Game A Épica Corrida ao Ovócito: curricular enrichment in the Science subject for students with giftedness

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Abstract: This paper aims to describe the development process of a game performed during specialized educational care (ESA) with a student with giftedness, aiming to identify contributions to curriculum enrichment and the improvement of executive functions. The creation of the board game addressed the human reproduction content provided for in the Science curriculum for the 5th grade classes of elementary school, with a view to its use in the classroom. The research is characterized as a case study of qualitative approach. The analysis was based on categories and was performed from field diary records and ESA reports. The results show that the creation of games can contribute to curriculum enrichment and favor cognitive skills, especially the inhibiting control and planning capacity, consolidating itself as a process of self-knowledge and self-regulation.

Keywords: Specialized Educational Service. Executive Functions. Reproductive System.

Juego A Épica Corrida ao Ovócito: el desarrollo de un juego como propuesta de enriquecimiento curricular en la disciplina Ciencias para estudiantes con altas habilidades/superdotación

Resumen: Este articulo tiene como objetivo describir el proceso de elaboración de un juego realizado durante el Servicio Educativo Especializado (AEE) con un alumno con Altas Habilidades/Superdotación, con el fin de identificar los aportes al enriquecimiento curricular y la mejora de las funciones ejecutivas. La creación del juego abordó el contenido de reproducción humana previsto en el currículo de Ciencias para las clases de 5to grado de la Escuela Primaria, con el propósito de que pudiera ser jugado por las clases escolares. La investigación se caracteriza por ser un estudio de caso con un enfoque cualitativo. El análisis se basó en categorías y se realizó con base en registros de diarios de campo e informes de AEE. Los resultados muestran que la creación de juegos puede contribuir al enriquecimiento curricular y favorecer las habilidades cognitivas, especialmente el control inhibitorio y la capacidad de planificación, consolidándose como proceso de autoconocimiento y autorregulación.


Jogo A Épica Corrida ao Ovócito: enriquecimento curricular na disciplina de Ciências para estudante com altas

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Resumo: Este trabalho tem o objetivo de descrever o processo de desenvolvimento de um jogo realizado durante o Atendimento Educacional Especializado (AEE) com um estudante com Altas Habilidades/Superdotação, visando identificar as contribuições para o enriquecimento curricular e o aprimoramento das funções executivas. A criação do jogo de tabuleiro abordou o conteúdo de reprodução humana previsto no currículo de Ciências para as turmas de 5º ano do Ensino Fundamental, com vistas a sua utilização em sala de aula. A pesquisa caracteriza-se como um estudo de caso de abordagem qualitativa. A análise pautou-se por categorias e foi realizada a partir dos registros em diário de campo e dos relatórios do AEE. Os resultados evidenciam que a criação de jogos pode contribuir com o enriquecimento curricular e favorecer habilidades cognitivas, especialmente o controle inibitório e a capacidade de planejamento, consolidando-se como um processo de autoconhecimento e autorregulação.


1 Introduction

A person with high giftedness (according to the Portuguese acronym AH/SD) has three behavioral traits: general and/or specific abilities above average, commitment to the task, and creativity at high levels (RENZULLI, 2004). The simultaneous intersection of these three indicators and their frequent and deep manifestation will indicate AH/SD (FREITAS; PÉREZ, 2012), but the intensity of their presentation can directly influence the environment. It can be qualified according to the appropriate care for their specificities.

According to Virgolim (2007), students with AH/SD indicators may face different barriers to identifying their characteristics since there are several myths related to this condition, such as the understanding that every person with AH/SD has a high IQ, is hyperactive, or learns alone. These myths make it difficult to recognize the need for differentiated service, both in the multifunctional resource room and the classroom. It is difficult to supplement the curriculum, provide new learning, and/or overcome possible difficulties (FREITAS; PÉREZ, 2012; ANTIPOFF; CAMPOS, 2010).

In this sense, understanding and recognizing these students’ specificities are essential to establishing quality care and ensuring their learning. The Política Nacional de Educação Especial na Perspectiva da Educação Inclusiva presents the following definition for this audience:

Students with giftedness demonstrate high potential in any of the following areas, isolated or combined: intellectual, academic, leadership,
psychomotricity, and arts, in addition to showing great creativity, involvement in learning and performing tasks in areas of interest (BRAZIL, 2008, p. 9).

Decree 7,611 guarantees this audience the assistance and monitoring by special education professionals through Specialized Educational Service (ESA). The ESA refers to the services offered to students who are the target audience of special education and constitutes the “set of activities, accessibility and pedagogical resources organized institutionally and continuously” (BRASIL, 2011, p. 1).

Therefore, Special Education is integrated into the regular school curriculum, aiming to supplement the curriculum of students with AH/SD, as well as working with other teachers in specific areas and guiding them to meet these students’ educational needs.

Following the national legislation (BRASIL, 2011; 2008; 1996), the Colégio de Aplicação da Universidade Federal de Santa Catarina (CA/UFSC) presents, since 2014, a Proposta Pedagógica de Inclusão (PPI/CA/UFSC) that aims to guarantee attendance to the target audience of special education students. Since then, special education teachers carry out the ESA of students with AH/SD after school hours and contribute to curricular enrichment in partnership with the other teachers.

The ESA is a planned, organized, and executed service according to the specificities of each student served. In this case study, an ESA clipping of a student with AH/DS is presented that, through different strategies from those used in the classroom, sought to enrich the curriculum, enhance the potential and work on the student’s difficulties in the school environment.

Curricular enrichment offers diverse experiences through the regular curriculum, favoring the development of the potential of students with AH/SD (CUPERTINO, 2008). According to Freitas and Pérez (2012), curricular enrichment can occur by adding more comprehensive content and/or deepening this knowledge through specific activities and/or projects developed in the classroom and/or in the ESA.

The service reported arose from the combination of the student’s expectations concerning the learning of curricular contents and the pedagogical objectives listed by the special education teacher, resulting in the development of an educational board game, which would, at another time, gain a digital version, programmed by the student himself.
The creation of games with students is considered an active methodology, known as Aprendizagem Baseada em Jogos Digitais, which according to Van Eck (2015), can contemplate four ways of acting: Gamification (involving game elements in other learning contexts); use of educational games; working on aspects of the curriculum through commercial games; and, finally, allowing the student to plan and create games.

In addition to learning related to the curriculum, the game’s development provides the development of different cognitive skills linked to executive functions, significantly contributing to student’s learning and integral development.

This article aims to describe developing a board game during the Specialized Educational Service with a student with AH/SD to identify the contributions to curricular enrichment and the improvement of executive functions through a case study.

2 Methodology

This article presents a qualitative approach to analysis that, according to Bogdan and Biklen (1994), brings a wealth of descriptions from the data collected during the investigation. For this reason, qualitative research “[...] delves into the world of meanings of human actions and relationships, a side that is not perceptible and not captured in equations, averages, and statistics” (MINAYO, 1994, p. 22).

With a qualitative focus, a case study was carried out, characterized by Yin (2001) as a relevant strategy to examine contemporary events from sources from direct observations, written records, and/or interviews. Regarding this form of research, the author also adds that “[...] the differentiating power of the study is its ability to deal with a wide variety of evidence – documents, artifacts, interviews, and observations – in addition to what may be available in the conventional historical study” (YIN, 2001, p. 27).

Given this, will be reviewed the case of a student with AH/SD from CA/UFSC under a fictitious name Roby enrolled in the 5th grade of Elementary School and attending the ESA after school hours, once a week, for 2 weekly hours/classes. During the consultations, Roby’s curriculum was enriched by creating an educational game to be played with the class, based on a curriculum content of the Ciências Humanas e da Natureza (CHN) subject, the reproductive system.

The focus of the analysis is the benefits arising from a proposal developed from
game-based learning, which encourages the student to be the protagonist of his knowledge construction process, providing the development of executive functions of planning, problem-solving, and inhibitory control, in addition to supplementing his learning.

The data come from the field diaries of the special education teacher, from the weekly records written by the student with AH/SD, and from the Special Education Pedagogical Evaluative Reports carried out quarterly by the ESA teacher. These were categorized and analyzed based on Bardin’s content analysis (2011), observing systematic qualitative procedures for coding the records within analysis categories and the data’s relevance, objectivity, and reliability.

The analyzed materials brought notes referring to the objectives and results of the meetings with the student and the whole process of the game’s elaboration. In a careful analysis of the records, the benefits related to Executive Functions and the appreciation of the student’s potential were highlighted.

Thus, the categories were formed to first describe the game development process and analyze the moments and situations that favored the student’s development regarding Inhibitory Control, Planning, Problem-Solving, and Curriculum Enrichment.

The first category describes the process and stages of board game development. The stages of game development are analyzed from the game development cycle of Schuytema (2008), divided into three moments: Pre-production, production, and post-production.

The second category of analysis concerns aspects of the planning and design of the game that favored the improvement of the student’s inhibitory control (DIAMOND, 2013). This cognitive skill refers to the attentional and behavioral capacity appropriate to the context.

Therefore, the analysis of this topic shows how the student’s role in the game’s development and consequent responsibility for the class’s learning about the science content mobilized these skills at different times and in different ways.

The third category shows how game-based learning has benefited the student regarding the executive functions of planning and problem-solving (COSTA et al., 2016). The analysis indicates how the interest of the student with AH/DS in the Science
subject and the conduction of the work based on game-based learning led him to improve his studies, elaborate his own reflections and challenge himself to think about the proposal in a more autonomous way.

The last category deals with how the game’s development favors curricular enrichment and the appreciation of the potential of the student with AH/SD. In addition to the executive functions, there is a deepening of the knowledge linked to the Science subject, which places the student in evidence in his learning process.

All the aspects mentioned above initially presented themselves as challenges for the student, demonstrating the complexity and importance of observing the characteristics of the person with AH/DS.

3 The case

The student with AH/SD presented characteristics with above-average logical-mathematical reasoning, easiness of memorization, and a spirit of leadership. At that time, he showed interest in science curriculum content. Both in the ESA and in the regular classroom, according to the teachers’ report, he had difficulties in some socio-emotional skills, such as responsibility with the delivery of tasks, self-esteem, sociability, and organization, as well as low tolerance for frustration, which reflected in his school performance.

Roby had a history of poor attendance and difficulty completing ESA projects due to the challenge of focusing and engaging in activities beyond those of interest. He started the semester researching the concepts of autonomy, responsibility, and credibility, and the importance of recording beyond school life to document events, agreements, proof of planning, and organization of life as a whole. Researching and discussing these issues was necessary to help the student better structure his school routine and social interaction with his colleagues.

Based on these researches, the agreements and rules of care were re-established, and the action plan for the semester was collectively organized. The methodological action plan is part of the student’s Individual Development Plan (PDI). This document guides specialized pedagogical actions, consisting of information and evaluations about the student and the intervention proposal of the service (POKER et al., 2013).

The service was divided into three moments: 1) game development work; 2)
recording and planning the actions of the following service; 3) pranks and free games. The third moment, requested by Roby, would only happen when he managed to complete the first two steps, making it a positive reinforcement for the work done (GAZZANIGA; HEATHERTON; HALPERN, 2018).

The student, who stood out for his logical-mathematical skills and showed great interest in technology and programming, had the desire to create a digital game. Still, at that moment, there was no possibility of establishing a partnership with programmers, so the board game became an alternative.

The board game was designed as a prototype for the further development of the digital game and the application of the game in the class as a usability test, which would also provide learning about curricular content for all students.

4 Results and discussion

The results include the report on the game development process, followed by the analysis and discussion organized by the categories built based on the literature review and analysis of the collected data.

4.1 The game development process in Specialized Educational Service

The game development stages were adapted from Schuytema’s (2008) game development cycle, a guiding document for the creation of digital games, which consists of three significant moments: 1) pre-production — the team creates a concept for the game, discusses ideas, evaluates existing games, plans the budget, and makes sketches and scripts; 2) production — finalization of the gameplay script, character creation, game programming, tests, and improvements; at this stage, the game is built; 3) post-production — after the game’s release, the public’s acceptance of the game and possible modifications are evaluated, as well as the creation of additional products.

The pre-production moment involved planning the game and included the following actions: researching games; playing physical and digital games to observe the mechanics, rules, and other characteristics relevant to each version; defining the type and mechanics of the game; creating game design sketch; listing the materials needed to make the physical game; and researching about game content.

First, Roby defined that the game would be about the Science subject. Then we studied the teaching plan of this subject to define the content covered in the game. The
student elaborated and asked questions to the subject’s teacher, seeking to understand what curricular content the game, as a pedagogical resource, could qualify the learning experience of all students. By mutual agreement, they chose the Reproductive System.

This was followed by the research of immersion in games (LA CARRETA, 2018), testing different physical and digital game types, and observing, among other aspects, their mechanics. During this period, Roby was active and participatory, demonstrated logical reasoning to identify the mechanics of each game we experienced, and showed ease in identifying which game models could or could not meet the demands.

Although collaborative-style games proved more attractive to the student, Roby concluded that the quiz-style game would best meet the established pedagogical objectives. After defining the game model, the student proved to be very creative and made the quiz more attractive by transforming it into a progression board game, with pawn markers that reinforce the game’s narrative and surprise “lucky and unlucky” chance cards as extra components.

After sketching the game design and studying the materials for making it, the content research began. At that moment, Roby showed greater resistance and difficulty in performing the task with commitment. The difficulties involved the research processes from a careful reading of the content, the selection of content appropriate to the level of the target audience of the game (5th-grade students), and the certification of the sites’ reliability.

The moment of production took place through the design and making of the game, involving the following actions: defining the game’s outline; elaborating the board design; setting the rules; elaborating the content of the cards; defining the questions and answers; finalizing and organize the printing of the board; making the purchase order for the data; making the pawns; printing the questions and making the cards; reviewing and printing the rules and template.

At that moment, the student used his creativity to compose the narrative and the title relevant to the game’s theme in a way that would attract the attention of his colleagues. Creativity also stood out when thinking about the content of lucky and unlucky chance cards, as they differ from conventional ones and make the game attractive. Roby showed ease in creating the board structure, allowing him to enable
different levels of difficulties, designed as a form of accessibility to the content, as it catered to all levels of knowledge of student players.

A significant challenge for the student was creating the questions and answers in a way that was adequate for the game’s purpose. The student was often resistant to using only academic terms and equivalent content with the 5th-grade curriculum. A new conversation with the Science teacher was necessary to re-establish the limits of the game. Hence, all the content went through prior approval by the classroom teacher and a 7th-grade Biology teacher interested in the game.

Board 1: Game rules

**A ÉPICA CORRIDA AO OVÓCITO: A QUIZ-style board game in which sperm are in a race to fertilize the egg. Each game kit consists of a board with 50 squares, a dice, four sperm-shaped pawns, and 50 cards with questions about the Reproductive System. The questions are classified into Easy, Medium, and Hard categories, represented by the colors green, yellow, and red, respectively. The blue color symbolizes the Lucky and Unlucky chance cards.**

**How to play:** The player rolls the dice and moves the indicated number of squares. The player must take a card of the square’s color where his sperm is. If it lands on the blue square, the card will indicate what the player should do (e.g., choose an opponent to go back two squares). The player must read the card question in the other colors and choose the correct one among the three alternatives. After checking the template, the player must move his piece according to the result. GREEN: The correct answer advances one square; the wrong answer goes back three squares. YELLOW: The correct answer advances two squares; the wrong answer goes back two squares. RED: The correct answer advances three squares; the wrong answer goes back one square. The player who manages to reach the egg at the end of the board first wins.

**Target audience:** 5th-grade of Elementary School students.

**Number of players:** From two to six players per board.

**Play time:** 30 min.

Source: The Authors (2021)

After its creation, the game was applied in the three classes of the 5th grade after the content presentation by the regent teacher. In each of the classes, four game kits were used. Roby acted as a mediator of the activity, organized the rooms, thought about accessibility strategies for students with Autism Spectrum Disorder, presented the game, explained the rules, and divided each class into four groups according to the number of boards produced.
At this stage, while experiencing the game, colleagues discussed questions, asked questions with the teacher, and discovered curiosities about the content that the teacher had not previously addressed. A formal evaluation of the game was not carried out with the students. Still, it was noticeable by the teachers of the class that the activity provided the collective construction of knowledge in a relaxed and fun way. All joined the game and were motivated to overcome the proposed learning challenges.

The post-production stage was dedicated to evaluating the game based on the experience with the classes and recording observations to improve the game for the digital version. From the reflections of what was observed in the game mediation and the feedback from colleagues after the experience of playing, Roby considered that the game reached its goals, helped in learning in a fun way, and had good acceptance by colleagues. The student could identify essential elements for the digital version, such as the template, which may be accompanied by a short explanation of the answers; if the student chooses the incorrect alternative, the answer with the explanation will help him to better understand the content.

4.2 Game-based learning for the development of cognitive skills related to inhibitory control

Some student difficulties related to inhibitory control came into evidence given the proposal to develop a project and, from this, a game that could serve as a learning tool for all 5th-grade classes at the school, considering the diversity of students that compose them. Thus, from the material analyzed, it is understood that the game’s planning, elaboration, application, and evaluation interfered with developing this critical dimension of executive functions.

Inhibitory control involves cognitive skills, such as controlling attention, thoughts, emotions, and behavior, to establish appropriate responses to the context and not respond to impulses (DIAMOND, 2013; LEMES, ROSSINI, 2012). Therefore, it can be said that inhibitory control makes it possible to evaluate situations and make a choice and/or change of actions or focus of attention (BARKLEY, 1997).

It is noteworthy that the student with AH/SD showed, throughout the consultations, difficulties in focusing his attention on the proposal, meeting deadlines, and often demonstrated challenges in dealing with frustration. In this sense, throughout the ESA, a moment of research and conceptual formation was organized on autonomy,
responsibility, and credibility to define the rules, establish attributions, and adjust expectations with the commitments linked to the project.

With this, Roby’s weekly record of the activity is made to help him select the relevant stimuli, focus his attention, and organize himself within school life according to his own planning. This aspect is directly linked to the cognitive abilities of selective attention, working memory, and self-regulation related to inhibitory control (BARKLEY, 1997). For Diamond (2013b), self-control is one of the aspects of inhibitory control responsible for the adequacy of behavior and emotions, involving capacities such as resisting temptation and not acting impulsively.

Inhibitory control is responsible for controlling internal and environmental interferences that may distract from performing the activity (GARCIA, 2017). Kluwe-Schiavon et al. (2012) point out that, in situations with different stimuli, in which an appropriate response and/or behavior is expected, this executive function acts in a way that the internal representations of the context inhibit non-relevant information in favor of other less usual stimuli.

Thus, from this organization, the student started to produce his game project and continued exercising the skills related to inhibitory control. An example of these moments is access to stimuli in the ESA room, such as the games that served as a model for the proposal and various Internet sites for studying and deepening the content. Roby needed to learn to focus on the objective and direct his choices to what he was proposing as a game producer and not, at this moment, as a player.

The production of a game must meet the target audience for which it was intended (SCHUYTEMA, 2008). Therefore, the student with AH/SD needed, throughout the production, to control the initial behavior of creating precise rules related to his own interests linked to the Science subject to think of something that could be understood and played by his colleagues for them to learn the content.

Taking the game to the 5th-grade classes to give the student a leading role in sharing knowledge regarding the reproductive system also required Roby to mobilize inhibitory control since his posture at that time was a mediator of the activity. For this reason, he needed to be clear in his explanations, answer colleagues’ doubts and focus and attention not to give the answers. The student was able to live the experience of being the creator of the game, not giving in to the initial impulses of wanting to participate as a player and/or intervene in the actions and responses of colleagues
during the game, which highlights the relevance of this activity for the improvement of executive functions.

The game’s development was inspired by the student’s experience as a player. By exploring different digital games, Roby found elements and subsidies for elaborating his proposal. This work of experiencing other games and adding elements to his own mobilized Roby’s inhibitory control on a large scale since he had to pay attention to the game’s different features and how they could contribute to his work and not just play it for fun.

Diamond (2013b) reinforces that the development of inhibitory control is related to the ability to continue performing a task despite boredom, an initial failure, an interesting digression, or a tempting distraction. Therefore, this executive function requires the ability to inhibit the inclination to give up or do something more fun than the task.

In general, it was observed that the organization for the game’s development, the study of specific contents related to the reproductive system, and the role of mediator of the activity required the student to mobilize skills related to inhibitory control (Diamond, 2013a). In turn, they directly interfere with planning and problem solving, dimensions of executive functions that are equally important and will be analyzed in the following category.

4.3 Game-based learning and its benefits for planning and problem-solving executive functions

The organization of the services in three moments proved beneficial for Roby because, after working on the game’s development, having a moment to record and plan the next steps resulted in a better organization on the part of the student. The final moment, with activities and games of free choice, was a positive reinforcement to motivate him to overcome the challenges of the previous moments.

It can be seen that the skills developed at work complement and support each other as the third moment of the ESA proved to be a relevant factor for self-regulation (inhibitory control), as the student began to expend greater efforts to resist distractions and boredom of performing tasks necessary for the project development, but which were not motivating. Therefore, this process reflected in the effort of more careful planning for productive activities and a better organization of the time for the execution
of the project activities and to have the third free time for games and games.

Planning was one of the dimensions of executive functions worked throughout the entire process. The student started to make a weekly record of the activities carried out and those that still needed to be accomplished because “learning to build their own reflections and having autonomy are capacities intrinsically related to the development of executive functions” (COSTA et al., 2016). Initially, the record was not perceived as a necessity by Roby; however, when understanding its applicability in the logical organization for the game’s construction, this aspect started to be more valued by him.

Throughout the development process, this ESA moment started to happen with greater fluidity since the student got used to this type of writing and managed to understand through practice how the record, by involving the skills of remembering, associating different information, reviewing the way of thinking and planning (COSTA et al., 2016), facilitated the organization and understanding of the stages of a creative process.

Creating a game requires careful planning of all aspects of this activity from the beginning. It is necessary to anticipate the conditions of time, materials, skills, and possibilities of carrying out the project. Thus, the student faced the first problem during planning: how to program a digital game?

According to Gazzaniga et al. (2018, p. 321) “a person has a problem when he does not have simple and direct means to achieve a specific goal.” Hence, drawing up a plan with strategies to overcome obstacles and reach the goal is necessary. For Matlin (2004, p. 234), problem-solving manifests “when we want to achieve a particular objective, but the solution does not present itself immediately. If it is presented, there will be no problem.”

Matlin (2004, p. 234) also states that “problems have three components: The initial state, the goal state, and obstacles.” Thus, as an obstacle to his process, the student faced the impossibility of partnering with UFSC programmers promptly to bring the game to the class due to the need to prepare a project and approve and select a scholarship.

As Roby did not want to develop a simple digital quiz game, only with questions and answers, which could easily be created from sites that provide this free tool on the Internet, the strategy was to create an analog game as a prototype. This first version
would be transformed into a digital game in another opportunity, configured as the goal state of problem-solving.

After defining the strategy to achieve the goal of developing the digital game in the future, the second step was to understand the game concept and its components. According to Huizinga (1980, p. 16), a game can be understood as

a voluntary activity carried out within certain and determined limits of time and space, according to freely consented but absolutely mandatory rules, endowed with an end in itself, accompanied by a feeling of tension and joy and an awareness of being different from everyday life.

From this concept, we seek to understand how a pedagogical game could keep its aspects linked to fun, also seeking to contribute significantly to the learning of curricular content. Given this, an alternative was to know and explore mechanics that could suit this proposal.

The choice for the quiz was based on the fact that educational games “(...) can (and should) be programmed to be played only two or three times, as it is enough time to put a rhetoric of content, a point of view, to a specific working group” (LA CARRETA, 2018, p. 1625). The delimited idea was for the game to be played annually by different groups because the moment the student/player overcomes the learning set as a challenge, the game becomes no longer interesting for him.

Thus, considering that the game mechanics met the curricular needs, Roby faced another obstacle: the quiz, in his view, would not be a fun game for his colleagues, as it was closer to an evaluative activity than a playful one. Thus, to solve this problem, the student joined the quiz with another mechanic, a board progression game, to find a balance between pedagogical objectives and fun (VAN ECK, 2006), reaching the goal state (MATLIN, 2004).

The moment of planning the game created an impasse between the student and the teacher. Roby established very complex rules with many conditioning factors to indicate the player’s score, which could end up inhibiting the game’s fun in the teacher’s evaluation. At that moment, the student did not accept the teacher’s suggestions to simplify them. Considering that to solve a problem, the first step is to understand it (MATLIN, 2004), it was decided to let the process of building the game flow and re-evaluate this issue later when the problem presented itself to the student.

Thus, throughout the construction of the questions and answers of the quiz, the
very complex rules proved to be a problem for the student, to the point that for each question created by him, it was necessary to think about the variables that were applied to the score. Thus, these norms were evaluated and redesigned by Roby to “[...] create interesting situations to challenge and oppose the player” (SHUYTEMA, 2008, p. 7) without becoming a limiting factor for fun.

Rules are the main elements of a game. For Salen and Zimmerman (2012), they are the form or internal organization of games; therefore, they will give identity to these. Huizinga (1980, p. 14) highlights the importance of planning them carefully since “they determine what counts and what doesn’t count during the game; the rules are indisputable and must be followed for the game to happen.”

The student’s desire for the digital game to keep all the components presented on the analog board is justified by the objective of giving the 5th-grade groups a fun activity for everyone. The digital platform game with board, dice, cards, and pawns, along with the aesthetics and narrative of its first version, adding to the rules, challenges, and rewards, is a factor that can provide motivation for learning in a playful and interactive.

Santos et al. (2013. p. 136) argue that “the game constitutes a strategy that can help to overcome the traditional structure of the classroom and capture the interest and attention of students, making learning a more dynamic process and the appropriation of the concept in a more effective way.”

In this sense, it is emphasized that “children are more motivated to use their intelligence because they want to play well; therefore, they strive to overcome cognitive and emotional obstacles. Being more motivated during the game, they are also more mentally active” (IDE, 2017, no page).

In this way, the game was a strategy thought by the student to solve the problem of sociability with the class. It was configured in an activity that favored the approximation with his colleagues since many of the issues between him and his colleagues were due to incompatibility of interests. The student found in the proposal a way to unite the objectives of the ESA, his work expectations, and the appreciation of his potential before the group and teachers through an activity evaluated as fun and relevant by all.

4.4 Game-based learning as an action strategy for curricular enrichment and
appreciation of the potential of students with AH/SD

The third category concerns the relevance of thinking about pedagogical practices that contemplate the specificities of the student with AH/DS, providing the appreciation of his potential and the supplementation of his learning. In this way, there is the creation of the game as a playful, interactive strategy that allows the necessary deepening of the curricular enrichment relevant to Roby’s learning moment.

Therefore, this enrichment and the educational inclusion of the student become effective, fulfilling the ESA's objective established by Decree No. 7,611 of “I – provide conditions for access, participation, and learning in regular education and guarantee specialized support services according to the individual needs of students” (BRAZIL, 2011. p. 1).

Despite the student’s difficulties in executive functions, the game allowed him to deepen his knowledge about the content he chose and, still, with the pedagogical support of the typical classroom teacher and the ESA. This aspect includes the intracurricular and extracurricular enrichment necessary to develop his potential.

Freitas and Perez (2012, p. 12) clarify that

In the case of students with AH/SD, enrichment can be carried out in different ways, in the curricular context, with flexibilization of curricular contents, adaptations, changes in objectives and methodology, as well as extracurricular, providing personal development programs for the subject, which can be carried out individually and in small groups.

Extracurricular enrichment will involve contents and proposals distinguished from the school curriculum and involve general and specific strategies that meet the demands and specificities of students with AH/SD (FREITAS; PÉREZ, 2012; SABATELLA; CUPERTINO, 2007). For this form of enrichment, one can count on the experience of different professionals and partners to contemplate the areas that make up the work proposal of/with/for the student.

ESA’s planning and development with Roby involved extracurricular enrichment when he starts to create strategies for the assembly and execution of the game, which should be thought of for colleagues and other 5th-grade students. This aspect demands the mobilization of knowledge and skills that go beyond the standard curriculum, such as the rules and processes for creating a game, the recognition and study of the series curriculum, and the need to record all stages (pre-project, project, and post-project), to
evaluate the process and qualify the construction of the game.

The game’s development was also configured as an intracurricular enrichment (FREITAS; PÉREZ, 2012), as the ESA and Science teachers were mobilized to provide Roby with a deeper understanding of the curricular contents of the subject. When rethinking pedagogical and evaluative objectives for the student based on his involvement with the creation of the game, the skills related to one of the areas of his interest, creativity, and commitment to the task were contemplated.

Thus, the proposal and elaboration of the game for the 5th-grade classes meet the necessary curricular enrichment for the student since they mobilized their previous knowledge, skills, and interests playfully and interactively through game-based learning (VAN ECK, 2015; PRENSKY, 2001).

Prensky (2001) considers that game-based learning contemplates different forms of student learning and has the potential to be adapted to almost all subjects and skills. It can be very effective and significant in the schooling and inclusion of all students when designed and applied according to previously established objectives. It can be said then that this way of acting provided Roby with the appreciation of his previous knowledge, his above-average skills, and the construction of new knowledge from challenges that expanded his engagement and involvement with the task (RENZULLI, 2004).

Fleith (2006) emphasizes that the above-average skill involves general skills and the ability to integrate experiences and process information. This results in adaptive responses to different situations and more specific skills linked to the subject’s areas of interest. Both aspects were valued and developed throughout the ESA since the student could contemplate his affinities and select and integrate the elements and contents he considered relevant, exercising his autonomy for the game’s creation.

Another indicator of AH/SD is the commitment to the task, which is related to criticality concerning work, motivation, perseverance to perform what one wants and self-confidence in one’s actions (FREITAS; PÉREZ, 2012; FLEITH, 2006). The manifestation of this behavior in Roby was noticeable when he defends his ideas/proposed rules for the game and topics covered in the quiz, often contradicting the Special Education teacher’s guidelines.

This is considered an essential aspect worked with the student since his
protagonism provided the need for reflection and planning of actions aimed not only at the commitment to his own interests but to all classmates, the target audience of the game.

Roby’s creativity could be evidenced throughout the creation of the narrative and the elaboration of the cards’ content, which stood out in comparison with other conventional question-and-answer games, making the game more interactive and attractive. The student’s aesthetic and creative sense was maintained when thinking about the board structure comprising different difficulty levels, designed to present the content to colleagues according to their knowledge and learning specificities.

In addition to the planning and production of the game, the stage of application and reflection on it is highlighted due to its relevance for learning. The student assumed the role of mediator of the activity; for that, he had to think of strategies accessible to the diverse demands of his colleagues, including those with Autism Spectrum Disorder (ASD). In carrying out this task, his satisfaction and improvement in self-esteem were noticeable in the face of the recognition of his colleagues and teachers, which qualifies the social relationships that had been established until that moment.

The work carried out with Roby brought visibility to this aspect and thoroughly considered the area of his interest related to programming, in addition to mobilizing the naturalistic, logical-mathematical, spatial, and linguistic areas (GARDNER, 2011). Thus, once the student’s difficulties were minimized, it was noticed that he starts to feel valued for his learning potential after supplementing his learning and curricular enrichment.

Carbo et al. (2019) understand that playful and practical activities are essential in the knowledge construction process, as they allow the development of skills in the training context in various aspects, such as communication, interpersonal relationships, teamwork, leadership, patience, balancing cooperation, and competition.

Thus, it is emphasized that game-based learning is shown in the analysis to be a valuable methodology for curricular enrichment aimed at this audience and to provide learning to all students in the class concerning Science content.

5 Final considerations

The process of building the game represented a significant project for the student, who explored the area of Science, his primary focus of interest at that time.
He also contributed to developing cognitive skills related to the executive functions of planning, inhibitory control, and problem-solving. In addition, the work motivated him to develop executive functions relevant to the learning process, such as registration and organization, through playful and interactive activities.

It is noteworthy that the executive functions worked during the activity are interrelated and, in this way, they interfere with each other. They can improve the learning of curricular subjects. Inhibitory control skills are highly relevant to mobilizing attention, planning, and problem-solving. These aspects could be observed throughout the work with the student with AH/DS when he starts to improve the planning of his actions, control his behavior in the face of distracting stimuli and direct his attention to his main task.

Game-based learning has provided Roby with learning that goes beyond improving cognitive skills. It was possible to deepen and qualify his knowledge regarding the content of the reproductive system; to value and mobilize naturalistic, logical-mathematical, linguistic, and spatial bits of intelligence; expand the student's interpersonal relationships and sociability with his colleagues and teachers at the time of the game with the whole class. There was an appreciation of his potential and enrichment of his school learning.

The educational game developed at ESA allowed for transforming the classroom into a fun, collaborative, and meaningful learning environment for the students of the whole class. In this way, the activity conceived by Roby reflected an approximation of the students while meeting their curricular demands. The game developed was characterized as a learning resource with the potential to be explored in the following years by the subject’s teacher, who can integrate it into the curriculum.

References


CENTER ON THE DEVELOPING CHILD. *Construindo o sistema de “Controle de Tráfego Aéreo” do cérebro*: como as primeiras experiências moldam o desenvolvimento das funções executivas. Harvard University, fev. 2011.


VAN ECK, R. N. Digital Game- Based LearningIt’s: not just the digital natives who are restless. Educause review, mar./abr. 2006.
VAN ECK, R. N. Digital Game-Based Learning: Still Restless, After All These Years. *Educause review*. nov./dez. 2015.
