Chemical educational game: A tool for understanding Organic Chemistry

Accepted 14th March, 2019

ABSTRACT

The ludic activities are a privileged practice for an education that aims at personal development and cooperative action in society, being motivating, attractive and stimulating instruments of the teaching and learning process and the construction of knowledge. This article aims to verify the production and use of play games as an evaluation tool in the discipline of Organic Chemistry in high school seniors in a public school in Brazil. In order to carry out this intervention, the members of the Federal University of Campina Grande teaching initiation program worked with the teacher in the classroom to perform the oxygenated organic functions: alcohol, aldehyde, carboxylic acid, ketone and phenol. Two games were made, the memory game and the game of the course. In order to facilitate and promote meaningful learning, play games were framed within a constructivist teaching proposal. The educational function of the educational game was easily observed during its application when we verified the favoring of the acquisition of knowledge in a climate of joy and pleasure.

Key words: Educational games, organic chemistry, teaching, learning, innovative methodologies.

INTRODUCTION

It was believed that learning occurred by repetition and that students who did not learn were solely responsible for their lack of success. At present, students' lack of success is also a consequence of the teacher's work. The idea of teaching aroused by the interest of the student has become a challenge to the competence of the teacher. The interest of the learner has become the driving force of the learning process, and the teacher, the generator of stimulating learning situations. It is in this context that the didactic game gains space as a motivating tool for the learning of chemical knowledge, as it proposes to stimulate the interest of the student. If, on the one hand, the game helps him to build new forms of thinking, developing and enriching his personality, on the other hand, for the teacher, the game leads him to be the driver, stimulator and appraiser of learning (Araújo and Santos, 2018; Cunha, 2012).

The ludic activity with the objective of providing the means for the student to induce his reasoning, reflection and consequently the construction of his knowledge, promotes the construction of cognitive, physical, social and psychomotor knowledge, which leads him to memorize the subject more easily addressed. In addition, it develops the skills necessary for today's educational practices. According to Melo (2005), the playful one is an important instrument of pedagogical work. The mediator, in this case the teacher, should offer possibilities in the construction of knowledge, respecting the various singularities. These activities allow the interlocution of knowledge, socialization and personal, social, and cognitive development when well explored. When a game is created or adapted to the school content, the development of skills that involve the individual in all aspects: cognitive, emotional and relational will occur. It aims to make you more competent in producing creative and effective responses to solving problems.

In general, games have always been present in people's lives, either as an element of fun, dispute or as a way of learning. From ancient times, philosophers such as Plato and Aristotle already saw the importance of using games as a learning tool. At that time, there are some references to the use of games or materials aimed at the learning of
children, for example, Rome bakeries that made small treats in the form of letters for children to learn to read and write (Kishimoto, 1994). From the sixteenth century, with the emergence of rebirth, the humanists perceive the educational value of the games, which incorporate the life of the young and adult's occurrence of the birth of educational games (Vos et al., 2011).

Jesuit colleges were the first to put them in the classroom and use them as a didactic resource. The founder of Jesus' company, Ignatius of Loyola, realizes the importance of exercise games for the formation of the individual and recognizes it as a didactic tool. At that time (16th century), a Franciscan priest, Thomas Muner edits a new dialectic in the form of a card game, since he realizes that this would be an efficient way for his students to learn such discipline, which until then was presented in Spanish traditional texts. In the eighteenth century, games designed to teach science were created. At that time, these were used so that the royalty and the aristocracy learned contents of the science, but soon they become popular, ceasing to be a privilege of the nobles. They also served as a vehicle for dissemination and criticism. For example, track-type counted the glory of kings, their stories and actions; the board releases historical events and were used as a means of popular indoctrination. In the twentieth century, the role of game in education was discussed. According to Godói et al. (2010), the games contribute to the intellectual development of children and become increasingly significant as they develop. However, this resource for Piaget does not have the capacity to develop concepts in the child, but because they play an important role in intellectual development, they promote conceptual learning.

A game can be considered educational when it maintains a balance between two functions: the playful and the educational. According to Kishimoto (1994), the playfulness is related to the character of fun and pleasure that a game propitiates, while the education refers to the apprehension of knowledge, skill and knowledge.

Sghaier et al. (2015) describes and analyzes the joint didactic activity of two teachers' with their students in swimming in Tunisia. Its objective is to determine the influence of the teacher's training and their experience in staging and in the regulation of the didactic situations. To clarify better the complexity of the observed reality, this study uses ordinary didactics as a method of observation and it relies on the triplet of the genesis of knowledge like an instrument of analysis. This qualitative research tries to analyze the didactic system with questioning the effect of proficiency degree in swimming. Results put in evidence the conjugated effects of teacher's training and their professional experience on their practice improvement.

With the progress of the game production technology, educational games became a developing trend in the field of education. As the soul of the game, the role of the game to a large extent influences the effect of educational games. Qiu et al. (2013) details the analysis and design process of roles about forestry basics educational games. According to the various elements of the project needs and virtual environments, ultimately the roles are divided into the main role, assisted role and the role of attack, and detailed design for all kinds of roles.

Several studies and researches show that Chemistry teaching is, in general, traditional, centering on the simple memorization and repetition of names, formulas and calculations, totally dissociated from the quotidie and the reality in which the students meet (Santos et al., 2016; Silva et al., 2016; Oliveira et al., 2016). Chemistry, in this situation, becomes a dull and monotonous matter, causing the students themselves to question the reason why they are taught, since the school chemistry they study is presented in a totally decontextualized way. On the other hand, when the study of chemistry allows students to gradually develop a critical view of the world around them, their interest in the subject increases because they are given conditions to perceive and discuss situations related to social and environmental problems of the environment in that are inserted, contributing to the possible intervention and resolution of the same (Souza et al., 2015, 2006; Lima et al., 2016).

The ludic activities are privileged practices for the application of an education that focuses on the personal development of the student and acting in cooperation in society. They are also tools that motivate, attract and stimulate the process of knowledge construction, and can be defined, according to Santos et al. (2016), as a function, whatever the linguistic context, disregarding the object involved in the action. If there are rules, this playful activity can be considered a game.

The games are characterized by two elements that present pleasure and spontaneous effort, besides integrating the various dimensions of the student, such as affectivity and group work. Therefore, they should be included as promoters in school work (Amory and Seagram, 2003). Educational games are indicated as a type of educational didactic resource that can be used at different moments, such as the presentation of contents and illustration of aspects relevant to the content, such as revision or synthesis of important concepts and evaluation of already developed contents (Cunha, 2012).

It is in this context that the scholarship recipients of the Initiation to Teaching Program fit as promoters of new methodologies, which help the teacher to innovate their way of working and the approximation of the experience of the teacher that is already inserted inside the school passed to the scholars, which combine to this new ideas experienced (Lima et al., 2016). The teacher is a mediator of knowledge and for this it needs to position itself as being responsible to promote the construction of the knowledge of its students; this is a difficult task for which the precise creativity is present in the classrooms, because it is necessary to create new methods, with construction tools accessible to the student.
The use of new methodologies in the teaching of Chemistry is necessary due to the complexity involved in the study of this discipline (Godoy et al., 2010). It is a challenge that the teacher must pass in order to innovate and facilitate with tools capable of promoting teaching and learning in a meaningful way. It is necessary to create accessible and low-cost methodologies and as such it was proposed to build two different play games as a viable method to enable the learning of Organic Chemistry for the students of the High School and innovator of the State School Orlando Venâncio dos Santos.

The didactic games used were the Memory Game, in which the students organized themselves in groups and carried out the research of the chemical structures of the organic functions for the assembly of the pieces that relate the structural formulas to the nomenclature or the organic function and the Course Game which consists of a mat with progressive phases where the students are the pieces themselves and advance as they correctly answer the questions raised.

### Memory game

For the production of the Memory Game the students were divided into five groups, which were directed to perform research on structural formulas, nomenclatures and organic functions. Each group of students was assigned to search for one of the organic functions they had studied in the classroom and as such group 1 was responsible for the organic alcohol function, group 2 was responsible for the organic aldehyde function, group 3 for the organic function carboxylic acid, group 4 by the organic ketone function and group 5 by the organic phenol function. After the researches done by the students, the production and confection of the game by the same ones occurred. Each group played a part of the game relevant to the organic function they searched for, and each set was made up of twenty tokens, in which five tokens were represented by the name of each organic function (alcohol, aldehyde, carboxylic acid, ketone and phenol), ten tokens per different structures of the respective organic function and five tokens with different nomenclatures of each organic function.

The preparation of the pieces of the Memory Game was done in the classroom; the scholarship recipients of the Federal University of Campina Grande (UFCG) Initiation to Teaching Program took to the classroom the necessary materials such as gouache card, craft sheet, scissors and glue, while the students took the data of their research needed for the production of the chips. After the students’ production, the fellows mixed the chips such that the chips were unified and the game was constituted by all the organic functions; the four tokens separated of each organic function that related, in this way were worked and elaborated chips with five organic functions; it was possible to build five Memory games with twenty pieces each.

The Memory Game was used as an evaluation tool through a gymkhana; each group was left with a game to play among the students in their group. They mixed the chips without seeing them and tried to memorize which chips are related. Each group then chose one component as a winner, which played the game with a student from another group in the semi-final. The students from the different groups competed so that only two students left for the final. The students selected for the final played the Memory Game again, and at the end of the game was elected a winner who represented their group.

### Course game

The Course Game was also used as an evaluation tool. The game worked as follows: a carpet made of TNT fabric, decorated with EVA paper, was created, so that the carpet contained a path, which was followed gradually when the students correctly answered the questions proposed by the scholars. Twenty questions were asked regarding the contents seen in the classroom on the organic functions (alcohol, aldehyde, carboxylic acid, ketone and phenol). Again, the class was divided into groups, where each group contained a representative with a total of four representatives from their respective groups. Each representative worked as a part of the game. Questions were asked and each group helped their representative. If they did, they would throw a dice that indicated how many houses they could carry on the course of the carpet. Two representatives followed on the right side of the course, while the other two followed on the left side of the course, the student who first hit the last home on the course of the carpet won the game.

### METHODOLOGY

Due to the numerous contributions made through playfulness, the creation of two different playful games about Organic Chemistry was proposed. This didactic tool was proposed for use by the last year of High School and Innovative Education of the Orlando Venâncio dos Santos State School, located in the city of Cuité, Paraíba, Brazil. We developed a case study with qualitative analysis using two classes of the 3rd year high school of the public school of the night period, totaling about 30 students involved in the work. The work was done with the commitment of the teacher and with the consent of the school management and coordination, being, therefore, an experience report of pedagogical practice, using the classroom as a research environment. Data collection was done through the direct observation of the classes in which the activities were carried out, the materials produced and the statements and essays of the students describing their difficulties and facilities when elaborating the games and also when they were played.

The proposal was to use game as an evaluation method of
learning. Initially, the content was worked in the classroom through the use of an image projector during classes to present the contents referring to the game. The organic functions studied were alcohol, carboxylic acid, aldehyde, ketone and phenol. The classes were given by scholarship recipients of the Federal University of Campina Grande (UFCG) Initiation to Teaching Program during the Scientific Initiation and Research classes, whose classes were designed to demonstrate the organic functions, their nomenclatures, functional class, characteristics, definitions and importance in the students’ daily life.

RESULTS AND DISCUSSION

Based on the proposal of the creation of two different play games to be used as an evaluation tool in the contents of Organic Chemistry, a set of lectures was held at the Orlando Venâncio dos Santos State School to learn five organic functions (alcohol, aldehyde, carboxylic acid, ketone and phenol), which were used for the students to fortify their previous knowledge acquired during Chemistry classes, and then the Memory Game and the Course Game were made and used to effect the fixation of the content, evaluating in a pleasant way the quality of learning of the students with a methodology different from the traditional one.

In the Memory Game, students showed their skills acquired in the study of Organic Chemistry in a relaxed way, where they played with their colleagues and selected the fiches for proper memorization, as well as, demonstrating mastery of the contents, knowing how to easily relate the tokens structure, nomenclature and name of each organic function, according to the images shown in Figure 1.

In order to carry out the Course Game, twenty questions were initially asked regarding the organic functions studied (alcohol, aldehyde, carboxylic acid, ketone and phenol) (Table 1).

For the execution of the Course Game, the questions in Box 1 were placed inside a box, then the fellows would take
Table 1: Set of questions regarding the Course Game.

<table>
<thead>
<tr>
<th>Question/Answer</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question:</strong> Write the structural formula of 2-methyl-propanol. <strong>Answer:</strong></td>
<td><img src="image" alt="Structural formula of 2-methyl-propanol" /> <strong>Answer:</strong> 3-tert-butyl-2-ethylheptanoic acid.</td>
</tr>
<tr>
<td><strong>Question:</strong> What factors characterize the oxygenated organic function Alcohol? <strong>Answer:</strong></td>
<td><img src="image" alt="Hexanoic acid" /> <strong>Answer:</strong> Hexanoic acid.</td>
</tr>
<tr>
<td><strong>Question:</strong> What is the nomenclature of the following structure? <strong>Answer:</strong></td>
<td><img src="image" alt="Hexanoic acid" /> <strong>Answer:</strong> Hexanoic acid.</td>
</tr>
<tr>
<td><strong>Question:</strong> What is the nomenclature of the following structure? <strong>Answer:</strong></td>
<td><img src="image" alt="3-isopropyl-hexan-2-one" /> <strong>Answer:</strong> 3-isopropyl-hexan-2-one.</td>
</tr>
<tr>
<td><strong>Question:</strong> What factors characterize the oxygenated organic function Phenol? <strong>Answer:</strong></td>
<td><img src="image" alt="Phenol" /> <strong>Answer:</strong> Contain hydroxyl (OH) attached directly to an aromatic ring.</td>
</tr>
</tbody>
</table>

one of the questions out and read aloud to a representative from each group, who listened carefully and argued with the best answer to the question asked. The representative went to the table in front of the room and showed all colleagues what response their group had received. The teacher together with the scholarship holders announced if the answer was right or wrong and if the answer was correct the student could play a data that represented how many houses he could advance; if the answer was wrong the student could not play the dice to pursue any house. Along the way they had some gifts that the students had to pass through, for example, return "n" houses along the way, imitate a teacher, tell a joke, and pay a mico proposed by the colleague who is further along the course, "n" houses.
As two students were placed on each side of the course, two on the right side and two on the left side, the student who first hit the other side would win the game, hence, one of the students on the right side or the left had to reach the end of the trail opposite that which had begun in order to be elected a winner, which represented one of the four groups formed.

Through the Game of the Course as an instrument of evaluation of learning it was possible to analyze the efficiency of shared knowledge with fun, where students were more involved in the learning process, because there was motivation to demonstrate that their understanding about Organic Chemistry was efficient against the proposed questions. The educational game had a fundamental role so that the students could express the learning achieved during the classes, besides promoting the team work, the division of knowledge and the construction of a knowledge shared with its colleagues. The students were motivated and protagonists of the scientific knowledge required in the activity in which they were involved, realizing that Chemistry is a knowledge present in their reality and that it is possible to learn to construct their knowledge about this discipline in a more comfortable and relaxed way (Figure 2).

The elaboration of Memory and Course games were proposed so that the students were encouraged to learn Organic Chemistry with ease, reaching other goals as well, because through the games students develop reasoning and reflection, promoting cognitive, physical, social and psychomotor knowledge. The lectures on oxygenated organic functions (alcohol, aldehyde, carboxylic acid, ketone and phenol), aimed to work on the nomenclature, structure, organic function, characteristics, definition and chemical concepts of these functions, so that they could be evaluated through games of course and memory. Thereafter, the class was divided into groups and the games applied at different times in order to analyze the effectiveness of this tool in the verification of learning of the group involved in this intervention.

According to direct observations, after the elaboration, preparation and application of the games, it was possible to reach the fun games functions, since the students' learning facility, which interacted with each other, sharing their knowledge with their group to participate in the games,
through the game of knowledge was evaluated and confirmed that this it is a viable and enjoyable method that involves students with each other, to participate, interact and pay attention to the importance of obtaining chemical knowledge.

Conclusions

The construction of the Game of Memory and the Game of Course made it possible to achieve the objectives that are sought when using a playful game aimed at teaching, because it was possible to establish scientific knowledge harmonized with the game. According to the results, it can be observed that Organic Chemistry was clear for the students involved in this learning process; this was seen during the games because the students showed a firm knowledge about the oxygenated organic functions studied (alcohol, Aldehyde, carboxylic acid, ketone and phenol) and developed through the effort of each of the collective knowledge students.

According to direct observations, the educational games help students develop beyond knowledge, group work, affection for their peers, respect, interaction and all the chemical knowledge linked to learning easily. In the classes that were previously classified as boring or exhaustive, the change in students’ attitudes through the execution of games, participation, interaction and the need to know with firmness the contents studied was noticeable.

Activities of this nature encourage and entice the student to remain in school and attain the skills and competences that are necessary for his life in society. For the teaching of current chemistry it is necessary to rescue the student and show him that science is capable of being learned with pleasure. In this context, play games play this role with ease and help the teacher as mediator of the scientific knowledge needed to be passed on to the students.

REFERENCES


Melo CMR (2005). The ludic activities are fundamental to subsidize the process of knowledge construction. Informação Filosófica. 2: 128-133.


