p. 267-275, November 2018	Periodic table; concept maps, JPCM
The corn of the typical June foods: a didactic sequence for the sociocultural contextualization in the teaching of Chemistry	Jéssyca B. S. Rodrigues, Patrícia M. M. Santos, Rozeane S. Lima, Teresa C. B. Saldanha and Karen C. Weber	Vol. 39, No. 2, p. 179-185, May 2017	Sociocultural contextualization; pedagogical moments; corn
The teaching of Chemistry using Guanabara Bay theme: a strategy for meaningful learning	Nathália Souza Abreu and Jefferson Leite Maia	Vol. 38, No. 3, p. 261-268, August 2016	Generator theme; meaningful learning; Guanabara Bay
Periodic table: conceptions of students throughout high school	Nycollas S. Vianna, Camila A. T. Cicuto e Maurícius S. Pazinato	Vol. 41, No. 4, p. 386-393, November 2019	Apprenticeship; alternative conceptions; periodic table
The playful in the teaching of Chemistry: considerations from the historical-cultural psychology	Hélio da Silva Messeder Neto and Edilson Fortuna de Moradillo	Vol. 38, No. 4, p. 360-368, November 2016	Ludic; historical-cultural psychology; Chemistry teaching
Use of the critical debate model as a didactic strategy for the construction of chemical knowledge from the perspective of critical meaningful learning	Kátia Aparecida da S. Aquino, Géssica Karla de Queiroz and Fabiana da S. Aquino	Vol. 43, No. 1, p. 119-128, February 2021	Chemistry Teaching; argumentation; concept maps
From intentionality to playful responsibility: new terms for a reflection on the use of games in the teaching of Chemistry	Cinthia M. Felício and Márlon H. F. B. Soares	Vol. 40, No. 3, p. 160-168, August 2018	Ludic; Chemistry teaching; games in Chemistry teaching
An active teaching approach in an electrolysis experiment	Gabriel S. Arini, Isis V. S. Santos e Bayardo B. Torres	Vol. 43, No. 2, p. 176-182, May 2021	Teaching of electrolysis; active learning;

			experimentation in teaching

Source: Information taken from the journal Química Nova and adapted by the author (2021).

Leite and Soares (2020) built a game containing simple rules in order to work the didactic method for the teaching of thermochemistry. This game was applied in a class with students of Youth and Adult Education (EJA). The game consisted of a board that occupied the space of the entire room, causing the students to move from a passive to active attitude. Initially, there was some resistance to the game by the students, who did not see the game as something serious but as a joke, but in the course of the activity, there was interaction and the concepts were successfully discussed and understood.

Oliveira *et al*. (2018) conducted an interdisciplinary activity involving Chemistry, History and Portuguese Language. The objective was to make a didactic game for the content called periodic classification of the chemical elements. The game called "Assembling the periodic table" was developed in groups, in which students were led to investigate the chemical elements, as well as their peculiarities and historicities. During the application, the role of the teacher was that of mediator, clarifying doubts and encouraging cooperation. The results were promising, facilitated learning and made interactions between teacher and students better. Another highlight for this application was that the students, in their majority (91%), never had contact with games during the educational process.

Winkler, Souza and Sá (2017) discuss the use of differentiated methodologies for the teaching of Chemistry with emphasis on teaching workshops (OE), which aim to promote teaching based on contextualization and dialogue. In this work an EO was developed to work on the content of natural products. The workshop was evaluated through the interpretation of students' questionnaires and through reflection on the practice of future teachers. The conclusions show the effectiveness of the method for learning, as they bring the content closer to everyday life and facilitate the interaction of students.

Silva, Cordeiro and Kiill (2015) believe that games are important tools for the teacher, since they seek to arouse the interest of students, promote integration in the classroom and facilitate the understanding of the contents addressed. The work carried out by the authors consists of developing, applying and evaluating a didactic game with an investigative character for the content of organic chemistry in a high school class. To obtain data for analysis, questionnaires were applied that were analyzed considering Vygotsky's conceptions about learning and interaction. The final considerations point to a feasibility of the use of didactic games for the teaching and learning process and a learning through the interaction between students.

Benedetti *et al*. (2021) developed and applied a board game called "Minerals" for teaching mineralogy concepts in a high school class. After the preparation of the game, it was sent to some students of the Chemistry course in order for them to evaluate the pedagogical potential, the

playfulness, the gameplay and the dynamics. The game was later applied to students, and data collection took place through interviews and registration in a field diary. Through the speech of the students, it can be noted that often the acceptance to play has a hobby bias and not a differentiated form of learning about the content. However, the authors indicate that, in the course of the activity, this bias ends up being modified when it is observed that students leave aside their notes and become protagonists of their own learning.

Santos *et al*. (2018) had as their objective, in their research, an experimental investigative methodology elaborated through the use of viable and non-toxic products so that the students could develop in practice the construction of a biochemical pile (made with lemons and English potatoes). The research was carried out in three stages. The first was a general approach in order to highlight previous knowledge about the content of electrochemistry. The second stage consisted of an *online research* on the possibility or not of batteries being made with biochemical materials and the construction of these batteries through the mediation of the teacher. In a final step, the texts transcribed by the students were analyzed through the Discursive Textual Analysis (DTA) method. It can be seen, through the reading of the textual productions, that it is possible to admit the concretization or the comprehension of a theory.

Silva *et al*. (2018) presented a teaching proposal to work organic chemistry in a playful way both in High School and in Higher Education. In order to get away from the mechanical and static learning of the nomenclature of organic compounds, the authors adapted an existing game and called it "Organic Clues". For data collection, questionnaires and field diary entries were used. The final considerations point out that the students present difficulty in contextualizing the contents and, through the games, they can develop a more significant learning of some concepts, such as properties and characteristics of the main organic functions, which are not so valued in dialogued expository classes.

Benedetti Filho, Cavagis and Benedetti (2020) innovated the traditional "Game of Seven Errors", applying it to revise safety standards in Chemistry laboratories. The activity was applied to all years of high school in a public school with the objective of providing a differentiated learning from the traditional perspective. The students were surprised by the activity and showed interest in solving it. The results obtained point to a lack of experimental and playful activities in public schools and show that, when they are performed, students value them, interacting in their groups with the help of the teacher of the discipline, who acts as a mediator to direct the discussions.

Fialho, Vianna Filho and Schmitt (2018) present in their research an account of experiences on the use of concept maps in the study of the periodic table of chemical elements. Concept maps can help the teaching of Chemistry in a significant way, stimulating students to deal with information to transform it into knowledge. After the presentation of how to perform the construction of concept maps, the students performed an evaluative activity using a puzzle of concept maps called *Jigsaw*

Puzzle Concept Map – JPCM. In order to evaluate the activities, the students answered a questionnaire. The final considerations reveal the relevance of using the concept maps in teaching practices, with indications of advancing with this teaching strategy due to the interest of the students in carrying out the activities and, mainly, to the exchange of ideas among them on the theme addressed.

Rodriguez *et al.* (2017), Seeking an approximation between the chemical concepts and the reality of the students, they proposed a didactic sequence structured in the dynamics of pedagogical moments. The theme chosen for this sequence was "Corn", because it is an ingredient widely used in Festas Juninas, which is common in our country. An initial questionnaire was applied in order to know the students' previous knowledge, and an approach was made to the content of Chemistry to be studied, using transversal themes related to agriculture and health. Finally, an evaluative questionnaire was applied to obtain data. The results show that, from the activities developed, there was an awareness about the presence of science in real situations of daily life and, it should be emphasized, the relevance of the discussion of socioeconomic issues that involve scientific concepts as a fundamental exercise in the search for the development of critical thinking.

Abreu and Maia (2016) worked on their research with the generative theme and, for this, they chose Guanabara Bay and a 9th grade class to apply the research, always aiming at meaningful learning. There was a diagnostic evaluation in order to raise previous knowledge. Subsequently, there was a debate on the generating theme, followed by a game on the periodic table in which the students contextualized the chemical elements with the substances found in the Bay. They made models with the objective of assimilating the content and, finally, there was an evaluative questionnaire. The final considerations showed that the teaching of Chemistry through the generating theme Guanabara Bay contributed to a more significant learning, because it enabled the interaction between the knowledge and the daily experiences of the students and the scientific knowledge, evidenced through the evolution of the answers given.

Vianna, Cicuto and Pazinato (2019) proposed a research paper in relation to the periodic table. The objective was to verify the learning on the subject in the three years of High School. The authors developed a questionnaire containing 27 statements with which students should agree or disagree. The results were evaluated by multivariate statistical methods, which allow the recognition of natural patterns. The results showed that the students had difficulties when consulting the periodic table to obtain explicit information, such as mass number and atomic number, and often cannot relate the chemical elements in everyday applications. Despite the difficulties encountered, there were indications of the occurrence of significant learning in some students throughout high school.

Messeder Neto and Moradillo (2016) address the theme of playfulness in the teaching of Chemistry and its relevance for a more dynamic and motivating class. Even with this subject so much on the agenda, there is still a lack of theoretical reference when these practices are applied. Aiming to

collaborate for the use of the playful in the teaching of chemistry, the authors sought some theoretical contributions from historical-cultural psychology to this field of study. One of the authors approached was Vygotsky, using two important concepts: elementary psychological functions (PEF) and higher psychological functions (SPF). It was also used the concept of zone of proximal development (ZDP) of the same author, which discusses what the student can do with the help of a pair and soon will be able to do alone. The authors' conclusions point to the use of theoretically well-founded playfulness, because when this does not happen, the game or activity becomes meaningless and becomes a mere joke.

Aquino, Queiroz and Aquino (2021) aim, in their research, to develop a teaching strategy from an argumentative environment that allows promoting the knowledge of chemical concepts through criticality and reflection. In order to achieve the proposed objective, they developed a didactic sequence adapted to the Critical Debate Model to be applied in a public school. Data were collected through concept maps that the students produced before and after the intervention. The final considerations show the importance of planning in teaching practice for the intervention to be effective, as well as the valorization of students' previous knowledge. Finally, the Critical Debate proved to be a strategy with potential for the development of critical thinking and for the promotion of Critical Meaningful Learning in the teaching of chemistry.

Felicio and Soares (2018) proposed a reflection on the theme of the playful in the teaching of chemistry from some aspects of the literature, as well as the possibilities of application in the classroom and even in the training of teachers. The authors address the theories about the games, which point out that the game needs to have an intentionality and be voluntary. The playful can contribute for the reenchantment of teaching, because it emerges naturally as an element of human culture, being intrinsic to being human. The basic idea was to propose new terms that can help researchers in some aspects of the game in its application.

Arini, Santos and Torres (2021) developed a didactic sequence to apply the active teaching strategy to an electrolysis class. Students started by answering a pre-test, followed a script for an experiment on the topic, and finished by answering the questions of a post-test. The results point to a significant improvement in the post-test responses. There were indications of significant learning, because by avoiding the class through exposure only, there was a more active teaching, in which students obtained more confidence and autonomy in their practice.

In this literature review, it is perceived the relevance of creating alternative tools for teaching and learning the content of chemistry, as well as the fundamental role of the teacher in daring in his practice, using playfulness, through games, as they are presented in the articles by Leite and Soares (2020), Oliveira *et al*. (2018), Silva, Cordeiro and Kiill (2015), Benedetti *et al*. (2021), Silva *et al*.

(2018), Benedetti Filho, Cavagis and Benedetti (2020), Messeder Neto and Moradillo (2016) and Felicio and Soares (2018).

None of the articles used UEPS, however, in seven articles were found authors in common with this research and that deal with significant learning. In the articles, names of theorists such as Ausubel and Moreira also appeared. In only one of the articles, written by Santos *et al*. (2018), Discursive Textual Analysis was used as a method for data analysis, a methodology that will be chosen for this research. Eight of the articles found deal with games and playfulness, using authors such as Huizinga, Kishimoto and Soares, who will be addressed in the course of this writing.

In the article written by Leite and Soares (2020), there is an important distinction between didactic games and educational games. Every didactic game is an educational game, but not every educational game is a didactic game. Soares (2015) goes further: for him, the educational game is half game and half education, fulfilling balanced functions. Such discussions go against what Kishimoto (1994) says, for which, in the broad sense, the educational game is like a material or a situation that allows free exploration in enclosures organized by the teacher, aiming at the general development of skills and knowledge in a restricted sense. For the didactic game, there is a need for material that requires guided actions with a view to the acquisition or training of specific contents or intellectual skills.

The other articles found and pertinent to the research point to the displacement towards a more significant learning, trying to move away from mechanical learning. The articles developed by Winkler, Souza and Sá (2017), Benedetti Filho, Cavagis and Benedetti (2020), Silva *et al*. (2018), Fialho, Vianna Filho and Schmitt (2018), Abreu and Maia (2016), Vianna, Cicuto and Pazinato (2019), Aquino, Queiroz and Aquino (2021) and Arini, Santos and Torres (2021) present, in common, ideas attributed to theorists Ausubel, Novak and Moreira.

Of the articles found, eight mention directly in their titles Games and Playfulness and have authors in common: Huizinga (2007), Kishimoto (1999) and Soares (2013).

The word playfulness was used frequently, but at no time was it defined. Playfulness, according to Luckesi (2014), is an internal phenomenon of the subject that results in external manifestations, that is, a certain activity can be qualified as playful (or not) depending on the subject who experiences them and the circumstance in which this occurs. Each student ahead of a given situation may have different feelings; If they are feelings of joy and fullness, one can consider the activity as playful. If the student does not feel happy to participate in a certain activity or is divided among other tasks, the activity will not be playful for him.

It is highlighted, then, that an activity, which may be an experimentation or a didactic game, presents a playful potential, but the experience or not of this Playfulness is individual. We can observe this fact in Luckesi's speech:

> Playing, playing, acting playfully, requires a total surrender of the human being, body and mind, at the same time. Playful activity does not admit of division; and, the playful activities themselves, lead us to this state of consciousness. If we are in a dance hall and we are truly dancing, there will be no room for anything other than the pleasure and joy of the rhythmic, harmonic and graceful movement of the body. However, if we are in a dance hall, pretending that we are dancing, but in fact, we are observing, with a critical and judgmental eye, how others dance, for sure, we will not be playfully experiencing this moment. (LUCKESI, 2000, p. 21)

The playful potential is specific. Perhaps what might make sense to one student will not make as much sense to another, since each will have their own experiences and different ways of interaction. According to Oliveira *et al*. (2018), the playful activity only becomes intentional when the teacher stimulates the students, directing the activity (game) as a mechanism in the learning process, which meets Kishimoto:

> When playful situations are intentionally created by the adult in order to stimulate certain types of learning, the educational dimension arises. As long as the conditions for the expression of the game are maintained, that is, the intentional action. (KISHIMOTO, 1999, p. 38)

According to Soares (2013), it is difficult to define game, because often what one person treats as a game may not represent the same meaning for another. The author cites the example of an indigenous child with a bow and arrow: for a person looking at the situation from the outside, it could be something playful, for the child, it is part of learning to hunt and survive. Kishimoto (1996) differentiates games through three levels: a) the meaning of the game depends on the social context, since each individual understands the game in a different way and this cannot be taken as something simplistic; b) a system of rules – the games are differentiated by their rules, it is these sequences of rules that allow the relationship with playfulness; c) an object – which is responsible for characterizing and playing.

Detailing the understandings about the concepts of games, the cited authors make a distinction between educational games and didactic games. For Soares (2013), the educational game seeks to approximate the existing playful character to the possibility of improving cognitive development, making the game balanced by becoming half game and half education. Kishimoto (1994) defines educational game as a material or a situation that allows free exploration in enclosures organized by the teacher, aiming at the general development of skills and knowledge in a restricted sense. When this material requires some form of guidance and aims at the training of specific contents, it is called a didactic game.

Another author often cited in the researched articles is Huizinga, who defends in his work **"Homo Ludens"** that knowledge itself is a game, and that the game is part of the essence of the human being. The game takes place in a sphere of fiction[4], but, paradoxically, there are rules.

> The game is a free action, but consciously understood as fictional and situated outside of real life. It is able to completely absorb the player in an action devoid of any material interest and any utility, which takes place in a circumscribed time and space, developing according to given rules and situated in the relation of groups, involving simultaneously tension and joy, and an awareness of being outside of ordinary life. (HUIZINGA, 2007, p.11)

In this clipping, the author brings us the idea of absence of usefulness in the game. We find here a paradox with the research, because, as it is a didactic game, we can understand that the goal is not to learn Chemistry as a chemist, or an engineer, an action that would be finalistic, outside, therefore, of what Huizinga understands as a game. On the other hand, a game involving Chemistry could enrich the daily life of the student, especially from the point of view of his interaction with colleagues and the teacher. In this sense, the game would "educate" rather than "teach."

For Felício and Soares (2018), it is necessary to clarify that the game has an end in itself. As considered by Huizinga (2007), this end in itself is related to the freedom that characterizes it and to the system of rules that need to be followed as a participant in the activity. Often, it can be a delineator of the rules of conduct or procedures essential to the game, which, when ruled, can become an educational game, developing autonomy and criticality.

3 EXPERIMENTAL ACTIVITIES

The importance of experimental activities is explicit in the National Common Curricular Base (2018), which emphasizes that students should appropriate procedures and practices of the contents, such as the sharpening of curiosity about the world, the construction and evaluation of hypotheses, the investigation of problem-situations, experimentation with data collection and analysis.

However, the teacher has a very important role in these activities, because they only become valid if they awaken the character invstigative in the student and possess the pedagogical function of assisting in the understanding of the phenomena

It is common to associate experimental activities as the practical demonstration of a theory, this mistake is not only committed by students, but by teachers as well. According to Galiazzi and Golçalvez (2004) when working experiments in classes, it is necessary to overcome the view that the experimental activity has the sole and exclusive function of proving the theory, because this would not be possible in just a few minutes of classes. What actually happens is a problematization of the content that is done through an observation of something that is happening.

[4] When it causes the shutdown of everyday life to introduce a world of "make-believe".

Linking the experimental activities to the Theory of Meaningful Learning, the teacher must conduct the class with questions, taking into account previous knowledge. Still second Galiazzi and Golçalvez (2004) for the teacher to perceive the way of thinking of this student it is necessary that he verbalizes this knowledge, it can be through an action articulated by the teacher that promotes discussions and debates. From the moment that there are no ready answers, the student is invited to problematize and question the knowledge, thus assisting in the teaching and learning process.

The experimental activities are, therefore, auxiliary in the learning process, because they promote discussions and invite the student to externalize his knowledge in order to explain the process and the results. They are based on observation and the mediation of the teacher helps in the teaching and learning process, by leaving the student more free to participate in the class and not demand a ready answer but something that can be built and discussed in the large group (colleagues).

4 PLAYFUL ACTIVITIES: GAMES

As already mentioned in the previous text, playfulness is an internal state of full experience, therefore, playful activities may or may not be fun and pleasurable depending on the student who will receive them. According to Luckesi (2005) the constructive side of the playful activities is in the instrumentalization of the creation of personal identity, that is, they establish a bridge between the inner reality and the outer reality and it is precisely in this bridge that the previous experiences can make them pleasurable or not. The playfulness is changing with the phases of life, but this does not mean that an adult will not have happy feelings when seeing a toy that was part of his childhood. But on the other hand, the adult seeks seriousness and this makes the game meet resistance, not because he does not want to participate in it but because of fear of society that does not understand games as something productive.

Several times the playfulness finds this resistance to be worked in classes that are not of early childhood education, because according to Ramos (1997) the term playful is often linked to the infantile, interpreted with a non-serious and inconsequential action as well as an activity that can not be deposited much time for the development.

It is up to educators, little by little, to introduce more playful activities in classes and present the positive results that they bring, through the development of creativity.

> The playful is the creative, free space that the child / adolescent has to develop their potentialities, there, playing, allows themselves to create and recreate possible and imaginary situations. Establish contact with the real and the imaginary, to the point that, being the main actor and active agent in the whole process, propose new learning experiences. It is also in this context that the child is placed as belonging to a society, because the rules, explicit or not are biological characteristics, but also socio-cultural interfering in the choices (YOSHIMURA, 2019, p. 50).

Also according to Ramos (1997), playfulness is not tied to a specific form, nor to an object, because it is a subjective interaction with the world, because several daily activities, professional or not, are impregnated by playful aspects. Regarding the learning process present in these activities, it can be said that:

> If the act of playing implies the use of rules or the mastery of a skill, learning will be intrinsic to the act of playing with that material and/or idea. Thus, even in an apparently disinterested game, the subject can unconsciously "supply" himself with information (through his actions) (RAMOS, 1997).

In the teaching of Chemistry, the use of games or games that contain rules aimed at learning a certain content, can rescue playful aspects and provide access to knowledge among all students. These activities will not be the assurance that learning has occurred, but they will act as catalysts in the cognitive process.

Ramos (1997) reports some possibilities that can happen when the teacher uses playful activities to develop a certain subject, such as: the formation of new concepts, cognitive development, the exercise of existing cognitive and motor structures and can also contribute to future learning, through a familiarization with the objects of the content.

From the playful activity that was carried out in this work, it is necessary a brief conceptualization of games as activities used in education.

There are a diversity of definitions for the word game, as the term is used for different situations. According to Brougère (2003) briefly game is a structure, a system of rules, which exists in an abstract way, for example, board games, everyone knows what these games are, without needing to be in physical contact with them. The author also mentions that game is what the scientific vocabulary calls "playful activity". When the game happens, there are basically three levels of games, the first is attributed to the playful situation, the second to the game containing a system of rules and the third level, associates game to the theme "toy". The last level is easily differentiated by the lack of rules it has. The first and second levels overlap, because both situations can happen in the same game, because games when physical/material explicitly imply a playful use that usually takes the form of a rule.

The rules are very important for the game, they provide limits so that the group experience is respectful. Teachers can use them to adapt already known games, changing the levels of difficulty and trying to insert the objectives to be fulfilled in the class.

Soares (2004) says that the games themselves present problems and challenges of various levels and that they require several strategies and this goes against the rules. Students must master them in order for the game to move forward.

Still according to the author, there are two main strategies that are used in games, the first, called macroscopic, which are objectives that must be achieved by the player, as for example, in the

board game used in this work, the objective will be to hit the answers to continue "advancing the houses". The other strategy is the microscopic one, which are composed of contextual decisions at each moment. As the game to be developed in this work uses a dice, it is considered lucky, but the decisions made for each answer go against the strategies cited as well.

In order for the desired learning process to be achieved in the course of the game, it is necessary that the rules are well defined and the role of the teacher is to predict each play and think of strategies that can achieve their goals.

To understand the use of games in education it is necessary to deepen the so-called educational games that according to Kishimoto (1999) are not games that began to be used now, quite the contrary, are dated in the Renaissance and began to gain prominence with the emergence of early childhood education. Educational games are understood as a resource that teaches, develops and educates in a pleasurable way. Every time the educator uses games in the classroom, he is enhancing the conditions of teaching and learning, because these actions maximize the construction of knowledge, introducing the properties of play, pleasure, the capacity for initiation and active and motivating action.

The author makes an important definition of the two functions that the educational game assumes. The first function is playful: it happens when the game provides fun, pleasure or even displeasure. The second function is educational: it occurs when the game teaches anything that completes the individual in his knowledge, his knowledge and his apprehension of the world.

> The balance between the two functions mentioned is the goal of the educational game. If one of these functions is used more than the other, that is, if there is an imbalance between them, two situations are caused: there is no more teaching, only play, when the playful function predominates too much, or the educational function eliminates all playfulness and fun, leaving only teaching. In the case of proposing a game in the classroom by the teacher, there is no voluntary choice of the game by the students, making the beginning of the activity have more of an educational function than a playful one (SOARES, 2004, p. 53).

For these functions to occur in a balanced way, it is the role of the educator to select and adapt the game, because when the playful activities are created with some intention that seeks clues of learning, they start to have an educational role as well.

Reflecting on these conditions, the game selected and adapted for this work, underwent modifications, starting to contain questions about the content with varying levels of difficulty, not leaving behind the playful character of the original board game, played with dice and a series of mysterious cards in which the error or hit resulted in something specific. The game, like all others, has rules to be respected and that will be defined at the beginning of the activity for a better progress.

5 MEANINGFUL LEARNING PRESENT IN PLAYFUL ACTIVITIES

Thinking of an activity proposal that arouses interest on the part of the students, it is sought to include the playful and experimental activities as a strategy to involve the students in the learning process, since:

> In the experience of a playful activity, each one of us is full, whole in that moment; we use mindfulness, as defined by the Eastern sacred traditions. As long as we are truly participating in a playful activity, there is no place in our experience for anything other than that activity itself. There is no division. We are whole, full, flexible, joyful, healthy. (LUCKESI, 2002, p. 23)

The speech of Luckesi (2002) points out that the playful activities can arouse the interest of the student and makes him willing to acquire knowledge from the interaction and the full attention that they have for this moment.

The educator needs to seek didactic alternatives in order to motivate and arouse the interest of his students, approaching the content of the day to day in which they are inserted. This is one of the most important points in Ausubel's theory:

> If I had to reduce all educational psychology to a single principle, I would say the following: of all the factors that influence learning, the most important is what the student already knows. Find out about it and teach yourself with it in mind. (AUSUBEL *et al.*,1980, p. 8).

This appreciation of the student's previous knowledge can be carried out in several ways. Using the Playfulness, already mentioned, one can resort to games that, in their development, can take into account what the student, in general, already knows and, then, provide him with opportunities to elaborate ideas of a higher level of the subject in question.

According to Soares (2013), the games carry in themselves problems and challenges of various levels and that require alternatives and strategies, which are defined through the creation of rules, that is: in the same way that the rules create steps for the game to happen, it will be mandatory for the player to master them for the game to advance. The operations that will compose the strategies can be defined from the objective that the student must achieve at the end of the game.

Still in this view of games as facilitators of teaching and learning, one can cite the previous organizers, defined by Ausubel as a didactic resource whose main function is to serve as a bridge between what the student already knows and what he should know so that he can acquire in a significant way a certain new knowledge. However, according to Moreira (2011) probably, previous organizers are more effective as a didactic resource to explain the relatability of the new material with subsuming concepts already existing in the cognitive structure of the student.

Therefore, the experimental and playful activities will be treated as auxiliaries in the process of Meaningful Learning, because they will have the function of arousing the interest of students

through activities different from the usual, carried out in groups and that seek the verbalization of knowledge with discussions and interactions.

The theoretical deepening points to positive evidence in the use of these activities in classrooms, because they act as motivators and motivation arouses interest. The playful activities developed through games and the experimental activities developed according to the discussions presented here in this chapter, will help in the construction of the knowledge of the Teaching of Chemistry. The variation of didactic material for use in classes meets the second condition for Meaningful Learning to occur:

> that the learning material (books, classes, applications, ...) has logical meaning (that is, it is relatable in a non-arbitrary and non-literal way to an appropriate and relevant cognitive structure) (Moreira, 2012, p. 8).

Emphasizing that the didactic material is only potentially significant, because the meaning is in the meanings attributed by the students: interest of the student, teacher mediation and syntheses of the construction of knowledge. These meanings interfere in the promotion of the construction of knowledge by students by using playful and experimental activities created by teachers in Potentially Significant Teaching Units in the Teaching of Chemistry.

Students are receptive to the use of games in the teaching of Chemistry, because for some, it may awaken feelings related to the internal state (childhood) and for others it may not have aroused any feelings at all. According to Ramos (1990), when using playful activities, several possibilities can happen such as: the formation of new concepts, cognitive development, the exercise of existing cognitive and motor structures and can also contribute to future learning, through a familiarization with the objects of the content.

Playful activities are not synonymous with success in learning, but serve as catalysts for the process. The signs of learning are present in the cognitive development that the game helped, because students need to think and reflect for the resolution of the questions. In the cognitive and motor structures that show the ability to apply a studied concept. According to the theory of Ausubel (1963) it is not possible to affirm that a student "learned in a significant way", but one can present indications that there was a significant potential in learning.

Thus, the teaching practices in the Teaching of Chemistry that use experimentation activities and games are different from the usual teaching and put the motivation of the students in evidence, with interest in participating in all activities. In this sense, the educational processes that involve the intentional planning of the different potentially significant activities are fundamental to create meanings in the construction of knowledge.

The production of this chapter allowed to broaden the reflection on teaching and to mark the importance of disseminating the practices with playful and experimental activities in the Teaching of

Chemistry to other teachers, so that they know this theory, in order to seek activities that really have the potential to achieve Significant Learning.

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