PROGRAMA DE PÓS-GRADUAÇÃO EM EDUCAÇÃO
EDUCAÇÃO EM FOCO | UEMG

Análise do potencial educativo de um jogo eletrônico comercial

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Resumo

Os jogos eletrônicos se destacam entre os interesses dos jovens e vários jogos eletrônicos são utilizados como recursos pedagógicos pelo seu potencial educativo. Dessa forma, foi pretendido analisar o potencial educativo de um jogo eletrônico comercial para o desenvolvimento cognitivo e afetivo dos jogadores. Para isso, foi realizada uma análise qualitativa, baseada na perspectiva tridimensional da Análise Crítica do Discurso. Foi verificado que o potencial educativo do jogo eletrônico analisado reside na temática abordada, nas instruções fornecidas, nas possibilidades de generalização das estratégias de resolução dos problemas apresentados, e pode variar conforme aspectos como o momento de desenvolvimento psicológico do jogador e o contexto deste. Foi concluído que o jogo eletrônico analisado é capaz de agir sobre a zona de desenvolvimento proximal de um indivíduo na condição de um instrumento de mediação entre ele e os conteúdos que perpassam pela narrativa do jogo.

Palavras-chave: Educação. Jogos eletrônicos. Psicologia.

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Analysis of the educational potential of a commercial electronic game

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Abstract
Electronic games stand out among the interests of young people and several electronic games are used as pedagogical resources for their educational potential. Thus, we set out to analyze the educational potential of a commercial game for the cognitive and affective development of its players. For this, a qualitative analysis was carried out, based on the three-dimensional perspective of Critical Discourse Analysis. It was found that the educational potential of the electronic game analyzed lies in the themes it approaches, in the instructions provided, in the possibilities of generalizing the strategies for solving the problems it presents, and may vary according to aspects such as the player's stage of psychological development and context. It was concluded that the electronic game analyzed is capable of acting on an individual's zone of proximal development, as an instrument of mediation between them and the content experienced throughout the electronic game's narrative.

Keywords: Education. Electronic Games. Psychology.

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Análisis del potencial educativo de un juego electrónico comercial

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Resumen
Los juegos electrónicos destacan entre los intereses de los jóvenes y son utilizados como recursos pedagógicos por su potencial educativo. Así, se pretendió analizar el potencial educativo de un juego electrónico comercial para el desarrollo cognitivo y afectivo de los jugadores. Para eso, se realizó un análisis cualitativo, fundamentado en la perspectiva tridimensional del Análisis Crítico del Discurso. Se verificó que la potencialidad educativa del juego electrónico analizado se encuentra en la temática del jugo, en las instrucciones impartidas, en las posibilidades de generalizar las estrategias para la resolución de los problemas presentados, y pueden variar según aspectos como el momento del desarrollo psicológico del jugador y su contexto. Se concluyó que el juego electrónico analizado es capaz de actuar sobre la zona de desarrollo proximal del individuo como instrumento de mediación entre él y los contenidos que transitan la narrativa del juego.

Palabras clave: Educación. Juegos electrónicos. Psicología.

Introduction

Currently, video games (VG) have taken a prominent position among the interests of people of various ages, drawing the attention of diverse sectors, such as the economic and media sectors, in order to exploit them as valuable resources in the pursuit of increasing engagement with a product or brand. The same is true in the educational field: games (of various types, whether electronic or not) have been used as a pedagogical strategy to stimulate students' engagement with proposed content.

Research by Rizzini et al. (2005) highlighted the significant presence of video games in the daily lives of young people. The data from the study show that, of the 949 middle-class youths surveyed, aged between 11 and 17, 72% had access to video game devices, and 47.8% to computer games.

The work of Oliveira (2017), conducted with 60 adolescents in vulnerable situations, aged 14 to 18, demonstrated that 93% of respondents played video games in the year prior to the publication of the research. Most players accessed games via a computer (71.9%), video game consoles (71.9%), or mobile phones (68.4%). In the same study, the average maximum number of consecutive hours that adolescents reported playing without stopping was five hours. This information illustrates a scenario in which these technologies are also present among the more popular strata of society and are commonly used by young people from these classes to access games.

A third data collection that contributes to our understanding of the strong presence of video games (VG) in the lives of young people is the Game Brasil 2020 Survey (PGB20), conducted by Sioux Group (2020), with 5,830 participants from different regions of the country in an online format. This data indicates that: 73.4% of respondents play some type of video game; for 57.1% of them, this type of game is the main form of entertainment; and 69.3% of participants were aged between 16 and 34 years.

On one hand, Santos and Souza (2016) warn of the health risks and cognitive development issues related to prolonged daily exposure to video games; on the other hand, there is no doubt that they have become a part of the lives of adolescents, young people, and adults, and that more studies are needed to verify the different effects of these games on this population.

The intensification of video game consumption and the amount of time spent on this type of activity indicate that video games are engaging enough to generate hours of involvement. This has drawn the attention of various sectors to the use of video games for purposes beyond mere entertainment or escapism, but for solving real-world problems, as argued by McGonigal (2012).

Fanaya (2018) points out that by attracting players' attention to understand the rules and successfully solve the challenges presented, games generally have the potential to generate engagement and improve user performance in physical and cognitive aspects, such as bodily skills, focus, self-determination, self-regulation, and self-motivation. These aspects justify the appropriation of games or the logic of games in other non-gaming contexts, such as business or educational environments, where individuals are often evaluated based on their level of engagement and performance.

In the educational context, the use of video games as a pedagogical resource has been analyzed by researchers from different theoretical and methodological approaches, intending to understand how they can serve educational purposes through the cognitive and emotional stimulation they provoke in players (CHOU, 2019; DIANA et al., 2014; FARDO, 2013; MATTAR, 2010; MCGONIGAL, 2012; RIBEIRO, 2016).

Carvalho, Pedrosa, and Rosado (2017) investigated how the production of video games functions and how they receive the educational label to understand what characterizes a game as educational. They found generalized responses, such as the presence of the same content from the game in the school curriculum or the participation of an educator who distributed materials on Vygotsky and Piaget to the game developers. The authors concluded that "the declaration of a game as educational is, to some extent, a simple process, with a set of underlying ideas in this attribution of meaning to the produced game" (CARVALHO; PEDROSA; ROSADO, 2017, p. 384), demonstrating that there are difficulties in defining a video game as educational and that the criteria used for such are subjective and circumstantial.

In this sense, the research by Ribeiro et al. (2015), which aimed to depict an overview of studies on games labeled as educational in Brazil, contributed by pointing out an important issue: 40.74% of the 27 studies analyzed addressed educational games that did not explicitly present any learning theory in their theoretical foundation, reinforcing the argument that the criteria used to evaluate a game as educational or non-educational are subjective and circumstantial. In other words, they refer much more to how they are used, for example, as auxiliary resources to address a theme in the classroom, rather than the proposition of educational content in itself, as proposed by the game.

Thus, it is understood that the subjectivity and circumstantiality in classifying a video game as educational are related to the evaluator's conception of what constitutes education and which aspects of the game are or are not encompassed by this conception. Furthermore, the proponent's conception of education may be based on common sense ideals or guided by learning and development theories that provide support for forming and evaluating theoretical and scientific criteria regarding: what learning is; what education is; what development is; and how these concepts are or are not related.

Aguiar (2010) proposed an evaluation model for educational games from the perspective of game design. She suggested a model in the form of a spreadsheet in which four sections can be evaluated based on a scale from 0 to 4, where 0 indicates that the requirement has not been met and 4 indicates that the requirement has been fully achieved. The proposed sections for analysis with their respective evaluation sub-items were: 1) Game Data, which registers identification and location information for the game; 2) Functional Specifications, through which aspects related to the tutorial, interface, mechanics, goals, and functionality of the game can be evaluated; 3) Content Requirements, which assess aspects such as ethical principles, citizenship and social coexistence, accessibility, pedagogical proposal, theoretical-methodological coherence, and concepts, information, and procedures; 4) Intrinsic Motivation, which encompasses challenges, fantasy, curiosity, control, and interpersonal motivation, in the case of multiplayer games.

Medeiros and Schimiguel (2012) proposed a model to assist teachers in evaluating educational video games. Their proposal, based on the Learning Object Review Instrument (LORI) and GameFlow methodologies, encompassed nine criteria to be evaluated descriptively: content quality; alignment of learning objectives; motivation; immersion; clear objectives; feedback and adaptation; presentation; social interaction; and reusability.

Both Aguiar (2010) and Medeiros and Schimiguel (2012) focused on ways to evaluate educational games, that is, those produced with the intention of being used pedagogically. As for commercial video games: do they also possess educational potential?

To contribute to clarifying this question, a commercial game not classified as educational was selected for this study, aiming to analyze the educational potential of a commercial video game for the cognitive and emotional development of players. The analysis was conducted from the perspective of Historical-Cultural Psychology, with the aid of a model inspired by the three-dimensional approach of Fairclough's Critical Discourse Analysis (2001).

Methodology

The video game Chronology was selected as the object of study for convenience. The game was specifically chosen for the following reasons: it was possible to play it; it is sold at an affordable price on the online platform Steam,[4] making it easily accessible for interested players, with the potential to

[4] The video game cost R$ 10.45 on 09/03/2021. Available at: https://store.steampowered.com/app /269330/Chronology/

reach a large number of young players and the ability to access feedback provided by them on the platform; express permission was granted by the game developers to use it in this study; and it was considered to retain the essential properties of a conventional game, namely: interactive narrative with clear objectives; tutorials for developing mechanical skills and/or game rules; challenges; and a system of progression and rewards (BUSARELLO; ULBRICHT; FADEL, 2014).

The participants in the research were two of the researchers. One took on the role of the player, whose function was to explore the game, while the other acted as an observer, recording information perceived in the player's interaction with the video game. Access to the game was made via a computer, with the game already installed. An Xbox 360 joystick was used for the players' interaction with the game interface; however, this interaction could also be performed using the computer keyboard or a mobile device screen.

When investigating the educational potential of the game, the aim was to identify elements capable of contributing to the cognitive and emotional development of the players—essential criteria in an educational conception based on the premise that education is a process of intentional mediation aimed at developing psychological faculties (affective and/or cognitive) relevant to living within a culture. Thus, the study was characterized as a qualitative analysis with exploratory and descriptive reach, given the analysis of the educational potential of commercial games - a topic still little explored in the educational field - with the purpose of providing detailed descriptions of the properties and characteristics of the analyzed object (SAMPIERI; COLLADO; LUCIO, 2013).

To proceed with the analysis, a model was created inspired by Fairclough's (2001) three-dimensional perspective of discourse, a methodology for data collection/production and analysis composed of three levels—text, discursive practice, and social practice—that do not overlap linearly but rather dialectically constitute what is understood as discourse in this semiotic approach.

In other words, the game's narrative (text) is constituted from the transfiguration of elements of reality, which can be accessed and interpreted by the player according to their subjective conditions, including their command of language and other socially shared resources that help them interpret elements of reality and the game, intersecting these two dimensions and recognizing the movements of continuity and rupture, coherence and contradictions inherent in each of these dimensions (discursive practice). This experience, formed in the realm of discursive practice, can be extrapolated and generalized to strategies that may be used in real situations, that is, in the everyday activities of individuals (social practice).

The model inspired by Fairclough (2001) and Historical-Cultural Psychology involves the collection and analysis of data regarding the context of production, structure, distribution,

consumption, and educational potential of the game to determine whether it reinforces stereotypes or transfigures existing conventions, generating new meanings and learning experiences.

In the dimension of production, the way producers convey their worldview is interpreted, which can be done through the description of the general characteristics and narrative of the game. In the dimension of structure, the aim is to grasp the characteristics and properties that comprise the analyzed game. In the dimension of distribution, the investigation focuses on the target audience of the game and the forms/media through which it circulates. Regarding consumption, the aim is to understand what the game offers to its target audience and how this audience evaluates the game in question. Additionally, there is a fifth and especially important dimension: the educational potential of the game, which should synthesize the cognitive and affective aspects potentially conducive to learning and development in the player's relationship with the game.

The strategy used to produce the model consisted, first, of defining what was to be observed: the educational potential of the game in psychomotor, cognitive, and affective dimensions. With this definition, the logic of the Marxist dialectical method of moving from the abstract to the concretely thought was followed. Thus, the actual act of playing the game was carried out, taking notes on possible events with educational potential (empirical concrete). Next, the information about the game was organized in the form of a table summarizing the aspects to be analyzed, before proceeding with the analysis (thought concrete, mediated by the abstract).

The procedures carried out in the analysis were: a) the development of the model with the selection, organization, and interpretation of general information; b) analysis of the cognitive and affective aspects addressed by the game. The resources that supported the analysis included information available on the developer's and distributor's websites, as well as the inclusion of four screenshots (a technique based on visual screen capture at moments when the variables appear) to support the reasoning developed.

Results and discussion

Following the procedures proposed in the methodology, we begin with the presentation of general information, then proceed to the description of the narrative with the selected images, and finally, conduct the analysis to verify the educational potential of the game for the players.

Analysis of the General Information of the Game

On the developer's website, the following definition for Chronology can be found:

> Chronology is a mind-blowing blend of puzzles, platforming, and adventure where you challenge time by manipulating the past and the future to fix the present. Play as the Old Inventor and his assistant, The Snail, and enjoy their special abilities—travel back and forth in time, stop time, manipulate objects, and solve puzzles (BADTIME DIGITAL GAMES, 2019, online, our translation).

Although it combines fantasy and science fiction, the game's narrative alludes, semiotically, to the appreciation of scientific discourse, represented by the moments in which the main character refers to the laws of Physics, evident both in the ways of thinking and acting of this character and in the construction of the setting.

The information available on the developer's and distributor's websites, along with other relevant information for the analysis, has been organized in the model presented in Table 1 below:

Table 1 – Model for Analyzing the Game Chronology

A. IDENTIFICATION AND PRODUCTION DATA OF THE GAME
● **Name:** Chronology ● **Expected playtime:** 2 to 4 hours, depending on familiarity with the game**.** ● **Release date:** 12/05/2014**.** ● **Producer/Distributor:** Badtime Digital Games ● **Genre:** Adventure, indie (abbreviation for independent).
B. DISTRIBUTION AND CONSUMPTION OF THE GAME
● **Platforms:** Computers and mobile devices**.** ● **Interface:** 2D cartoon; subtitles in the language selected in the game settings**.** ● **Distribution channels:** Steam, App Store, Windows Phone, and Google Play**.** ● **Target audience:** No specific age range indicated**.** ● **Rating:** 90% positive from 264 reviews (reported by the Steam platform in 2021).
C. STRUCTURE OF THE GAME
● **Items in the main menu:** Play (start the game); Chapter (select a specific chapter to start the game, available after completing the game once); Settings (settings for sound effects volume, available languages, subtitles, screen resolution, and action buttons for each character); Credits (team responsible for production and distribution); Exit (leave the game). ● **Characters:** Old Inventor (the main character. He is an elderly man with white hair, wearing a red hat and aviator glasses, along with a scarf, brown jacket, gray t-shirt, green pants, and brown shoes. His main features include a large red nose and a thick mustache) and Snail (his companion, characterized by an orange color and possessing a metal shell). ● **Resources available during the game:** Clock (an object used for time transition between past and future); consciousness exchange between Old Inventor and The Snail; The Snail's shell (capable of freezing time). ● **Number of levels:** Eight chapters. ● **Types of challenges:** Puzzles and riddles; jumping over cliffs, constructions, or holes. ● **Feedback and/or rewards system:** Feedback is perceived by the player themselves, with their mistakes and successes allowing progress in the narrative. There are no reward systems (scores, badges, or special item gains), only skills unlocked as the narrative progresses.
D. EDUCATIONAL POTENTIAL OF THE GAME
● **Game Characteristics:** It is a voluntary activity; the narrative presents some elements of reality, but in a cartoon format; it has a defined duration; it is a role-playing game with rules, where the player takes control of the Old Inventor and must solve challenges within the conditions established by the game's mechanics and dynamics. ● **Game Mechanics:** Tutorials for each new function/skill/item available (mediation); a system of rules that limits/defines actions (self-regulation); symbols that guide the player's conduct. ● **Objective:** Solve puzzles using the resources provided; explore different elements from various cultures and time periods.

- **Stimulated Functions**:
  - Psicomotoras: coordenação entre pensamento e motricidade para executar os comandos (combinações de botões e funções);
  - Cognitivas: percepção e atenção concentrada para perceber as informações, nuances, detalhes e dicas disponíveis no cenário; memória para recuperar as funções operacionais das habilidades e comandos aprendidos, pensamento por conceitos para poder utilizar as habilidades de diferentes formas nos contextos e desafios diversos; linguagem para compreender a narrativa e aprender com os tutoriais disponibilizados; imaginação e criatividade para recombinar as habilidades aprendidas desenvolvendo novas estratégias de resolução de problemas, adequadas conforme o grau de dificuldade dos desafios e os recursos disponíveis.
  - Afetivas: evocação de memórias afetivas que aparecem na forma da emoção do jogador ao cumprir os desafios; ao se deparar com laços afetivos do personagem protagonista em relação às outras personagens do game; e do jogador em relação ao personagem protagonista e aos demais.

Source: produced by the authors, 2021.

Table 1, above, functioning as an organizer of the information produced about the game, allowed for the continuation of the analysis of its component parts namely: items A, B, C, and D. It is important to clarify that this table is not merely a reproducer of the collected information but is itself a product of abstraction and concretion of thought, converted into an analytical tool. In other words, the structure of Table 1 was outlined according to the proposed analysis model to enable a comprehensive view of the aspects intended for analysis; the information contained therein is not merely a reflection of its sources but syntheses of the experience in the research conducted, such that the table itself is part of and initiates the movement of analysis.

Items A, B, and C of Table 1, above, were developed based on Fairclough's (2001) recommendations for selecting and organizing information for analysis. The information presented in these items makes it possible to identify the game, understand its component parts, and situate it culturally and historically. Item D was constructed based on the identification of the basic elements of games described by Huizinga (2018) and the considerations made by Elkonin (2009). The psychological functions considered in item D were selected based on the definitions of higher psychological functions described and explained by Vygotsky (1991).

According to Huizinga (2018), the characteristics of play include: being a voluntary activity linked to free choice; allowing an escape from reality into a temporary sphere of activity, as if it were a break in everyday life that enables the player's immersion; presenting elements that distinguish it from "common" life; being spatially and temporally bounded; allowing for the creation and adherence to rules and orderings; and facilitating the emergence of social groups that differentiate from the rest of society.

Elkonin (2009) proposed the following theses that underpin the analysis conducted: the role (assumed by the player) is the fundamental unit of the game; the fundamental content of play is the

human being; play produces psychological development. It is worth noting that, although the author specifically refers to the relationship of children with play, we believe that his theses can be applied at any moment in a person's life when, in a playful experience, they develop resources to reorganize their behavior and, as a result, can overcome a challenge that arises.

It is well known that both authors, Huizinga (2018) and Elkonin (2009), do not specifically discuss video games, but rather address the general characteristics of games that are also applicable to video games for this reason.

Analysis of the Context of Production and Distribution of the Game

In the first stage, an effort was made to synthesize the data allocated in items A and B of the model presented in Table 1, which assists the analyst in the task of sketching, mentally, the 'unsaid' by the video game what is not evident but contributes to its creative process and the achievement of the message within the narrative.

The developer (Badtime Digital Games) is a Danish video game company founded in 2011 by amateur game design students in the indie style, initially targeting an audience that appreciates products or cultural styles distinct from mainstream ones, identifying with the different forms and possibilities of attitudes, thoughts, or behaviors provided by the video game.

The company facilitates various mass distribution methods for the product (Steam, App Store, Windows Phone, and Google Play), demonstrating the intention to popularize and expand the product's reach. This strategy is convenient for its survival in the capitalist world, although it comes with a cost - not only in terms of production but also identity - related to the identity issue that supposedly attracts the indie audience. On the other hand, this contradiction may signify the propagation of the indie style[5] through the video game.

It is also noted that the video game Chronology is relatively recent, having been made available in 2014 for play on digital interfaces, via computer or mobile device. During this period, there is a high consumption rate of digital products, such as smartphones, tablets, and other forms of portable computing (SIOUX GROUP, 2020), which have become more accessible to the general population, offering everything from basic models to more sophisticated ones in terms of features, but in both cases, with configurations that allow access to certain applications and types of games (QUEIROZ, 2018).

[5] Indie is the abbreviation of the English term "independent." Initially, the term was used to refer to a movement of musicians who conceptually opposed the massification promoted by major record labels and distributors (HESMONDHALGH, 1997). This same meaning has been imported into the context of video games.

As of 2021, the game received 264 reviews, of which 90% were rated by the players themselves as very positive. The reviews are public and available on the Steam platform, and it is evident from the arguments used in the review messages that several of them were made by players who already possess a high level of conceptual thinking and are experienced in video games.

Game Analysis

In this stage, the focus was on understanding the structure of the video game and how it provides experiences that potentially stimulate the cognitive and affective functions of the players. It was necessary to play the game in full twice: the first time for recognition and the second time to note the most significant moments of stimulation of the functions as they appeared in the game. Thus, having a partner to assist in observing and recording the phenomena was a significant advantage. Following that, the collected information was integrated with the experience of having played the game and the data presented in items C and D of Table 1, provided above, along with the support of a theoretical framework to understand the occurring phenomena.

It is evident that the video game under analysis features a cartoon style, which can be characterized as a simplified representation of the main characteristics of a reality, aiming to provide recognition of the represented elements and be more attractive to its viewers. Illustrator Cabral (2013), in his online tutorial on how to draw cartoons, clarifies that this type of drawing often targets children and that great masters of cartooning, such as Walt Disney, Hanna-Barbera, and Walter Lantz, dedicated themselves to studying children's perception to construct their works.

Despite having a graphic and sound design that resembles that of a cartoon, appealing to children, the video game in question – Chronology - presents situations involving puzzles and riddles that, to be solved, constantly require conceptual thinking and both inductive and deductive logical reasoning, which tend to be more developed starting from adolescence.

The game provides tutorials on how to utilize the available resources, but the hints for solving the problems are quite subtle, lacking any type of luminescence or arrows to highlight them. They may appear in the form of a discreet sign placed in some part of the scene, which can only be noticed with a certain degree of concentration. If the player does not master the available resources and cannot use logical reasoning to identify the opportunities for action at the right time and place, they will struggle to solve the problems and progress in the game.

At this point, we highlight the educational potential of the analyzed video game as a stimulator of conceptual thinking. Vygotsky (1996, p. 196) points out that "[...] the function of concept formation

is not only related to the development of other functions such as memory, attention, and perception of reality [...] but also to the development of personality and the worldview."

Personality and worldview are crucial elements for an individual's integration into society and are developed precisely through the subjects' relationship with culture, especially through the educational processes that permeate various spheres of cultural life.

The cognitive functions highlighted by Vygotsky (1996) are constantly stimulated in the practice of the analyzed video game. There are moments in the game where it is necessary, for example, to position the character at a specific angle or position for progression in the level to be possible. As the player is instructed by the tutorial and gains experience dealing with obstacles, they may become capable of forming or evoking previously established conceptual systems to assist them in overcoming these challenges. They need to have a notion, for instance, of the height, speed, and minimum and maximum length that the character can jump to reach a certain place, and prior to that, they need to have personal experience and memory of the possibility of performing certain actions, such as jumping over a gap or climbing onto a platform, for example.

Thus, players of different ages tend to focus on different aspects of the game—not because of age itself, but because, according to the periodization of human development proposed by Elkonin (1987), at each stage of life, certain activities have the potential to generate learning and guide human cognitive and affective development toward new, superior possibilities in form and content. This occurs because people's motivation changes as they mature and gain access to new environments, relationships, and cultural resources, directing their focus of interest and attention to activities related to this new phase of their lives. Therefore, at different moments in life, the way a player perceives, interacts with, and interprets the game may vary, and this variation has the potential to alter how they relate to the video game and to concrete reality, generating an upward spiral of cognitive and affective development.

Analyzing aspects related to games as activities of the human psyche, Elkonin (2009, p. 23) explains:

> Of course, every activity, and play is no exception, can be decomposed into a sum of faculties: perception + memory + thought + imagination; it may even be possible to determine with a certain degree of accuracy the weight of each of these processes at various stages of the development of one game or another. However, when decomposed into elements, play completely loses its original qualitative nature as a unique activity of the child, as a special form of their life and their connection to the surrounding reality. Even if we were able to find ways to determine with sufficient precision the weight of each psychic process in each type of activity and thus demonstrate that in different types of activity the proportion of these processes is different, we still would not be able to understand the nature and qualitative originality of each of these types of activity, and in particular, the nature of play.

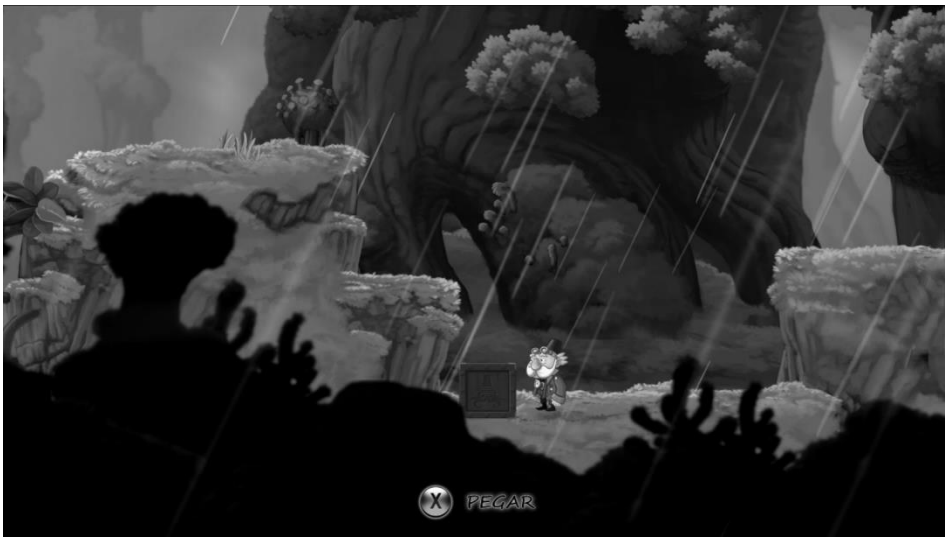
Although Elkonin referred to the impact of games on child development, it is assumed that the faculties mentioned are also present in other age groups, at more complex levels. From this perspective, more than the age of the player, a determining factor for the educational potential of the video game is the producer's intention when creating situations that mediate the player's experience, encouraging them to find new commands and reasoning to solve problems.

Another important point to consider is that the video game under analysis also presents playful elements capable of distancing the player from reality. In it, the player assumes the perspective of a particular character, represented by an old inventor, who lived during a time of uncontrolled technological advances and contributed to the unchecked technology causing the "destruction" of the world.

The video game begins with a narration by the main character stating: not long ago, society's economic foundation was based on technological industrial growth achieved by steam-powered machines. It is said that, due to the effort to create a new energy source, a great catastrophe occurred, and he was there and allowed it to happen. The characters always narrate the events of the game and even point out some issues to guide the player, which directly refers to the mediation of the more experienced individual (the game designer), who instructs the less experienced individual in that environment (the player) on the correct use of the available elements, acting upon their zone of proximal development (VYGOTSKI, 1995) through the explanations and playful situations of the video game.

As the game progresses, it is possible to notice that new interaction commands with the environment are gradually made available. At the beginning, the player can press buttons that make the character move forward, backward, and jump. However, as the player advances in the game, they are instructed and prompted to use new commands, with more interaction buttons, and to combine actions corresponding to different buttons to perform more complex tasks. For example, there comes a moment when the Old Inventor needs to reach an object that is inaccessible with the basic commands available, requiring the combination of actions to form an appropriate strategy. Image 1 below shows one of these moments: the Old Inventor needs to reposition a box to reach the higher level of the terrain.

Image 1 Character Interaction with Objects

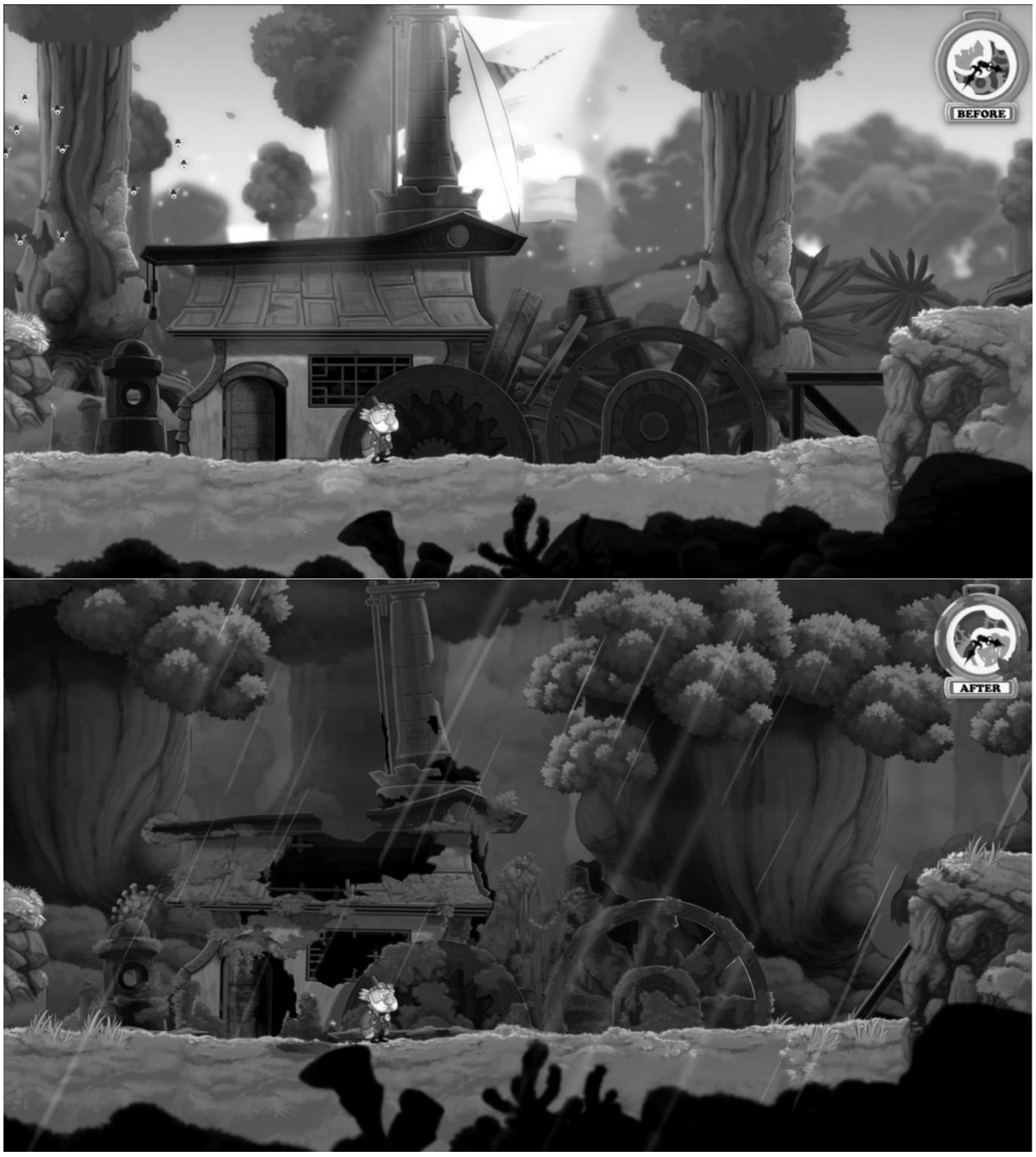


Source: Screenshot of the game taken by the authors, 2021.

When this type of event occurs, it marks the need to learn a new skill or to combine already learned skills to form a new strategy. At this moment, performance instructions are provided by the video game, indicating the new actions available. These instructions evoke motor coordination, imagination, and creativity to tackle the proposed challenges. According to Vygotsky (2009, p. 17), “it is this ability to construct elements, to combine the old in new ways, that forms the basis of creation.”

Another situation arises when the Old Inventor finds an object he has been looking for, claims to have created it, and upon picking it up, a new symbol appears on the screen (button B), through which the character acquires the ability to travel between the past and the future. The transition of time can be observed through the visual change in the scenery: the past is depicted with more vivid images (the trees in the background appear fuller, and there aren’t as many fungi as in the future setting; bees are seen flying, gears and other constructions are functioning, etc.). The change of time is also noticeable by looking at the emblem displayed in the upper right corner of the screen, which indicates the words "before" and "after" as the player makes transitions (Image 2).

Image 2 – Passage of Time: Before and After



ource: Screenshot of the game taken by the authors, 2019.

A sign is an artificial stimulus created by humans, used as a means to control their own conduct or that of others (VYGOTSKY, 1995). In this sense, the time emblem can be understood as a sign that communicates to the player the possibility of executing a new action: time travel.

Furthermore, as the player progresses in the game, they will notice that there are resources that can only be accessed in one of the eras but may be needed to solve problems in the other. For example, at times, it is necessary to reach ledges or metal platforms that, in the past, are new and block the

character's passage, while in the future, they are already destroyed, allowing access to those areas. One example is the platform next to the waterwheel, depicted in Image 2.

In this same vein, it is possible to perceive that, when transitioning from one time to another, the objects held by the character also travel with him. Thus, some objects need to time travel to function properly. This presents a conception (scientifically distorted but acceptable within the game's fantasy) of time/space, according to which time is continuous for the character, who neither rejuvenates nor changes when traveling through time but retains characteristics of the present time. The same applies to the things he carries. However, this does not happen with all other objects, which change depending on the time, including ceasing to exist in the past.

Paradoxically, this seems to be one of those moments in the game when a child's more objective thinking by complexes can more readily accept the circumstantial immutability of certain objects at the expense of others to complete a task, compared to a teenager whose conceptual thinking is more developed. However, to effectively solve the challenge, thinking by complexes may not be sufficient, since it is conceptual thinking that allows the player to reflect on how the essence of the video game evokes the need to discover and understand concepts and principles distinct from those applicable in reality.

This is one of the moments where logical reasoning is essential for progression. Logical thinking, according to Vygotsky (2001), is not something added to concepts but a situation of the concepts themselves in action. Thus, the author posits the thesis that a fundamental change in the form of adolescent thinking is the mastery of logical thinking. For him, logical and abstract reasoning encompasses rational operations such as analysis and synthesis, comparison, generalization and systematization, abstraction and concreteness.

From these excerpts of the game, it is possible to see that the challenges are increasing and can act within the zone of proximal development because they instruct players on the skills needed to advance and provide space for players to experiment with these skills in the game's phases. When a skill is mastered, subsequent phases require that learned skill while adding the need to advance further, providing new instructions and possibilities for action that are more complex than the previous ones and, when combined with them, promote the development of strategies for problem-solving, constituted by the complex and interconnected relationship of various cognitive and affective elements (perception, memory, attention, logical reasoning, emotions, feelings, etc.).

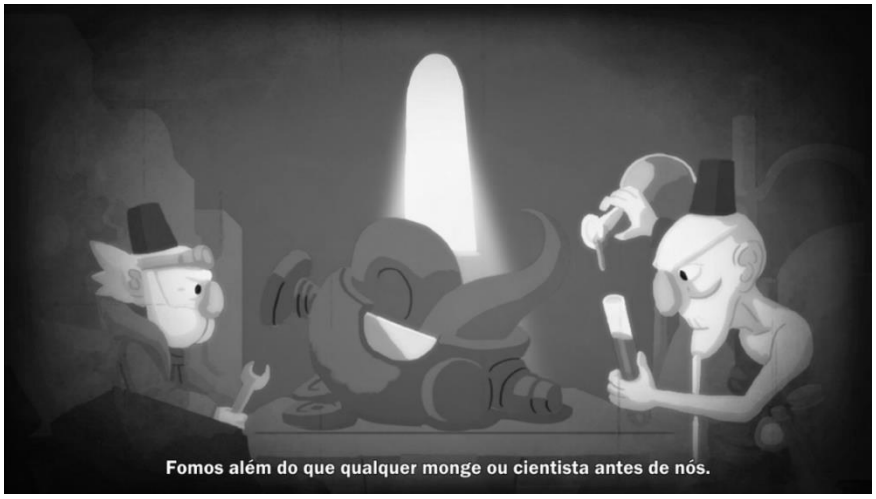
Regarding the progression through the degrees of difficulty of the video game, it is noted that the developers used the strategy of starting with challenges whose solutions lie within the player's direct visual field, but as the game progresses, the challenges require more of the player's teleological

capacity. This rhythm of progression, from simpler intellectual tasks to more elaborate and abstract ones, can be understood based on what Vygotsky and Luria (1996) point out: in young children, primitive thinking predominates, limiting their actions to the perception they have of the objects available in their direct visual field. Only later, through cultural mediation and the maturation of the nervous system, does the individual become capable of thinking in complexes and concepts, using signs to aid memory and communication, and thus using instruments in more elaborate and teleologically superior ways.

> The ability to use tools becomes an indicator of the level of psychological development. We can confidently assert that these processes of acquiring tools, along with the specific development of internal psychological methods and the ability to functionally organize one's own behavior, characterize the cultural development of a child's mind (VYGOTSKY; LURIA, 1996, p. 183).

Regarding the affective aspects, as the player progresses, they gain access to the character's story, memories, thoughts, feelings, and emotional ties. The character recounts experiences from their childhood, at the monastery where they learned mystical practices of Alchemy and the physical laws of Science from their mentor, about the experiences they shared together, and the invention of a new energy source capable of inaugurating a new field of consciousness. Image 3 illustrates one of these affective memories.

Image 3 – Affective Memory



Source: Screenshot of the game taken by the authors, 2019.

Memory and affectivity (emotions and feelings) are present in the scene shown in Image 3 and clearly constitute aspects of the character's motivation to continue their journey, which, in turn, impacts the player as the "embodiment" of the character, deeply involved in their role.

Para Vygotsky,

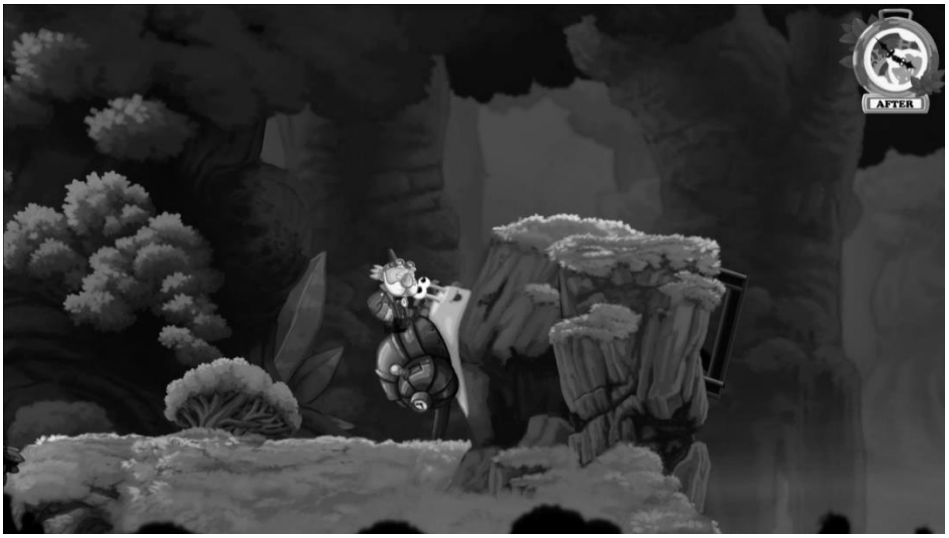
> Emotional reactions have a fundamental and absolute influence on all forms of our behavior and at every moment of the educational process. If we want students to

> remember better or engage their thinking more, we must ensure that these activities are emotionally stimulating (VYGOTSKY, 2003, p. 121).

Although the author referred to the teaching-learning process in a different context, this excerpt perfectly applies to the purpose of this analysis. The educational potential of the analyzed video game traverses, precisely, through the affective dimension of the player who, for various personal reasons, voluntarily decides to start the game and continue playing it, until its completion or not. These reasons are permeated by the player's systems of beliefs, values, emotions, and feelings, and as they are accessed, they stimulate the player to play for a longer time, during which cognitive skills are also stimulated. The union of cognition and affect, therefore, has the potential to generate pleasure and learning in other words, meaningful learning.

During the storyline, a second controllable character emerges, the Snail, which possesses unique abilities: it can only crawl and cannot jump, but as it is sticky, it can assist in climbing certain areas (Image 4).

Image 4 – Interactions with The Snail



Source: Screenshot of the game taken by the authors, 2019.

The relationship established between these two characters highlights other affective aspects present in the game, as both help each other to achieve the final objective while also experiencing conflicts; during a discussion, the characters distance themselves, remaining separated for a period of time. It is evident that the main character has feelings of affection for The Snail (for example, when the Old Inventor apologizes to The Snail, it becomes clear that he knows he needs his help). The player witnesses the dialogue and, in the experience of the video game, also realizes that he truly needs The Snail to progress. Here, the message is conveyed that one cannot do everything alone and that, to handle more complex situations, one often needs to collaborate with others; this collaboration

can stem from the affection that exists between the parties or a common goal. In each role assumed by the player, "the affective motivation and the technical-operational aspect of the activity are represented in an inseparable union" (ELKONIN, 2009, p. 29).

There is a moment in the video game where the Old Inventor, through the relationships he establishes with the environment and other characters, realizes the impact of having invented, alongside his mentor, the energy source that destroyed the world in the future. According to Vygotsky, Luria, and Leontiev (2010) and Leontiev (1978), consciousness is not something that arises spontaneously nor is it continuous over time; rather, it refers to a developmental process that has activity as its explanatory principle, mediated by cultural instruments that allow the individual to access and give meaning to things in the world. Signification occurs following the movement in which the concrete, in reality, is appropriated by the individual and transforms into generalized abstraction, which then ascends back to the concrete in thought. From this, the individual acts upon reality again, modifying it and modifying themselves, according to the principles of Marxist dialectics.

This process is evident in the narrative of the video game, which tells the story of an inventor embarking on a journey to correct mistakes made in the past, upon becoming aware of them. Here, the educational potential lies both in stimulating reflection for self-awareness and in the message that it is possible to rectify one's attitudes by reflecting on them and envisioning new ways of being and existing in the world.

Elkonin (2009) suggests that different roles, precisely because they place the individual in various perspectives, enable them to execute distinct actions and operations, as well as new ways of thinking and relating to things. In the video game, the ability to switch consciousness between controlling the Old Inventor and the Snail allows the player to access different skills and perspectives, which can contribute to the development of their analytical capacity.

It is relevant to consider that having to play with a predefined character, without any option to customize their characteristics, may initially lead one to assume that the relationship between the player and the character is superficial, which would diminish the bond between them. However, while the lack of customization and the limitation of actions might hinder the player's identification with the character, on the other hand, and paradoxically, this very limited context is potentially important for the higher development of thought, as the player is constantly challenged to mentally reorganize all available resources to plan more efficient actions.

Based on Leontiev (2001), it is understood that in the practice of games with rules, there is potential for learning and for mastering one's own behavior, making it possible to control it and

subordinate it to a specific purpose. It can be observed that, in the context of the video game, faced with an objective to be achieved and a challenging situation, when making a mistake, the player can, due to the game's dynamics that allow for various attempts, reflect and recognize the reasons why the strategy used was ineffective. From this, the player can become aware of what will be necessary to construct new strategies that are more suitable for overcoming the given challenge.

In this sense, the video game can become

> [...] an ally in the classroom and, consequently, in other demands, as it allows for the learning of other aspects, not only content-based but also social interaction, taking the perspective of others, developing strategies, anticipating thoughts, and even dealing with frustrations when not succeeding in their plays (CARCANHOLO, 2015, p. 90).

Thus, when it is assessed that the analyzed video game has educational potential, in addition to its mechanical system, programmed to guide/assist the player in discovering the necessary skills to overcome challenges, both in the game and outside of it, its dynamics and narrative can also be converted into interesting resources for pedagogical purposes. For example, the game in question addresses the impact of technology on the future of the planet, and through the gaming experience, the player may become sensitized to this topic and even begin to reflect on aspects that have gained meaning as a result of this experience.

Finally, it is evident that the video game, without mediation, has the potential to offer situations for spontaneous learning at the player's own pace. However, considering that, for Vygotsky, Luria, and Leontiev (2010), good teaching is that which precedes and guides development, the educational potential of the video game could be directed and enhanced through the pedagogical intervention of an educator. A teacher could, for instance, propose that students experience the video game and then leverage that experience to discuss the impacts of human relationships and their relationship with the environment in an enjoyable way. Another teacher could use it in a physics class to discuss the properties of time and space or matter.

Final Considerations

The presented model helped organize the necessary information to carry out a critical appraisal of the educational potential of the video game. It is a semiotic methodology that involves the selection of information from various sources (primary and secondary, visual and discursive, such as the inclusion of screenshots of the analyzed events) to be examined through the lens of a theory - in this case, the Historical-Cultural Theory - allowing for scientifically based syntheses and the potential for

generalization of the model for the analysis of other digital technology visual objects.

Using this methodology, it was possible to comprehend and integrate general information about the analyzed video game, its production context, the elements of its configuration, its narrative, and the experience of playing it. The analysis resulting from this integration concludes, in summary, that its educational potential lies in both the mechanics and dynamics of the game, particularly in the theme addressed, the metaphors present in the narrative, the instructions provided, the analogies that can be drawn, and the possibilities of generalizing the strategies for solving problems experienced in the video game to real-life situations. It is precisely in this last point that the greatest educational potential of the game resides, as education bears the responsibility of developing individuals' faculties for life in society.

While the analysis model suggests that many, if not all, video games could be considered potentially educational, it is important to emphasize that the word "potential" denotes not a certainty but a possibility, which may or may not occur depending on the mediations made by the video game or by a third party, and the syntheses developed by the player.

It should be emphasized here that the importance of pedagogical mediation lies in the organization of the elements that strengthen the educational potential of the analyzed video game. The teacher can integrate and direct the experiences from the game by selecting the content to be worked on with the student. Thus, even a video game that is not intentionally educational can effectively act upon an individual's zone of proximal development, serving as a mediating instrument between the player and certain content that runs through the game's narrative.

Finally, it is believed that an interesting extension of this analysis would be the development of systematic studies with a larger number and diversity of players to verify whether similar conclusions to those presented here are reached, or to explore other conclusions that have not yet been examined. Additionally, applying the model to other commercial video games would help assess their viability as auxiliary pedagogical resources.

References

AGUIAR, M. P. *Jogos eletrônicos educativos*: instrumento de avaliação focado nas fases iniciais do processo de design. Dissertação. Programa de Pós-Graduação em Design do Setor de Humanas da Universidade Federal do Paraná, 2010. Disponível em: < https://acervodigital.ufpr.br/bitstream/handle/1884/24073/AGUIAR%2c%20M.%20P%5b2010%5d-Dissertacao-PPGDesign%5bUFPR%5d.pdf?sequence=1&isAllowed=y>. Acessado em: 21 ja. 2021.

BADTIME DIGITAL *GAME*S. *Chronology*. Disponível em: < https://www.bedtime.io/ *Chronology*-the-*game*>. Acesso em 22 de julho de 2019.

BUSARELLO, R. I.; ULBRICHT, V. R.; FADEL, L. M. A gamificação e a sistemática de jogo**:** conceitos sobre a gamificação como recurso motivacional. *In*: FADEL, L. M.; ULBRICHT, V. R.; BATISTA, C. R.; VANZIN, T. (orgs.). *Gamificação na educação*. São Paulo: Pimenta Cultural, 2014.

CABRAL, C. G. *Fundamentos de Cartoon*: Como Desenhar Rostos em Estilo Cartoon Corretamente, 2013. Disponível em: <https://design.tutsplus.com/pt/articles/*cartoon*-fundamentals-how-to-draw-a-*cartoon*-face-correctly--vector-15792>. Acessado em: 24 ago. 2019.

CARCANHOLO, F. P. de S. O jogo como a atividade principal para a aprendizagem e o desenvolvimento infantil pela perspectiva da teoria histórico-cultural. *Revista Memorare*, Tubarão, SC, v. 2, n. esp., VII SIMFOP, p. 80-91, set./dez. 2015. Disponível em: <http://www.portaldeperiodicos.unisul.br/index.php/memorare_grupep/article/download/3340/2377>. Acessado em: 13 ago. 2019.

CARVALHO, S. P.; PEDROSA, S. M. P. A; ROSADO, L. A. S. A produção de jogos eletrônicos para a educação: investigando os bastidores. *Educação Unisinos*, vol. 21, n. 3, 2017. Disponível em: <http://revistas.unisinos.br/index.php/educacao/article/view/ edu.2017.213.11>. Acessado em: 04 ago. 2020. DOI: https://doi.org/10.4013/ edu.2017.213.13727

CHOU, Y. *Gamification*. 2019. Disponível em: <https://yukaichou.com/gamification-examples/top-10-education-gamification-examples/#.WvHle1SpnyU>. Acessado em: 04 ago. 2020.

DIANA, J. B.; GOLFETTO, I. F.; BALDESSAR, M. J.; SPANHOL, F. J. Gamification e Teoria do Flow. *In*: FADEL, L. M.; ULBRICHT, V. R.; BATISTA, C. R.; VANZIN, T. (orgs.). *Gamificação na educação*. São Paulo: Pimenta Cultural, 2014.

ELKONIN, D. Sobre el problema de la periodización del desarrollo psíquico en la infancia. *In*: DAVIDOV, V; SHUARE, M. (Orgs.). *La psicología evolutiva y pedagógica en la URSS* (antologia). Moscou: Progresso, 1987.

ELKONIN, D. *Psicologia do jogo*. São Paulo: Martins Fontes, 2009.

FAIRCLOUGH, N. *Discurso e mudança social*. Izabel Magalhães (coord. trad., rev. téc. e prefácio). Brasília: Editora Universidade de Brasília, 2001.

FANAYA, P. F. *Gamificação na educação*: uma tendência irreversível e irresistível. Artes Tecnológicas Aplicadas à Educação, 2018. Disponível em: <https://www.academia.edu /38441747/Gamifica%C3%A7%C3%A3o_na_educa%C3%A7%C3%A3o_uma_tend%C3%AAncia_irrevers%C3%ADvel_e_irresist%C3%ADvel>. Acessado em: 13 ago. 2019.

FARDO, M. L. *A gamificação como método*: estudo de elementos dos *game*s aplicados em Processos de ensino e aprendizagem. 2013. Dissertação (Mestrado em Educação) – Universidade de Caxias do Sul, Rio Grande do Sul. Disponível em: <https://repositorio.ucs.br/xmlui/bitstream/handle/11338/457/Dissertacao%20Marcelo%20Luis%20Fardo.pdf?sequence=1&isAllowed=y>. Acessado em: 13 dez. 2020.

HESMONDHALGH, D. Indie: the institutional politics and aesthetics of a popular music genre. *Cultural Studies*, v. 13, n. 1, p. 34-61, 1999.

HUIZINGA, J. *Homo ludens*: o jogo como elemento da cultura. João Paulo Monteiro (trad.). 8ª ed. São Paulo: Perspectiva, 2018.

LEONTIEV, A. N. *Actividad, conciencia y personalidad*. Buenos Aires: Ciencias del Hombre, 1978.

LEONTIEV, A. N. Os princípios psicológicos da brincadeira pré-escolar. *In*: VIGOTSKII, L. S.; LURIA, A. R.; LEONTIEV, A. N. *Linguagem, desenvolvimento e aprendizagem*. 7ª ed. Maria da Penha Villalobos (trad.). São Paulo: Ícone, 2001.

MATTAR, J. *Games em Educação*: como os nativos digitais aprendem. 1ª ed. São Paulo: Pearson, 2010.

MCGONIGAL, J. *A realidade em jogo*: por que os *game*s nos tornam melhores e como eles podem mudar o mundo. Eduardo Rieche (trad.). Rio de Janeiro: BestSeller, 2012.

MEDEIROS, M.; SCHIMIGUEL, J. (2012). Uma abordagem para avaliação de jogos educativos: ênfase no ensino fundamental. *RENOTE - Revista Novas Tecnologias na Educação*, v. 10 n. 10, 2012.. Disponível em: < https://www.researchgate.net/publication/ 272139663_Uma_abordagem_para_avaliacao_de_jogos_educativos_enfase_no_ensino_fundamental>. Acessado em: 20 jan. 2021. DOI:10.22456/1679-1916.36378.

OLIVEIRA, M. P. M. T. Uso de internet e de jogos eletrônicos entre adolescentes em situação de vulnerabilidade social. *Temas em psicologia*, v. 25 n. 3, 2017. Disponível em: <https://www.scielo.br/scielo.php?pid=S2358188320170003011 67&script=sci_abstract&tlng=pt>. Acessado em: 15 dez. 2020. DOI: https://doi.org/10.9788/tp2017.3-13pt

QUEIROZ, L. R. IPhone, Android, e a consolidação da cultura do smartphone: o papel do IPhone e do Sistema Operacional Android como catalisadores da consolidação no mercado de smartphones em escala global. *R. Tecnol. Soc*. v. 14, n. 30, p. 47-70, jan./abr. 2018. Disponível em: <https://periodicos.utfpr.edu.br/rts/article/view/5413>. Acessado em: 20 jan. 2021. DOI: 10.3895/rts.v14n30.5413

RIBEIRO, R. J.; SILVA JUNIOR, N.; FRASSON, A. C.; PILATTI, L. A.; SILVA, S. C. R. Teorias de Aprendizagem em Jogos Digitais Educacionais: um Panorama Brasileiro. *Novas Tecnologias na Educação*, v. 13 n. 1, 2015. Disponível em: <https://seer.ufrgs.br/renote/ article/view/57589/0> . Acessado em: 11 fev. 2021. DOI: https://doi.org/10.22456/1679-1916.57589

RIBEIRO, J. de O. N. *Newsgames e aprendizagem*: possibilidades de construção de conhecimento a partir da interação com jogos digitais. 2016. Tese (Programa de Pós-Graduação em Educação) – Universidade Federal de Juiz de Fora. Disponível em: <https://repositorio.ufjf.br/jspui/handle/ufjf/5811>. Acessado em: 09 ago. 2020.

RIZZINI, I.; PEREIRA, L.; ZAMORA, M. H.; COELHO, A. F.; WINOGRAD, B.; CARVALHO, M. Adolescentes brasileiros, mídia e novas tecnologias. *ALCEU*, v. 6, n. 11, 2005. Disponível em: <http://revistaalceu-acervo.com.puc-rio.br/media/Alceu_n11_Rizzini .pdf>. Acessado em: 10 fev. 2021.

SAMPIERI, R. H.; COLLADO, C. F.; LUCIO, M. P. *Metodologia de pesquisa*. 5ª ed. Porto Alegre: Penso, 2013.

SANTOS, N. M. G.; SOUZA, G. A. D. B. Influência negativa dos jogos eletrônicos no desenvolvimento cognitivo. *Revista da Universidade Vale do Rio Verde*, v. 14, n. 1, 2016. Disponível em: <http://per http://periodicos.unincor.br/index.php/revistaunincor/article/ download/2918/2361>. Acessado em: 10 fev. 2021.

SIOUX GROUP. *Pesquisa Games Brasil 2020 (PGB20)*. Painel Gratuito 2020. Disponível em: <https://www.pesquisagamebrasil.com.br/pt/ebooks/>. Acessado em: 02 jan. 2021.

VIGOTSKI, L. S. *Imaginação e criação na infância*. São Paulo: Ática, 2009.

VIGOTSKII, L. S.; LURIA, A. R.; LEONTIEV, A. N. *Linguagem, desenvolvimento e aprendizagem*. 11ª ed. Maria da Pena Villalobos (trad.). São Paulo: ícone, 2010.

VYGOTSKI, L. S. *Obras escogidas.* Tomo IV. Madri: Visor, 1996.

VYGOTSKI, L. S. *Obras escogidas.* Tomo II. Madri: A. Machado Libros, S. A., 2001.

VYGOTSKY, L. S. *A formação social da mente*: o desenvolvimento dos processos psicológicos superiores. 4ª ed. São Paulo: Martins Fontes, 1991.

VYGOTSKY, L. S.; LURIA, A. R. *Estudos sobre a história do comportamento*: símios, homem primitivo e criança. Lólio Lourenço de Oliveira (trad.). Porto Alegre: Artes Médicas, 1996.

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