EDUR • Educação em Revista. 2021; 37:e25000
DOI: http://dx.doi.org/10.1590/0102-469825000

ARTICLE

A PROPOSAL FOR THE ELABORATION OF A PEDAGOGICAL GAME FROM THE FORMULATION OF CONCEPTUAL SCHEMES

FERNANDO APARECIDO DE MORAES[1]
ORCID: https://orcid.org/0000-0002-8714-6533

MÁRLON HERBERT FLORA BARBOSA SOARES[2]
ORCID: https://orcid.org/0000-0002-3273-8603

ABSTRACT: This theoretical article aims to present a proposal of how the pedagogical game should be analyzed and understood from the conception of conceptual schemes. To do so, the authors discuss the conception of recreational games from the point of view of three conceptual schemes: Rules, Playful Interaction, and Culture. Later, after characterizing the pedagogical game, according to the discussion held in the light of specific literature, the authors present and discuss in detail the primary scheme proposed by them to think about the pedagogical game, the Formal Education scheme. Finally, the authors point out that the proposal can be used to think and elaborate pedagogical games not only for the teaching of Natural Sciences practiced in Basic Education, but in any discipline linked to Formal Education.

Keywords: Pedagogical Game, Ludic, Formal Education, Conceptual Schemes

UMA PROPOSTA PARA A ELABORAÇÃO DO JOGO PEDAGÓGICO A PARTIR DA CONCEPÇÃO DE ESQUEMAS CONCEITUAIS

RESUMO: Este artigo teórico objetiva apresentar uma proposta de como o jogo pedagógico deve ser analisado e compreendido a partir da concepção de esquemas conceituais. Para tanto, os autores discutem sobre a concepção de jogos recreativos a partir da ótica de três esquemas conceituais, os esquemas: Regras, Interação Lúdica e Cultura. Posteriormente, após caracterizar o jogo pedagógico, de acordo com discussão realizada sob a luz da literatura específica, os autores apresentam e discutem em detalhes o esquema primário proposto por eles para se pensar o jogo pedagógico, o esquema Educação Formal. Por fim, apontam os autores que a proposta pode ser utilizada para se pensar e elaborar jogos pedagógicos não somente para o ensino das Ciências Naturais praticado na Educação Básica, mas em qualquer disciplina vinculada à Educação Formal.

Palavras-chave: Jogo Pedagógico, Lúdico, Educação Formal, Esquemas Conceituais

UNA PROPUESTA PARA LA ELABORACIÓN DE JUEGO PEDAGÓGICO A PARTIR DE LA CONCEPCIÓN DE ESQUEMAS CONCEPTUALES

[1] Universidade Federal de Jataí (UFJ) (Federal University of Jataí). Jataí, GO, Brasil. <fernandoaparecido@ufj.edu.br>
[2] Universidade Federal de Goiás (UFG) (Federal University of Goiás). Goiânia, GO, Brasil. <marlon@ufg.br>

RESUMEN: Este artículo, de carácter teórico, objetiva presentar una propuesta de como el juego pedagógico debe ser analizado y comprendido a partir de la concepción de esquemas conceptuales. Para tanto, los autores discuten a respecto de la concepción de juegos recreativos desde la óptica de tres esquemas conceptuales: Reglas, Interacción Lúdica y Cultura. Posteriormente, después de caracterizar el juego pedagógico y de acuerdo con discusión realizada a la luz de la literatura específica, los autores presentan y discuten en detalles un esquema primario para pensar el juego pedagógico: el esquema denominado Educación Formal. Por último señalan que la propuesta puede ser utilizada para pensar y elaborar juegos pedagógicos no solamente para la enseñanza de las Ciencias de la Naturaleza en la Educación Básica, sino en cualquier asignatura de la Educación Formal.

Palabras clave: Juego Pedagógico, Lúdico, Educación Formal, Esquemas Conceptuales

INTRODUCTION

This article presents a proposal developed in a recently defended doctoral thesis, which aimed to investigate the possibilities of knowledge construction from the elaboration of a pedagogical game, under the light of the concept of conceptual schemes and Jean Piaget's theory (1896-1980), to work with evolutionary concepts in Biology teaching in High School. In specific, we will address theoretical aspects of the elaboration of the pedagogical game from the conception of four conceptual schemes, three of them proposed by Salen and Zimmerman (2004), and the other, proposed by us.

The article is structured in topics that will address, initially, what we understand by pedagogical game. After that, we will discuss the conception of the primary conceptual schemes to think about a game from the perspective of the primary schemes proposed by Salen and Zimmerman (2004), namely: Rules, Playful Interaction, and Culture. Based on the discussion of this referential, we will propose a new scheme, called the Formal Education primary scheme, in an attempt to think about the creation of a pedagogical game.

The theoretical discussion established in the text is based on the approximation between Salen and Zimmerman (2004) and the classical authors of the game field, in the strict sense, such as Brougère (1998), Huizinga (2012), and Caillois (2017). Finally, the study points to the possibilities of using the pedagogical game as one of the pedagogical strategies for the teaching and learning process, both in the teaching of Natural Sciences and for other disciplinary areas of Formal Education.

THE PEDAGOGICAL GAME

At some point in history, games have taken on the perspective of teaching something, or more precisely, some school content. From then on, it has received specific adjectives, such as didactic game, educational game, and pedagogical game. But what makes it an educational, didactic, or pedagogical game? Is there a difference between them?

Based on a recent discussion held by Cleophas, Cavalcanti, and Soares (2018), we will address some aspects regarding the different conceptions that involve the game in an educational perspective, seeking to characterize the conception of pedagogical game that we are addressing in the article. But, before that, we will go back a little in time to situate the educational game in a historical context.

It should be noted that in the 16th century there was a major event that boosted the interest for educational games: the appearance of the Society of Jesus. According to Soares (2004, p. 36), "Ignacio de Loyola, a military man and a nobleman, understood the importance of exercise games for the formation of the human being and recommended their use as an auxiliary teaching resource".

Kishimoto (2011, p. 32) points out that in the Renaissance the game assumes an important educational role, because "by meeting children's needs, the children's game becomes a suitable form for

learning school content. Thus, to counteract the verbalist teaching processes, the prevailing palming, the pedagogue should give a playful form to the contents".

In the 18th century, under the strong influence of the development of positivist science, there was an increase and diversification of games in different areas, including Natural Sciences, with the purpose of teaching sciences to royalty and aristocracy (SOARES, 2004). From that time on, the game gains space in the classroom, supported mainly by Mathematics, which uses it and starts to manifest itself in its defense for the development of logical reasoning.

In the following centuries, the game became increasingly object of interest in areas related to development and learning of the individual. Authors such as Piaget (1896-1980) and Lev Vygotsky (1896-1934) attribute important significance to play in the learning process. Although differently, both are responsible for giving a prominent place to play in the process of subject development and learning construction. Much of what is discussed today about educational games is based on the knowledge presented by these two important authors.

Soares (2013, p. 45) highlights that "certainly, for a long time, the game has been related to learning, however, the idea that the game lends itself more to recreation than to teaching, as opposed to school work, has always predominated." Considering this statement, we argue that it is necessary to overcome the conception that the game in the classroom is being used only to make the teacher's life easier, passing the class time, or serving as an auxiliary tool when he/she stops planning the lesson.

In this way, it is also necessary to overcome what Brougère (1998) calls the "educational game paradox", in which it would be inconceivable to think of a voluntary playful activity associated with the imposing seriousness that the teaching and learning process demands. The specific literature has presented us with significant results of the numerous possibilities that the game brings to the classroom, including in the teaching and learning process of Natural Sciences (GALVÃO *et al.*, 2012; MIRANDA, 2015; ANJOS; GUIMARÃES, 2018; LOCATELLI, 2018).

Rezende *et al.* (2019, p. 257), on the advantages of the educational game in teaching chemistry, point out that

> The development of the educational game made it possible to verify how important the ludic is in the teaching and learning processes, and that this methodology contributes to the students' learning, putting them in a position of protagonism of the construction of their own knowledge [...].

In the XI National Meeting of Research in Science Education, Duarte et al. (2017) presented the paper entitled "Roulette of Evolution: a didactic tool for teaching Biology in High School". The authors conclude the paper by stating that "[...] it is possible to suggest that this model has effectiveness in the teaching learning process, if used correctly by the teacher" (DUARTE *et al.*, 2017, p. 9).

Araújo and Santos (2018, p. 82), on the use of educational game for teaching Physics, point out that "[...] the use of educational games, facilitate the understanding of the contents, besides promoting the interaction and participation of students in the proposed activity. Such resources potentially stimulate cognition, affection, socialization, motivation, and creativity".

In order to advance the theoretical discussion about educational games, Cleophas, Cavalcanti and Soares (2018) discuss, in the light of references from the game theoretical field, the educational quality attributed to the game, considering that it, in its *stricto* (strict) sense, is voluntary and free and cannot be an imposed activity, because then it would cease to be a game, as pointed out by Brougère (2002), Huizinga (2012) and Caillois (2017). Based on their discussion, Cleophas, Cavalcanti, and Soares (2018) defend the idea that educational play can be accepted without the concern that, because it is educational, it would cease to be play, in the "paradox of educational play".

From then on, Cleophas, Cavalcanti, and Soares (2018) present two types of educational games, the first of which is the informal educational game, which would be the one that teaches in an unpretentious way, that is, it was not thought for a formal teaching purpose and is used, initially, with a merely playful purpose. In another way, they present us the formalized educational game, which will be organized in two subcategories: the didactic game and the pedagogical game. For them, the formalized

educational game is the one that, unlike the informal one, has some direct relation with formal education, either in the aspect of its construction or in the aspect referring to the proposal of its educational use.

When defining the differences between the didactic game and the pedagogical game, the authors present us the peculiar characteristics for each one. The main differentiation they make between the two types of games is found in the game development process and in relation to the objectives of use. For them, the didactic game arises from the adaptation of an existing game; moreover, the school contents are proposed, in general, for a reinforcement or a diagnostic evaluation. In relation to the pedagogical game, the authors highlight the need for unprecedentedness, i.e., its design is thought and prepared specifically to develop cognitive skills, and can be used at different times in the school context, such as to teach some content (CLEOPHAS; CAVALCANTI; SOARES, 2018).

Thus, they define the educational game as:

> Formalized Educational Game that has not been adapted from any other game, that is, it would be a game containing a high degree of uniqueness, aiming to develop cognitive skills on specific contents. This type of game maintains, in its essence, the instructional role, thus acting as a teaching strategy that has been cautiously planned to stimulate the capacity for intentional self-reflection in students, leading them to a change in behavior in relation to their learning, without losing the pleasurable aspect that a playful activity has (CLEOPHAS; CAVALCANTI; SOARES, 2018, p. 39).

It is important to highlight that, in addition to this conceptualization established by Cleophas, Cavalcanti, and Soares (2018), there are other classifications adopted by other authors, such as Kishimoto (2011) and Chateau (1987). For some of them, the terminologies "pedagogical," "didactic," and "educational" are equivalent. Others, consider them completely different, as in the case of Cunha (2012), in relation to the educational game and didactic game. For the author, the educational game would involve several types of actions in the corporal, cognitive, affective, and social spheres of the student. The didactic game, on the other hand, would be a regulated and more specific activity, related to the teaching of concepts and/or contents.

Regarding this conceptual discussion, Messeder-Neto (2016, p. 179) states that being "educational" or "didactic", what matters is that "in case the game goes to the classroom, it will always have to have content and or concepts, otherwise it should not be in this institution". He also states that "regardless of calling it an educational game or a didactic game, what the teacher needs to pay attention to is whether the content is present and whether it occupies a central place in the game" (MESSEDER-NETO, 2016, p. 180).

Given the conceptual divergences presented, our thinking is in line with the ideas of Cleophas, Cavalcanti, and Soares (2018), regarding the conceptualization of educational, didactic, and pedagogical games. Hence comes our understanding of pedagogical game used in this paper, thinking that it is necessary to deepen the theoretical discussion of the formalized educational game, even to avoid certain deforming assimilations, fruits of confusions between the terms "didactic", "pedagogical" and "educational", which lead to conceptual errors regarding the preparation, evaluation and use of games in the classroom.

Thus, when considering the concept of pedagogical game presented by the authors, we feel the need to expand the discussion about the characteristics to be considered in this type of game, of "high degree of unprecedentedness" and "aiming to develop cognitive skills on specific contents". Therefore, we present the proposal that considers the characteristics of a pedagogical game from the conception of conceptual schemes.

THE CONCEPTION OF THE PEDAGOGICAL GAME FROM THE PRIMARY CONCEPTUAL SCHEMES

Salen and Zimmerman's primary schemes

Considering that there is an extensive literature discussing play in the strict sense, as in Chateau (1987), Brougère (1998), Huizinga (2012), Soares (2013) and Caillois (2017), in this paper we present a theoretical discussion of Salen and Zimmerman's (2004) primary conceptual schemes, establishing a dialogical relationship with what the specific literature in the field of play points out.

Salen and Zimmerman (2004) understand recreational play from what they call primary schemes. In a text that dialogues with important references in the game theory field, they choose to consider the game as a system. In the words of the authors themselves "a game is a system in which players engage in an artificial conflict, defined by rules, that implies a quantifiable outcome" (SALEN; ZIMMERMAN, 2012a, p. 95).

Detailing this concept, the authors point out to us that, firstly, considering a system as a set of parts that together form a complex whole, and organically different from the individual parts, the game should be considered as a system. The players are defined as the participants who interact with the system, experiencing the playful interaction of the game. In interacting with the system, players experience conflicting situations, whether represented by moments of competition or cooperation. These experiences are normalized by the rules, which impose what the players can and cannot do. As a result of all this, we can verify that some goal was achieved, which can be victory or any other goal that the game presents and is verifiable (SALEN; ZIMMERMAN, 2012a).

Regarding the design and analysis of a game, the authors present us the theoretical idea that interested us a lot, which would be to work under the optics of primary conceptual schemes, defined by them as follows: "a scheme is a way to systematize and organize knowledge. *A game design scheme* is a way of understanding games, a conceptual lens that we can apply to the analysis or creation of a game" (SALEN; ZIMMERMAN, 2012a, p. 23, *emphasis added*).

To propose this idea of primary schemes, one of the authors used by them as a theoretical reference was Piaget. For Piaget (1980; 1987) the schemes are understood as cognitive structures necessary for the individual to accommodate the assimilated information. In the beginning of life, subjects present primordial schemes that are gradually transformed and originate other schemes. The more assimilation and accommodation take place, the more the pre-constituted schemes will change, or new schemes will be created. Piaget states that the schemes become more and more complex and allow us to understand objects, as well as their interrelationships in the world we live in.

Primary schemes can be understood, from the thought of Salen and Zimmerman (2012a), as a conceptual structure that organizes some particular aspects of a system, of a game. When special attention is given to a scheme, the other conceptual structures remain in the background, even though we know that they are interrelated with it. By better understanding how each primary scheme is constituted, we can better understand how the game constitutes a system designed for playful interaction.

Under this model of conceiving a game, the authors then propose three primary schemes, these being: the Rules, the Playful Interaction, and the Culture. For them:

> These schemes not only organize ways of looking at games, but also when taken as a whole, provide a general method for studying game design. Each scheme brings out certain aspects of games by building on previous schemes to arrive at a multipurpose understanding of games (SALEN; ZIMMERMAN, 2012a, p. 23).

Thus, in the following topics we will briefly discuss the three schemes presented by Salen and Zimmerman (2004).

Primary Scheme – Rules

The rules in a game are responsible for inserting and keeping us in the fictional universe proposed by the game. They are what make it happen, enabling the interactive experiences within what Salen and Zimmerman (2004) call the "magic circle". The rules must be followed and respected so that the game can achieve its intended goals. In this regard, Huizinga (2012, p. 14) points out that "every game has its rules. It is these that determine what "counts" within the temporary world circumscribed by it.

The rules of all games are absolute and allow no discussion." For Soares (2013, p. 40) rules "[...] imply a social contract of coexistence among the participants."

Seeking to conceptualize the game, Caillois (2017, p. 19, emphasis added) highlights the importance of rules by stating that "every game is a system of rules that define what is or what is not of the game, that is, what is allowed and what is forbidden. These conventions are at once arbitrary, imperative, and unappealable."

Both Huizinga (2012) and Caillois (2017) present the idea that play constitutes an "autonomous reality," which is the ability to transport players to another world, outside of the everyday reality to which players belong. To understand this better, we suggest that everyone think about their own experiences with games. By doing so, it is possible to realize that when we are playing a game that manages to involve us in its "magic circle", we spend several hours, even days, without caring about what is around us, that is, real life. We plunge into another dimension of our life, one in which we can assume different roles, without responsibilities, above all, without thinking about our worries of everyday life.

Regarding this magic that the game presents us with, Salen and Zimmermam (2004) elaborate the idea of the "magic circle", briefly mentioned by Huizinga (2012) in the work Homo Ludens. For the authors, the "magic circle" deals with a special place created by the game, "[...] is where the game takes place. Playing a game means entering a magic circle or, perhaps, creating one when the game begins.", concluding that "the term 'magic circle' is apt because there is, in fact, something truly magical that happens when the game begins" (SALEN; ZIMMERMAN, 2012a, p. 111).

Interestingly, Soares (2013, p. 108), when discussing board games, informs us that:

> [...] board games are symbolic representations of the Mandala, a Sanskrit term meaning "magic circle". Their circular, or even square shapes, must imply the presence of a center around which they are organized, expressing the idea of totality, of something perfect, closed in itself.

Such characteristic puts the game in a different situation from everyday life, because, unlike it, the game always takes place in a determined historical time, having a beginning and an end. Space is relativized in the game, and it can happen on a level of imaginative virtual environment, such as role-playing games or role simulations, like the Roling Playing Game (RPG). Caillois (2017), when seeking to point out the characteristics of the game, highlights that it is an activity circumscribed in limits and proper spaces, uncertain and endowed with a fictitious reality, which, also, meets the idea of "magic circle". With these considerations, Huizinga (2012, p. 24) alerts us that "the game has, by nature, an unstable environment. At any moment it is possible for 'everyday life' to reassert its rights [...]".

Thus, considering the "magic circle" as something unstable, Sallen and Zimmerman (2004) present us that the rules are responsible for its maintenance, that is, without them the circle is broken, breaking it may be the end of a game, because people may lose interest in it. From this direct relation of the rules with the "magic circle", we understand that they operationalize a way for the players to interact with the system, creating the "magic circle" and making possible that the experiences lived happen within the space of possibilities that the game presents, even though we know that in the conception of a game we cannot predict all the possible experiences of interaction.

In view of the above, we present the main characteristics that Sallen and Zimmerman (2012b) list about the rules. For them, rules limit player action (regulate actions); are explicit and unambiguous (complete and unambiguous); are shared by all players (unanimity); are fixed (do not change when a game is played); are mandatory (unquestionable); and repeatable (are maintained between one game and another).

About these characteristics, we disagree only with the statement that the rules are fixed, because we understand that this will depend on the type of rule we are talking about. In the authors' own text, we find a typification of the rules that show us that some of them, such as the implicit ones, are not fixed and depend on the interaction between the players.

Salen and Zimmerman (2012b) present us the existence of three types of rules: the operational ones (those that are presented at the beginning of the game and seek to guide the players' behavior, allowing the game to start and develop); the constitutive ones (those underlying that are "under

the surface" of the operational rules, which appear throughout the game); and the implicit ones (those "unwritten" rules, which concern situations that may or may not happen in the game, depending on how the players are interacting with the system). In this case, about the implicit rules we cannot say that they are fixed, because they will depend on the players' attitudes towards the game.

Kishimoto (2011, p. 27) also discusses different types of rules in a game and presents us that "there are explicit rules, as in chess or hopscotch, implicit rules as in the game of make-believe, in which the girl pretends to be the mother who takes care of her daughter. They are internal, hidden rules that order and conduct the game." Soares (2013, p. 42) partially concurs with the author when talking about explicit and implicit rules, stating that "the explicit rules are the declared and consensual rules of a game itself, the implicit ones are the minimum skills necessary to be able to practice a game in which there are explicit rules."

In general, theorists in the field of play who present us with rules as one of the main characteristics of a game are extremely in favor of abiding by them. However, they know that at some point in the game they can be broken. In this regard Sallen and Zimmerman (2012b, p. 27) state that "it is clear that the authority of the rules is not always strictly obeyed: cheating happens." For Caillois (2017) from the moment that the game establishes a tenuous boundary between the real and the fictional, the contamination of the game with real-life elements can easily corrupt the nature of the game.

To further discuss players' behavior in relation to the rules, Sallen and Zimmerman (2012b) introduce us to some common types of players, being: the standard player (respects the rules and his authority in the game), the dedicated player (besides presenting the characteristics of the standard player, he studies all the possibilities of the game, exploring better strategies to get the victory), the anti-sportive player (follows the rules but does not care about others), the cheater (breaks the rules to try to get the victory), and the spoilsport (almost without characteristics of a player, does not engage in the magic circle and can end a match).

In general, the first two types of players prevail among the numerous types of games that are available to be played. However, to think about the creation of a game it is important to consider the existences of the other types, because all of them can coexist in a game, which will change the dynamics of the interactive system established by the rules, and may even put it at risk, as is the case of the cheater.

About the cheater, Caillois (2017, p. 89) highlights that "[...] he remains in the universe of the game. When he circumvents the rules, at least he does so by pretending to respect them. He seeks to sell a pig in a poke. He is dishonest and hypocritical." The cheater is that player who uses various strategies and does not accept the rules to achieve the final goal of the game, for example, that card player who hides a wild card to use it at the right moment and win the game.

As we have presented, as a primary scheme Salen and Zimmerman (2004) organize the Rules scheme taking into account the conceptual scope that they present to us as necessary to better understand the scheme. In this way, they discuss the nature of rules, the types of rules, and their relation to the designed system, there involving several issues, such as the conflicts and uncertainties that manifest themselves in the space of possibilities of the "magic circle". In addition, the authors highlight the possibility of players breaking the rules, which leads us to think of other possibilities within the system.

In view of the above, we state that the rules of a game allow us to understand the system that has been or is being designed. Rules, as a primary scheme of conceptual organization, organize a scope of knowledge that comes together in search of the construction and maintenance of the "magic circle" of a game. We argue, therefore, that from the rules on, the system starts to work, not being restricted only to this initial moment, because they will also be responsible for the maintenance of the ludic interaction that will take place in the interactive experiences. The ludic interaction in a game will only be allowed from the moment the players are seduced to enter the "magic circle" of the game, that is, the fictitious time-space that the game presents. However, the permanence in the game will be guaranteed by the interactions that, in turn, will be normalized through the rules.

Primary scheme - Playful Interaction

Interact comes from the word interaction, action between two objects or people, or between people and objects (HOUAISS, 2009). In our conception of interaction focused on the game, we highlight that, besides the important interaction between people, the players, there is the interaction of people with the system that was designed for this, i.e. the game, as well as the interaction of people with the knowledge present in the game.

The term "ludic", according to the Houaiss Electronic Dictionary of the Portuguese Language (HOUAISS, 2009), is sometimes directly associated with play, sometimes with childish behavior or the feeling of pleasure. Moreover, it is also associated with behavior observed in phases of human development, according to Psychology and Psychopedagogy. In fact, we can observe this in important theorists, such as in Piaget (1978) and Chateau (1987). For Piaget (1978), it is through playful activities that the child is satisfied and nurtures the (re)construction of schemes. It was not for nothing that Huizinga (2012) brought us the idea of Homo Ludens. For him, the spirit of play is something natural to human beings, part of their constitution as social beings.

To further clarify this complex relationship between playfulness and gaming, Salen and Zimmerman (2012c) defend gaming as a type of playful activity, one that promotes playful interactions. However, they consider that play is not the only one responsible for such interactions, since they can be verified in other human activities and behaviors, through playful being. In the game, interaction happens through the experiences lived in the designed system. In this regard, Salen and Zimmerman (2012c, p. 36, *emphasis added*) state that:

> To interact with a game is to *experience* the game: to see, touch, hear, smell, and taste the game; to move the body during the game, to feel emotions about the outcome of the ongoing game, to communicate with other players, to alter normal thought patterns. Unlike the clear mathematical forms of the rules, the experiential play interaction of a game is diffuse, obscure and confusing. But it is in this realm that players actually participate in a game, entering into meaningful playful interaction.

It is from this thought that the authors highlight the importance of the primary scheme Playful Interaction, as it would be responsible for organizing a conceptual scope, allowing a game developer to think about the whole space of possibilities to promote meaningful experiences for players. They point out that this is one of the biggest challenges, because, "[...] it means considering micro dimensions and macro dimensions, from the small moment-to-moment interactions that confront a player, to the way these basic interactions combine to form a larger trajectory of experience" (SALEN; ZIMMERMAN, 2012c, p. 38).

To have a good game, it is not enough to create the "magic circle", it is necessary that the magic made possible by it is able to seduce and conquer the players so that they want to stay within the fictional universe of the game. After all, when we consider gaming as a voluntary activity, people play because they want to. For this, interactive experiences must contemplate pleasure. Pleasure, derived from numerous physical, emotional, psychological or ideological sensations, will always be a profound experience in gaming, as Salen and Zimmerman (2012c) point out. It is that feeling that "at any given moment in a game, a player is thrown in several directions at once, experiencing a complex mix of pleasures" (SALEN; ZIMMERMAN, 2012c, p. 70).

On this aspect Soares (2013, p. 25) highlights that "to say that a game is not pleasurable, is to say that it is no longer playful, is to conclude that it loses the character of game." For the author, playfulness is intrinsic to the game and the contrary conception needs to be overcome, because there are epistemological issues of more urgency in the theoretical field of games to be discussed. However, we still find in many scientific papers presented in national congresses and events in the area of Science Teaching, titles that present the term playful game, showing that the confusion has not been overcome yet. The game is ludic, i.e., it intrinsically brings the characteristic of fun and pleasure to the players.

However, it is important to note that some authors, such as Kishimoto (2011), point out that, in some cases, displeasure is the element that characterizes a specific type of game. On this aspect Salen and Zimmerman (2012c) discuss that sensations contrary to pleasure, such as boredom and anxiety,

are "traps" possible to be observed in a poorly designed game, i.e., they are not intrinsic situations to the game. Considering the possibility of non-existence of pleasure in a game makes us think about the need for attention when the system is being designed, so that pleasure can emerge and remain throughout the experiences. As Salen and Zimmerman (2012c, p. 61) rightly point out, "Thinking of games as pleasure systems implies that the game designer is a craftsman of desire, shaping the pleasure of the players of a game."

Thus, considering the primary scheme Playful Interaction, it is important to highlight that the game is a system designed for playful interaction. Interaction that can happen all the time in the game should therefore be charged with good sensations, such as pleasure. Salen and Zimmerman (2012c) point out that these interactions are very important, and can even assume a transformative role even outside the "magic circle". The authors further note that "[...] the playful interaction of play represents an end in itself. We play, to some extent, for the playful interaction itself" (SALEN; ZIMMERMAN, 2012c, p. 54).

Huizinga (2012), also concurs with this thought, when he states that one of the important characteristics of play is found in its power of fascination and intensity, which cannot be explained only by biological analysis. For him "[...] it is in this intensity, this fascination, this capacity to excite that lies the very essence and primordial characteristic of the game" (HUIZINGA, 2012, p. 5).

It is this interaction that makes the players attribute meanings to what is being done in the game. Therefore, it is important to consider all interactive possibilities when designing a game system. The essence of the game is in the possible interactions within the "magic circle", created from the moment the game starts.

Primary scheme - Culture

There are several studies that seek to delimit the concept of culture, demonstrating the polysemy of the term. In this work we have adopted the categorizations of culture presented by Bodley (1994). For the author, the concept of culture can be systematized into a few categories: topical, historical, behavioral, normative, functional, mental, structural, and symbolic. In doing so, the author relates culture to several characteristics, such as traditional issues, human behavior, ideas and values, a way of life, a complex of ideas and habits arbitrarily attributed and shared in a given society (BODLEY, 1994).

From the moment that culture is understood as a polysemic term, it is important to be clear about what meanings it assumes so that we can think about the numerous conceptual issues that may relate to the primary scheme Culture. A limited view of the term can lead us to a reductionist view of the importance of culture in the process of developing a game, since it should be taken into consideration even before the game conception begins, because it will be from the culture that the meaning will be attributed to it.

A game can be considered a game in one culture and not a game in another. Kishimoto (2011, p. 19) points out that "[...] each social context builds an image of game according to its values and way of life, which is expressed through language". Huizinga (2012) presents us that play precedes culture, since animals did not wait to be initiated into cultural practices to perform various types of games. Many animals, especially when young, perform various interactive practices described as games. However, the author points out that play has a significant function that goes beyond simple instinct or physiological issues. This significant function, which gives a social meaning to the game, makes it an important element of culture.

Thus, it is important to think that games are elaborated by adding aspects of contemporary culture to them, and at the same time they become a new element of this culture, becoming part of it. Games are influenced by culture, but they can also influence it, since they are loaded with meanings. Sallen and Zimermman (2012d), in understanding culture as a constitutive element of the game itself and, at the same time, understanding the game as culture itself, propose the primary scheme Culture stating that:

> Unlike the schemes in Rules and Play Interaction, cultural schemes of game design do not derive directly from the internal and intrinsic qualities of games, but come from the relationship

> between games and the larger contexts in which they are played. These contexts can be ideological, practical, political, or even physical (SALEN; ZIMMERMAN, 2012d, p. 25).

The authors lead us to think that even if the game creates its own reality within the "magic circle", it will be historically located in a real context, as they very well highlight when they state that "the magic circle is an environment for the game, the space in which the rules take on a special meaning. But the magic circle itself exists within an environment, the larger sphere of culture in general" (SALEN; ZIMMERMAN, 2012d, p. 21).

To further discuss the primary scheme Culture, Salen and Zimmerman (2012d) present us with two ways in which we can understand games as culture, these being: as reflection and as transformation. For the authors, there are games that directly reflect culture, presenting direct elements that demonstrate that they are inserted in the respective culture. Others have the ability to transform culture, going beyond the interactions experienced in the "magic circle". But the authors also consider that these forms are not necessarily exclusive and can be found in the same game.

From this point of view, games are seen as symbolic objects loaded with cultural expressions. They can even be thought of as resistance mechanisms. When we think of games that bring to their context issues that go beyond the limits of the "magic circle", we are thinking of games that can be influenced by culture, but mainly influence it, promoting transformations in its aspects. In this regard Salen and Zimmerman (2012d, p. 35) state that "games put culture 'in play', not just reflecting culture, but changing between and within existing cultural structures-sometimes transforming them as a result." In this sense, they point out that game designers need to analyze very well what meanings are explicit and implicit in a game.

Another aspect highlighted by Salen and Zimmerman (2012d, p. 51) about the various ways we can see the game through the Culture scheme, is to consider it as an ideological instrument of cultural rhetoric. In this case, the authors point us to numerous situations that games consider and reinforce issues, for example, gender, politics, among others. For them "cultural rhetoric can be an unconscious aspect of a game's ideology or can be consciously conceived in a game". When they are consciously present, they become important ideological mechanisms, therefore, they need to be analyzed very carefully in order to avoid certain types of situations in which social values and behaviors that are harmful to the collective good of a society that seeks to be democratic are reproduced.

When discussing the Culture scheme, as well as its importance, and thinking about associating it with the other two schemes, Rules and Playful Interaction, we begin to visualize how complex it is to conceive a game taking into consideration all the aspects of the three schemes in an integrated way. To seek the construction of a system that as a primary result promotes playful interaction, but that, in addition, is historically localized, becomes a huge challenge to be faced.

As a conclusion to this topic, we present the concept of game that we formulated based on the concept presented by Salen and Zimmerman (2004). We understand the game as being: **a system designed from the association between primary conceptual schemes to promote a ludic interaction in a "magic circle", allowing several experiences**. With this concept we are considering the game as a system, consisting of several parts that interact like gears of a machine. A system designed, that is, planned in detail. Projected from the primary schemes that, necessarily, are not limited to the schemes Rules, Playful Interaction, and Culture, but include them as a *sine qua non* condition. From this, we think that the system enables several interactions in fictitious space/time, promoting different types of experiences.

That said, we move to the next topic of the article to present the way we understand the conception of a pedagogical game, with an educational character that, in this case, enables learning experiences. This type of game, which, besides contemplating the primary schemes proposed by Salen and Zimmerman (2004), in its conception needs a specific primary scheme for the educational aspect. Because we feel this need, we propose the primary scheme Formal Education, presented from now on.

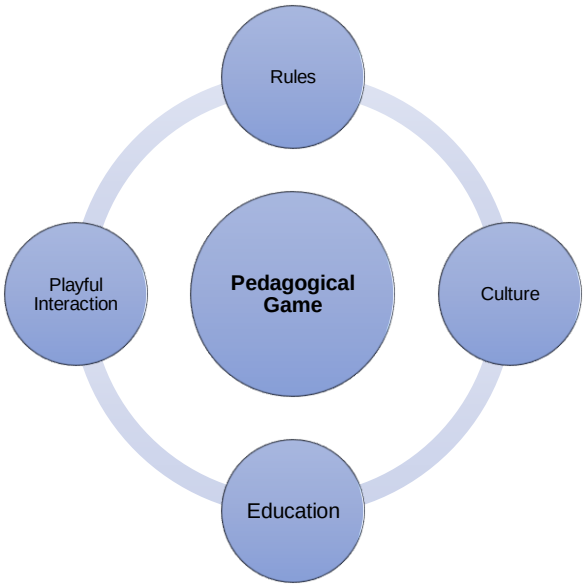
The primary scheme Formal Education

When we came across Salen and Zimmerman's (2004) concepts of primary schemes, proposed to think about the process of creation and analysis of a recreational game, we felt the need to build and propose a fourth scheme. This scheme, associated with the other three, would allow us to think about the process of creating and analyzing a pedagogical game, considering its peculiarity regarding the formalized educational purposes.

To plan, analyze, and build a pedagogical game demands that we consider, besides the Rules, the Playful Interaction, and Culture, the educational conceptual scheme. It demands, among other issues, to gather the students' previous knowledge, to master the specific content to be worked on in the game, and, above all, to be clear about the learning theory that will be the basis for the pedagogical actions. Therefore, considering these and other demands, we systematized them into what we are calling the Primary Formal Education scheme, that is, a conceptual structure that organizes several important characteristics, as conceptual sub-schemes that interrelate so that the possibilities of a good pedagogical game materialize.

We suggest that this scheme, as well as the others, be taken into consideration in the creative and evaluation process of games that fall into the group of pedagogical games, whether with the purpose of teaching concepts or reinforcing such process in a broader planning that involves different pedagogical approaches and methods. We argue that the process of creating a pedagogical game should be thought of from the four primary schemes that are equally associated: Rules, Playful Interaction, Culture, and Formal Education (**Figure 1**).

Figure 1: Illustration of the interaction between the four primary schemes



Source: prepared by the authors.

Before we enter the discussion about the characteristics of the primary scheme Formal Education, we propose to discuss a little about the term "education", since the scheme is directly related to it. In the LDBEN (BRASIL, 1996), we find in its first article, the understanding that "education comprises the formative processes that take place in family life, in human coexistence, at work, in teaching and research institutions, in social movements and civil society organizations, and in cultural manifestations. Based on Piaget (1982), we think that education, in fact, is a formative process. A process that seeks the adaptation of the subject to society. It involves development and construction. Which should promote the constant unbalancing of the subject, making it seek a new condition of balance. A dialogical social process that involves learning, which, in turn, demands teaching and interaction.

From the moment the school proposes to be a formal educational environment, through the coexistence and interaction between people with formalized knowledge, we have to be very careful with the process that will be developed there. The path to be followed for this process to happen must be very well constructed and outlined by the school's curriculum. Curriculum, which cannot and should not be understood simply as disciplinary "grids" that organize content in a semester schedule, but as a cultural product built by the struggle of the school in assigning its own meanings and symbolisms (LOPES; MACEDO, 2011).

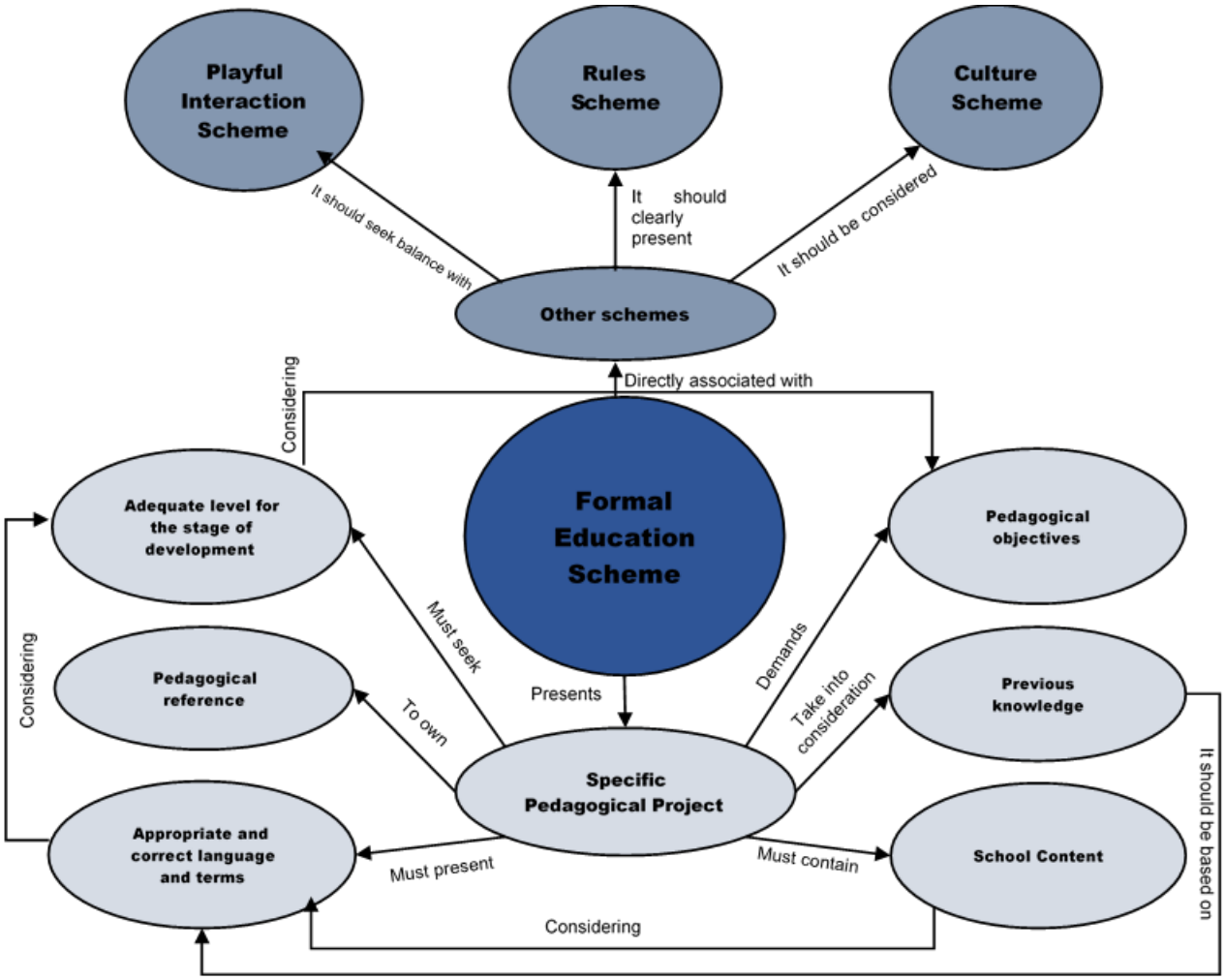
Considering the curriculum in the construction of meanings in school, we highlight the importance of strategies and teaching resources to be used to achieve this goal. In our case, under the Piagetian referential, we highlight that such strategies can remove students from the famous "comfort zone" in which they usually find themselves, and can unbalance them, provoking them to leave their passive conditions and act on the objects of knowledge, in search of organization and adaptation that will lead them to new rebalances, which will result in the learning process.

Among the various possible pedagogical strategies, we advocate the use of formalized educational games, especially educational games as part of a set of strategic situations that will be proposed for the teaching and learning process. About educational games, Soares (2013, p. 45) points out that they seek "[...] to bring the playful character of the game closer to the possibility of enhancing cognitive development. Therefore, when considering that the pedagogical game aims to develop cognitive skills, it is necessary to think about what should be considered as important at the time of its elaboration. And, precisely for this reason, we present our proposal.

We emphasize that, for us, the pedagogical game should be seen as a system designed to enable pedagogical experiences, however, it should be understood as part of a larger system that is the formalized educational process. In thinking like this, we emphasize that it is necessary to be clear that the presence/absence of pedagogical games in classrooms cannot be blamed for failures in the school teaching and learning process. The pedagogical game should not be seen as the panacea responsible for seeking the success of the whole process. That said, let's go to the characteristics of the Formal Education scheme!

When talking about a game with pedagogical purpose, it is important to know which constituent elements this game should have in order to state that it can be in a classroom, that is, that it is a formal pedagogical strategy. For a better understanding of what we are proposing, we have elaborated a conceptual diagram that seeks to present, in a related way, the main characteristics of the primary scheme Formal Education (**Figure 2**).

Figure 2: Diagram about the primary scheme Formal Education.



Source: prepared by the authors.

When seeking to build a pedagogical game, it is necessary to consider that, interdependently, the association of the Formal Education scheme with the other primary schemes should occur: Rules, Playful Interaction and Culture, because the game cannot fail to maintain its basic characteristics, even if with intended pedagogical objectives. In other words, the system should be designed considering the constructive and pedagogical interactions that will take place in the space of possibilities provided by the rules, the "magic circle", and the cultural elements that are part of the game.

The association of the Formal Education scheme with the Playful Interaction scheme leads us to consider the need for the pedagogical game to preserve the playful character, intrinsic to the game, and to add to it the pedagogical character. Soares (2013) states that a game with educational purposes must have a very well balanced didactic and playful character. We emphasize that the result of this balance, between the playful interaction experiences of the players and the specific knowledge, is what will result in the educational process. For this, we understand that it is necessary to carefully plan the types of playful interactions that can enable the pedagogical purpose. It is also worth pointing out that even if it is a pedagogical game, the players should feel like playing for the simple pleasure of playing.

Regarding the nature of the interactions, the planning of the game should be done with a lot of knowledge and care so that it fulfills the pedagogical purpose and, at the same time, is fun and pleasurable. In this case, the necessary knowledge we refer to is related to that of the game's theoretical field, which will subsidize the elaboration of the game following the necessary criteria so that it enables the ludic interaction in different ways, trying to contemplate all those involved, being, mainly, the players and, also, the master, narrator, organizer, or game facilitator, if any.

Another essential association to be considered is the Formal Education scheme with the Rules scheme, since pedagogical games, in general, are regulated games. In defense of rules, Soares (2013, p. 47) states that "[...] for a perfect relationship between the learner and the game, it is necessary to have rules, explicit or not [...]". The author also points out that "[...] for a game to work properly in the classroom, a good rule is necessary and it must be extremely clear. Many failures in the classroom are not caused by the game, but by the poor explanation and explicitness of the rules" (SOARES, 2013, p. 42-43).

Explicit rules need to be clear, present adequate language, and extensively clarifying how each participant should play. Moreover, depending on the type of game, the rules need to highlight the importance of being followed so that the game does not take other paths during its realization. Another point to consider about the rules is that they are responsible for keeping the players in the game, keeping the "magic circle" in action, so this also needs to be considered when creating a pedagogical game.

Finally, about the interaction between the schemes in the creative process, the Formal Education scheme should be directly associated with the Culture scheme. About this scheme, it only exists because the human being is a social being capable of learning and transmitting what he/she learned to the next generations, and the game is understood as a social practice transmitted throughout time. In this way, when we think about the association between the schemes, we understand that when we try to teach certain content with the use of games, we have both the content and the game itself imbricated in a culture. It is precisely this imbrication that allows us to contextualize the pedagogical game in a historical educational process.

Another important aspect of this association between the two conceptual schemes is in the fact that the Culture scheme presents possibilities of transformation and overcoming. Depending on the pedagogical objectives of the game, some aspects of culture may be more or less present in the game. For example, a pedagogical game that aims to work with certain issues of Human Genetics can deal with prejudices that are still very present in today's culture, such as racism.

Concomitant to these associations among the primary schemes, we propose that the Formal Education scheme bases the elaboration of the pedagogical game on its peculiar characteristics, which we are calling Specific Pedagogical Project. In it, we organize the general characteristics, the subschemes, as follows:

• **Pedagogical objectives** - a pedagogical game must have pedagogical objectives. With this, we need to pay attention to the need for careful planning of such objectives. Some questions should be a common practice in the initial process of developing the game, among them, we highlight: is it a game to work on the teaching of certain content (scientific concepts)? Memorization? Reinforcement? Learning evaluation? Who will the game be aimed at? For which educational level? What will be the teacher's participation?

For example, if we intend to work with the teaching of Natural Science concepts, we need to consider the need for the schooling of such concepts for the context of the game. This schooling of the content should take into account peculiar aspects that relate to the "what" and "how" one intends to teach. In the schooling of the content there is a transposition of knowledge so that it can be taught through games. For this knowledge to be properly transposed, it is necessary that the developers have the exact understanding that there is a difference between the scientific knowledge produced by scientists, the scientific knowledge transposed to Higher Education (offered in undergraduate courses) and the scientific knowledge transposed to Basic Education (offered in Elementary and Secondary School subjects), as this will avoid a greater "deformation" of knowledge, adapting it to the audience in question.

For the content to be taught, the educational game must present a storyline and/or an interaction dynamic that makes this possible. It is important to clarify that the pedagogical purpose of the game must be considered, such as teaching new concepts or just fixing and memorizing concepts that have been previously worked on. The game's script, as well as its dynamics, should always be elaborated taking into account the pedagogical objectives that are intended to be achieved; after all, the pedagogical character is what justifies the idea of a pedagogical game.

When thinking about the pedagogical character from a game, it is important to note that the game brings, intrinsically, a very significant feature to the teaching and learning process, which is the ability to arouse curiosity and interest. Soares (2013) highlights the advantage of working with the pedagogical game. For the author, the game is intrinsically interesting to the student, awakening the desire for the act of playing. Consequently, if the student is interested in the game, this interest may migrate to the content present in the game, which makes it advantageous in the learning process.

Besides this intrinsic interest in the game, Messeder-Neto (2016, p. 174) points out that in school "[...] the game is a way to help the teacher take the student by the hand and bring him/her to where he/she wants the student to arrive in the educational process." Our thinking is in line with that of the author, however, we emphasize the importance of the pedagogical objectives of the game being very clear. We assert, therefore, that the act of creating a pedagogical game should begin, like any other pedagogical act at school, with the pedagogical objectives that are intended to be achieved.

• **Prior knowledge** - we understand that this subscheme is directly associated with the pedagogical objectives, but does not necessarily precede them. For example, if you intend to teach certain scientific concepts with a game, this will be the goal and, from there, you should investigate the students' prior knowledge about the concepts.

Considering the educational process as an adaptation of the subject to society, through the innumerous processes of assimilation and accommodation to which he undergoes, it is important to understand how the individual's cognitive schemes are presented and organized for a certain type of knowledge. This way of presenting and organizing the subject's schemes, specific to a given subject, is what we call prior knowledge. This knowledge, regardless of the names it receives, has received a lot of attention in recent decades, in research focused on the teaching and learning processes of Natural Sciences, as we can see in Carvalho (1992), Delizoicov, Angotti and Pernambuco (2002), Vasconcelos, Praia and Almeida (2003), Cachapuz et al. (2005) and Silva and Soares (2013).

Seeking to know how the subject's cognitive structures are organized to relate to the objects of knowledge will provide subsidies that will contribute to the creative process of the pedagogical game, relating it to the intended objectives. The survey of the students' prior knowledge may allow the creator of the pedagogical game to think of interactive situations that promote imbalances from what the students have schemetized in relation to certain content.

Furthermore, it should be noted that the responsibility of formal education practiced in schools is with scientific knowledge, although it does not intend to, and should not, disregard other types of knowledge, such as popular knowledge. However, by checking the students' prior knowledge, it is possible to visualize which types of knowledge are prevailing in the process of building their conceptual meanings. Thus, it is possible to propose activities, such as the pedagogical game, that can directly intervene in the (re)construction of schemes, with emphasis on scientific knowledge.

Thus, we argue that the pedagogical game, built from the students' prior knowledge, may be more familiar to them and facilitate the process of knowledge construction and, consequently, learning.

• **School content -** since we are dealing with a game with pedagogical purposes, in the context of Formal Education, we have to be clear which school contents will be present in the game. Now, if the game is being designed with the purpose of promoting learning, it is crucial to be clear about what is expected to be learned.

The pedagogical game should have some school content to be learned, otherwise it ceases to be pedagogical. In this regard, Messeder-Neto (2016, p. 173-174) points out that "[...] the game needs to help the student in the appropriation of scientific knowledge, because only then it will be contributing to the psychic development and demanding from the student more than he can at the moment, always advancing to the study activity." However, the author points out that for this to happen it is necessary that the game is not empty of content. Therefore, the game planning should be attentive to the choices that will be made, at the risk of failing to build a pedagogical game, but only a recreational one.

The choice of the school content to be covered by the game is a process that demands a lot of care and attention, and it should be taken into account the domain of such knowledge by the creator of the educational game. Ideally, the knowledge should be directly associated with the curriculum that is the basis of the school unit. Moreover, that this content, when conceptual, has the commitment to scientific knowledge and that it is not transposed in the wrong way, coming much closer to a popular knowledge than to a scientific one, due to the deformations suffered.

Another aspect to be considered regarding the content is that, depending on its nature, it will be necessary that the game presents it in a logical sequence, so that it can make sense in the comprehension process. As with any other pedagogical strategy, some contents need to follow a sequence to become understandable and, above all, learned. For, in order to understand a certain concept, it will be necessary to have organized previous conceptual schemes.

• **Level appropriate to the stage of development -** this subscheme is also directly associated with the pedagogical objectives of the game, because when we think about the objectives, we must have clear the profile of the players for whom the game will be intended. We have already said that the pedagogical game must be able to involve the students in its plot, making them abstract from real life by immersing them in the imaginary situation that will be provided. For this, it is important that the game is appropriate to the development level of the players, considering the skills and cognitive abilities presented by them. After all, it is not by chance that the commercial games available in the market bring the recommended age for players.

Considering the specificity of the adopted theoretical referential, in our case Piaget, it is necessary to take into consideration the subject's development. For Piaget (1982) learning occurs from the development, therefore, if the subject has not developed enough, he or she will not have the cognitive capacity to understand and learn certain contents, such as complex concepts that require abstraction. In this case, there is no point in seeking the understanding of certain concepts by the students; the game should be adequate to the players, not the other way around! A game that presents content far beyond what can be understood may lead to lack of interest, become tiring, complicated, and possibly boring, which may break the "magic circle".

In this search for adequacy to the stage of development, the type of game should also be considered because, depending on the level of complexity, the players won't be able to play, or even if they do, they won't be able to achieve the pedagogical objectives that the game proposes. For example, it is useless to play chess with a 2-year-old child, much less to teach him/her a school content through the dynamics of the chess game.

Once the stage of development is taken into account, it is also necessary to consider how long the game will last. Depending on the age of the players the attention will be lost in a short time. Time may influence the types of playful interactions that will be achieved by the game. Tiredness can lead to disinterest, which in turn can lead to the breaking of the "magic circle". However, we are not saying that pedagogical games should be fast, we are just saying that game time should be thought of according to the developmental stage of the players. After all, even if some games are long, they can be dynamic and not tiring.

• **Appropriate language and terms -** something that is directly associated with the proposed contents in the educational game, is the care with the language and terms to be used. We could have even had this discussion within the "Schooling content" subproblem, however, we didn't because we are not only considering here the care with the content, but also with the game in general.

Appropriate language is very important when considering the schooling of the content in the game; if it is not understandable, given the different types of students' literacies, the content will not be learned. However, the appropriateness of the language does not mean that it should be simplified to the point of resembling the colloquial aspect, whose intention is to approach the students, but that it should consider their context and present a vocabulary that is compatible with their levels of understanding. Messeder-Neto (2016, p. 177) points out that "it is necessary that the concept that will be learned,

discussed or resumed is clear to the student throughout the game, otherwise it will not occupy a central place in the activity performed".

Careful choice of terminology is also very important. In certain areas, such as Biology, scientific knowledge is built with the use of many terminologies, many of which are difficult to understand. Therefore, when designing a game, it is important to consider whether there is a need to use certain terminology or not. Reflecting on the real meanings that may be attributed to the term during the game is an exercise that we recommend you do during the creative process.

It is important to point out that the more comprehensible the pedagogical game presents school content to the students, the better the chances of learning without deforming assimilations. Considering that deforming assimilations can contribute to the construction of schemes that will consolidate into misconceptions, or conceptual errors.

In addition to the care with the language and the terms related to the school content to be worked on in the game, we highlight the need for care that must also happen in relation to the use of language and terms appropriate to the school environment. After all, this is not a game designed for leisure time in informal spaces. In the school environment, good behavior should be valued and the use of certain terms, such as swear words, should be avoided. Unless one of the purposes of the game is to present a reflection on some contemporary cultural aspects, as in the case of understanding the game as an element of cultural transformation.

Another important aspect of the concern with language and terms, is related to the use of complicated terms in the elaboration of the rules. This should be avoided, because it is worth remembering that the rules need to be completely understandable for the smooth running of the game. If certain terms are far from the players' vocabulary, they will face difficulties understanding the mechanics of the game.

•**Pedagogical referential -** finally, as a specific pedagogical characteristic of the primary Formal Education scheme, we need to think about the referential that will support the planning of the teaching and learning process. We propose that the pedagogical game should be thought out from referentials that are directed towards what is intended to be achieved as a formalized educational activity. Something that should be natural, but unfortunately it is not.

Soares (2018, p. 235) points out that the proposals for formalized educational games that are based on some learning referential are still very incipient. For him "[...] it is important to point out that, in fact, there are few works that make a direct relationship of the game with some learning theory - mainly regarding Piagetian theory."

Rezende (2017) verified that the games used in the teaching of Chemistry, have used theoretical/epistemological references such as Piaget and Vygotsky, but the way the references have been appropriated by the games demonstrates the little concern of the authors with the learning theories. In many cases, games end up losing their pedagogical aspects.

Any formal education process needs to be based on specific theoretical references that discuss learning processes. Regardless of the theoretical framework adopted, it is necessary that the planning takes into account questions such as: how does learning occur? What is the participation of the student (subject)? What is the participation of the teacher? Where does the pedagogical game fit into the learning process? How can the pedagogical game contribute to learning? How will the relationship between the subject and the learning object occur through the pedagogical game?

These and other questions must be answered with the help of a consistent theoretical reference, which allows the person responsible for creating the game to find the best project to be developed to achieve the intended goals. In our work, we rely on Piaget as the reference that provided us with all the necessary answers to think about the pedagogical game, considering the conceptual elements of the Formal Education primary scheme. However, other references can be adopted, such as Vygotsky, Wallon (1879-1962), and Gagné (1916-2002), depending on the theoretical positions of those who are developing the game.

With this, we conclude the presentation of the primary scheme Formal Education, considering it as a conceptual scheme that can help in the planning, elaboration, and evaluation of pedagogical games. We hope that it can be useful for the elaboration of successful pedagogical games. We emphasize, however, that we are clear that even if the pedagogical game is of great quality, it will be the way it is used in the classroom that will determine its success. In this case, we prefer to keep the subjects of the relationship, students and teachers, in the spotlight.

FINAL CONSIDERATIONS

As teacher educators in the area of Natural Sciences, we presented our proposal considering the possibilities of using educational games to work in the teaching and learning of specific contents of this area. However, we do not rule out the possibility of using educational games for teaching and learning content related to any area present in the context of formal education, from kindergarten to college.

We hope that this work can contribute to the expansion of the theoretical discussion about formalized educational games, in order to reflect on the need to advance in the theoretical aspects related to this production, giving more theoretical density to the game, raising it to the condition of an important pedagogical strategy for the classroom.

* The translation of this article into English was funded by the Fundação de Amparo à Pesquisa do Estado de Minas Gerais – FAPEMIG – through the program of supporting the publication of institutional scientific journals.

REFERENCES

ANJOS, José Ayron Lira; GUIMARÃES, Ricardo Lima. Potenciais contribuições do jogo didático na perspectiva da teoria de aprendizagem de Gagné**.** *In*: CLEOPHAS, M. G.; SOARES, M. H.F.B. (Orgs). **Didatização Lúdica no ensino de Química/Ciências:** teorias de aprendizagem e outras interfaces. São Paulo: Editora Livraria da Física, 2018. p. 139-149.

ARAÚJO, Everaldo dos Santos.; SANTOS, Bianca Martins. JOGO DAS GRANDEZAS: UM RECURSO PARA O ENSINO DE FÍSICA. **Revista do Professor de Física**, [S. l.], v. 2, n. 2, 2018. DOI: 10.26512/rpf.v2i2.12079. Disponível em: https://periodicos.unb.br/index.php/rpf/article/view/12079. Acesso em: 3 março. 2020.

BODLEY, John H. **Cultural Anthropology:** Tribes, States, and the Global System. New York: McGraw-Hill Higher Education, 1994.

BRASIL. **Lei nº 9.394/96, de Diretrizes e Bases da Educação Nacional**. Brasília: Subsecretaria de Edições Técnicas, Diário Oficial da União, 23/12/ 96, Brasília – DF, 1996.

BROUGÈRE, Gilles**. Jogo e educação**. Trad. Patrícia C. Ramos. Porto Alegre: Artes Médicas, 1998.

_____. Lúdico e educação: novas perspectivas. **Linhas Críticas**, [S. l.], v. 8, n. 14, p. 5–20, 2002. DOI: 10.26512/lc.v8i14.2985. Disponível em: https://periodicos.unb.br/index.php/linhascriticas/article/view/2985. Acesso em: 5 março. 2020.

CACHAPUZ, Antônio; GIL-PEREZ, Daniel; CARVALHO, Anna Maria; PRAIA, João; VILCHES, Amparo. (Orgs.). **A necessária renovação do ensino das Ciências.** São Paulo: Cortez, 2005.

CAILLOIS, Roger. **Os jogos e os homens**: a máscara e a vertigem**.** Trad. por Maria Ferreira. Petrópolis, RJ: Editora Vozes, 2017.

CARVALHO, Anna Maria Pessoa. Construção do conhecimento e ensino de Ciências. **Em Aberto**, Brasília – DF, v. 11, n. 9, jul./set., 1992. DOI: http://dx.doi.org/10.24109/2176-6673.emaberto.11i55.1852. Disponível em: http://rbepold.inep.gov.br/index.php/emaberto/article/view/1852. Acesso em: 5 março. 2020.

CUNHA, Marcia Borin. Jogos no Ensino de Química: Considerações Teóricas para sua Utilização em Sala de Aula. **Química Nova na Escola**, São Paulo - SP: SBQ, v.34, n.2, p. 92-98, maio, 2012. Disponível em: http://qnesc.sbq.org.br/online/qnesc34_2/07-PE-53-11.pdf. Acesso em: 3 março. 2020.

CHATEAU, Jean. **O jogo e a criança.** Trad. por Guido de Almeida, São Paulo: Summus, 1987.

CLEOPHAS, Maria das Graças; CAVALCANTI, Eduardo Luiz Dias; SOARES, Márlon Herbert Flora Barbosa. Afinal de contas, é jogo educativo, didático ou pedagógico no ensino de Química/Ciências? Colocando os pingos nos "is". *In:* CLEOPHAS, Maria das Graças; SOARES, Márlon Herbert Flora Barbosa (Orgs). **Didatização Lúdica no ensino de Química/Ciências:** teorias de aprendizagem e outras interfaces. São Paulo: Editora Livraria da Física, 2018. p. 33-43.

DELIZOICOV, Demétrio; ANGOTTI, José André; PERNAMBUCO, Marta Maria. **Ensino de Ciências:** fundamentos e métodos. São Paulo: Cortez, 2002.

DUARTE, Thiago Sousa; BATISTA, Daniele Mesquita; JESUS, Andressa Kelly Silva; MEDEIROS, Maria Helena; OKADA, Yukari; IKETANI, Gabriel. Roleta da Evolução: uma ferramenta didática para o ensino de Biologia no Ensino Médio. *In:* ENCONTRO NACIONAL DE PESQUISA EM EDUCAÇÃO EM CIÊNCIAS, 11., Florianópolis, 2017. **Anais do XI Encontro Nacional de Pesquisa em Educação em Ciências** – XI ENPEC - Universidade Federal de Santa Catarina, Florianópolis, SC, 2017.

GALVÃO, Mayra de Freitas; BASTOS, Rafael Wesley; MOREIRA, Fabiana Freitas; RODRIGUES, Adriana de Castro; YOTOKO, Karla Suemy Clemente. Jogo da Evolução. **Genética na Escola**. Sociedade Brasileira de Genética, v. 7, n. 2, p. 66-73, 2012. Disponível em: https://7ced070d-0e5f-43ae-9b1c-aef006b093c9.filesusr.com/ugd/b703be_293e65d230354d2ba43b50ae10f41336.pdf. Acesso em: 10 março. 2020.

HOUAISS, Antônio. **Dicionário Eletrônico Houaiss da Língua Portuguesa**. Rio de Janeiro: Objetiva, 2009. *E-book*.

HUIZINGA, Johan. ***Homo ludens:*** o jogo como elemento da cultura. Trad. por João Paulo Monteiro, 7ª ed., São Paulo: Perspectiva, 2012.

KISHIMOTO, Tizuko Morchida. O jogo e a Educação infantil. *In:* KISHIMOTO, Tizuko Morchida (org.) **Jogo, brinquedo, brincadeira e educação.** 14ª ed., São Paulo: Cortez, 2011. p. 15-48.

LOCATELLI, Solange Wagner. Jogo e ensino de Química: uma relação metacognitiva no processo de aprendizagem. *In:* CLEOPHAS, Maria das Graças; SOARES, Márlon Herbert Flora Barbosa (Orgs). **Didatização Lúdica no ensino de Química/Ciências:** teorias de aprendizagem e outras interfaces. São Paulo: Editora Livraria da Física, 2018. p. 153-165.

LOPES, Alice Casimiro; MACEDO, Elizabeth. **Teorias de Currículo**. São Paulo: Cortez, 2011.

MESSEDER-NETO, Hélio da Silva. **O lúdico no ensino de Química na perspectiva histórico-cultural:** além do espetáculo, além da aparência. Curitiba: Editora Prismas, 2016.

MIRANDA, Ana Flávia Souza. **Jogos pedagógicos no processo de ensino e aprendizagem em Química na modalidade Educação de Jovens e Adultos**. 2015. Dissertação (Mestrado em Educação em Ciências). Universidade Federal de Goiás – UFG, Goiânia – GO, 2015.

PIAGET, Jean. **A formação do símbolo na criança:** imitação, jogo e sonho, imagem e representação. Trad. por Álvaro Cabral e Christiano Monteiro Oiticica. 3ª ed., Rio de Janeiro: Zahar Editores, 1978.

_____. Epistemologia Genética. *In:* EVANS, Richard I. **Jean Piaget:** o homem e suas ideias. Trad. por Angela Oiticica. Rio de Janeiro: Forense-Universitária, 1980.

_____. **Psicologia e Pedagogia.** Trad. por Dirceu Accioly Lindoso e Rosa Maria Ribeiro da Silva. Rio de Janeiro: Forense Universitária, 1982.

_____. **O nascimento da inteligência na criança**. Trad. por Álvaro Cabral. 4ª ed., Rio de Janeiro: LTC, 1987.

REZENDE, Felipe Augusto de Mello. **Jogos no ensino de Química**: um estudo sobre a presença/ausência de teorias de ensino e aprendizagem à luz do V epistemológico de Gowin. 2017. Dissertação (Mestrado em Educação em Ciências e Matemática) – Universidade Federal de Goiás – UFG, Goiânia – GO, 2017.

REZENDE, Felipe Augusto de Mello; CARVALHO, Christina V. M.; GONTIJO, Lucas C.; SOARES, Márlon Herbert Flora Barbosa. RaioQuiz: Discussão de um conceito de propriedade periódica por meio de um jogo educativo. **Química Nova na Escola**, vol. 41, n. 3, p. 248-258, 2019. DOI: http://dx.doi.org/10.21577/0104-8899.20160149. Disponível em: http://qnesc.sbq.org.br/online/qnesc41_3/07-RSA-19-18.pdf. Acesso em: 15 janeiro. 2020.

SALEN, Katie; ZIMMERMAN, Eric. **Rules of play:** game design fundamentals. Cambridge, MA: The MIT Press, 2004.

_____. **Regras do jogo**: fundamentos do design de jogos. Principais conceitos, vol. 1. Trad. por Edson Furmankiewicz. São Paulo: Blucher, 2012a.

_____. **Regras do jogo**: fundamentos do design de jogos. Regras, vol. 2. Trad. por Edson Furmankiewicz. São Paulo: Blucher, 2012b.

_____. **Regras do jogo**: fundamentos do design de jogos. Interação Lúdica, vol. 3. Trad. por Edson Furmankiewicz. São Paulo: Blucher, 2012c.

_____. **Regras do jogo**: fundamentos do design de jogos. Cultura, vol. 4. Trad. por Edson Furmankiewicz. São Paulo: Blucher, 2012d.

SILVA, Vitor de Almeida; SOARES, Márlon Herbert Flora Barbosa. Conhecimento Prévio, Caráter Histórico e Conceitos Científicos. **Química Nova na Escola**. v. 35, n 3., p. 209-219, 2013. Disponível em: http://qnesc.sbq.org.br/online/qnesc35_3/10-PE-04-12.pdf. Acesso em: 10 janeiro. 2020.

SOARES, Márlon Herbert Flora Barbosa. **O lúdico em Química:** jogos e atividades aplicados ao Ensino de Química. 2004. Tese (Doutorado em Ciências) – Instituto de Química, Universidade Federal de São Carlos, São Carlos – SP, 2004.

_____. **Jogos e Atividades Lúdicas para o ensino de Química**. Goiânia: Kelps, 2013.

_____. O jogo e suas possíveis relações com a Epistemologia Genética de Jean Piaget: em um tabuleiro de xadrez. *In:* CLEOPHAS, Maria das Graças; SOARES, Márlon Flora Barbosa Soares. (Orgs). **Didatização Lúdica no ensino de Química/Ciências:** teorias de aprendizagem e outras interfaces. São Paulo: Editora Livraria da Física, 2018. p. 235-248.

VASCONCELOS, Clara; PRAIA, João Félix; ALMEIDA, Leandro S. Teorias de aprendizagem e o ensino/aprendizagem das ciências: da instrução à aprendizagem. **Psicol. esc. educ.**, Campinas, v. 7, n. 1, p. 11-19, jun. 2003. Disponível em <http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S141385572003000100002&lng=pt&nrm=iso>. Acesso em: 10 março. 2020.

Submitted: 28/08/2020
Approved: 10/03/2021